1. INTRODUCTION
The Munich Centre for Economic, Environmental and Social Statistics

1.1 INFORMATION ABOUT THE INSTITUTION

1.1.1 Munich Centre
The Munich Centre for Economic, Environmental and Social Statistics comes under the aegis of the Carl Duisberg Gesellschaft e.V. (CDG). The Centre was founded in 1972 jointly by the Federal Republic of Germany, the Commission of the European Communities and the CESD. The Munich Centre’s programme policy is agreed annually with representatives of these institutions. Over 1000 statisticians, mainly from African, Caribbean and Pacific countries, have taken the opportunity for advanced training Munich since the centre first opened its doors.

1.1.2 CDG - An Overview
The Carl Duisberg Gesellschaft e.V. is a non-profit organisation dedicated to international training, exchange and development. Together with partner organisations at home and abroad it forms an international association which runs practically-based training, exchange and foreign-language programmes for specialists and managers from all over the world. Since its foundation in 1949 more than 200,000 people have taken part in the CDG’s programmes. As part of its co-operation activities, the CDG plans and runs practical continuing education programmes and courses for the exchange of international experience for specialists and managers from developing countries. This work is mainly carried out at the request of the German Federal Ministry for Economic Co-operation and Development and the governments of the German Länder.

1.1.3 Mission of the Centre
Sustainable policies must be underpinned by a reliable information base which is adapted to requirements of the countries concerned. Sound decisions can only be made if data are firmly grounded in their context.

In our advanced training courses, therefore, the emphasis is not just on the pure techniques of data production but rather also on the political, social and economic concepts that underlie sustainable development, structural adjustment or efforts to combat poverty and that require quantitative information.

Statistics should contribute to the transparency and evaluation of social and political actions.

The aim of carrying out training activities is to generate information such that it serves as a basis for decision-making for sustainable policies and promote dialogue between representatives of government, public interests, the business community and international development organisations.

1.1.4 Training Courses
The focal areas of the training courses are

- monitoring economic activities;
- shaping social development; and:
• developing ecological information systems.

By providing better access to data for large sections of the population, statistics can assist in the democratisation of society.

The interests of the user are of prime concern in every course.

All courses are run in the *lingua franca* used in the country of origin of the course participants, these are generally in English or French.

1.1.5 Continuing Education in Germany

Methods and concepts associated with in specialist areas are taught in 3-4 month. Subjects such as the information base, the analysis of macroeconomics interrelations, social policy and environmental policy are covered for participants who already have professional experience in these fields.

1.1.6 Local Training

In order to address the specific needs of individual countries and regions we offer customised local seminars. They last 1-6 weeks and deal with topical issues such as “Household surveys with particular reference to poor social strata” in Abidjan or “Revision of national accounts” in Harare.

1.1.7 Seminars for Directors

Directors of statistical offices and senior civil servants from ministries have the opportunity to attend special seminars in which to exchange information and experience on the latest trends in statistics and current information requirements for decision-makers.

1.1.8 International Co-operation

The Munich Centre is in close contact with institutions and statistical offices at a national and European level and is a member of the “Centre Européen de Formation de Statisticiens Economistes des Pays en Voie de Développement” (CESD - European Centre for Training Economic Statisticians from Developing Countries). The dialogue with international organisations, universities and development co-operation institutions also guarantees that a high level of training courses is offered.

1.1.9 Lecturers

Our lecturers are highly competent in theoretical and particularly in practical aspects, including those relating to developing countries. This ensures that the topics covered in the training courses are current, and that the methods are taught in accordance with the relevant latest standards.

1.1.10 Prerequisites for Attendance

The prerequisite for attendance at one of the Munich Centre’s seminars is a university degree or equivalent qualification in statistics or an equivalent subject which is closely related to the course topic, together with several years of professional experience.

Invitations are forwarded via our partners (European Commission, German Federal Government, statistical offices) to institutions which nominate the applicants. Requests by individuals cannot therefore be considered.
1.2 THE 49TH COURSE ON “STATISTICS FOR ENVIRONMENTAL POLICY”

1.2.1 Background to the Course

The Munich Centre for the first time organised the course on “Statistics for Environmental Policy”. It was deemed necessary to organise this course because of the need to provide information on sustainable development to policy and decision makers.

In recent years, sustainable development aiming at combining ecological, social and economic aspects is evolving as a recognised strategy in international forums. Policy-makers have become increasingly aware of the fact that disaster prevention to reduce the danger of droughts or floods has to be supplemented by a strategy to fight against systematic environmental degradation. This is in the form of deforestation, desertification, soil degradation, the deterioration of water and air quality etc. The dangers posed not only threaten present but also future generations. The international community took up this issue at the World Summit in Rio de Janeiro in 1992 emphasising the need for maintaining the natural environment in the interest of the countries concerned, but equally as well in the interest of all countries to prevent global dangers, such as the change of climate.

An environmental strategy cannot be drawn up without reliable knowledge of facts focused not only on the results of natural disasters but as well of gradual ecological deterioration which will have serious long term effects on the well being of the population and the economic growth potential. This implies information on the status of the environment (soil and vegetation, water, air, subsoil assets) and its changes. A more policy oriented approach has to address itself to collection of information on pollution by industries and the consequences of human settlement to provide concrete results to decision makers.

The course treated the concept of sustainable development and the corresponding goals and the statistical tools such as information frameworks and geographic information systems. Focus was put on the questions why data on changes to the environment and the role of human activities are relevant; how to collect information, (preference on the use of records existing in the statistics office or in other departments) and how to analyse it and to present it in the form of short indicators. Furthermore material and energy balance sheets were discussed as well as the new approaches of integrated environmental and economic accounting.

1.2.2 COURSE CONTENT

The course content is summarised below:

1. Programme Discussion: Presentation of the course programme. Expectations and proposals of the participants related to the programme (10 hrs).
2. Quantitative Aspects of Sustainable Development: Policy aspects of environment, environmental degradation and resulting national needs of environmental management. The way towards quantifying sustainable development (10 hrs).
5. Data Dissemination: User-oriented and user-friendly publications and the principles of dissemination through different print media (10 hrs).
6. **Geographical Information System (GIS):** Concepts and characteristics of GIS, its use in analysis and presentation of environmental information; use in data collection (20 hrs).

7. **Information System on Land Use:** Data sources, classifications and compilation with focus on soil degradation, desertification, deforestation (10 hrs).

8. **Management of Communication:** Planning and implementation of a statistical programme and organisation of a statistical unit, methods to improve information flows (15 hrs).

9. **Information System on Supply and Use of Material:** Data on direct and indirect material flows; their calculation based on a model (10 hrs).

10. **Information System on Supply and Use of Energy:** Monitoring and assessing energy stocks and flows; supply and use of energy; construction of energy balances (15 hrs).

11. **Environmental Modelling:** Estimation and forecasts of the structure demand and supply of energy and its environmental implication (10 hrs).

12. **Statistics on Water and Air:** Structure of demand and supply on water, access, reserves, pollution, transport; monitoring quality air, urban air pollution (10 hrs).

13. **Quantification of Environment relevant Activities of Industries:** Effects of mining and manufacturing on the state of land, water and air; use of land through manufacturing and pollution caused by by-products, statistical methods utilised for monitoring; ecological effects of tourism (15 hrs).

14. **Effects of agricultural Activities on the Ecosystem:** Effects of livestock and crop production on land and water (erosion, overgrazing) (10 hrs).

15. **Information System on forestry:** Forces shaping forestry, forestry principles, concept of sustainable forest management, forest assessment, forest inventory, measurement of losses and quality (10 hrs).

16. **Human Settlement and Environment:** Consumption of natural resources by households; access to drinking water infrastructure and sanitation (25 hrs).

17. **Environment and Economic Accounting:** Principles of SNA; valuation; matrix, presentation (IOT, SAM) (20 hrs).

18. **Natural Resource Accounting:** Assessment of natural resources with focus on forest accounts, subsoil assets and water accounts based on case studies (20 hrs).

19. **Environment Indicators:** Indicators according to agenda 21, the framework for the development of environment statistics; the framework of indicators for sustainable development (25 hrs).

20. **Train the Trainer:** In service training, use of didactic tools (5 hrs).

21. **Final report:** Participants had to write individual reports on a subject related to environment statistics. These reports were presented and discussed (15 hrs).

22. **Study Tour:** The course included a one-week tour to EUROSTAT in Luxembourg, and to the Federal Statistical Office in Berlin.

### 1.2.3 Training Methodologies

The lecturers used a mix of methods with an emphasis on the visual impressions. The most commonly utilised aid was the transparencies. Some of the lecturers made presentations on slides. Other techniques that were utilised included video presentations and power point (a computer based presentation package) presentations.

A primary emphasis was given to interactive methods and participatory approaches. In this regard group discussions and brainstorming on cards were utilised. In addition, practical computer exercises were utilised. Most of the lecturers prepared papers which provided the summary of the contents. Additional background materials were also availed to the participants.
Some tutorial sessions were held during the evenings the topics discussed were:

- Power Point Presentation Package by Matthais Fischer;
- Additional tutorial lessons on EDP techniques by Harold Kronester;
- The Construction and Uses of Energy Balance Sheets by Dieter Stentzel; and;
- Internet and E-mail presentation by Clemens Schröter.

The following excursions to environmental related institutions were organised:

- Soil Cleaning at the GHB Gebr. Huber Bodenrecycling GMBH;
- Meeting with Green Party in the Bavarian parliament;
- Discussion with an ecological farming family; and;
- Explanations of the household waste disposal system by Dieter Stentzel.

1.2.4 Evaluation
Two methodologies were utilised to evaluate the course. These were a topic by topic evaluation and an overall evaluation. The topic by topic evaluation determined the interest and relevance of topics and efficiency, effectiveness and qualification and degree of preparation by the lecturer. The overall evaluation was carried out by an external evaluator namely Mr. Phil Crook from DFID. Participants in the overall evaluation filled in a general evaluation questionnaire and were also invited to offer suggestions for the improvement of the course.
2. **QUANTITATIVE ASPECTS OF SUSTAINABLE DEVELOPMENT**

   **by Peter Bartelmus**  
   **United Nations Statistical Division, New York**  
   **(March 13 - March 14, 1997)**

2.1 **INTRODUCTION**

The quantitative aspects of sustainable development was a topic introduced to serve as a framework for the rest of the course and give the participants a broad overview of what sustainable development is and a broad understanding of its importance to the environment. In this regard the purpose of this topic was to raise awareness on environment in terms of sustainable development and emphasis was given to sustainability concepts to guide in formulation of environmental policies.

In order to achieve the aims above, the discussion was tailored as follows:

- From Stockholm to Rio;
- Operationalising sustainability-dichotomy of approaches;
- Data systems;
- Data use;

2.2 **FROM STOCKHOLM TO RIO**

The United Nations Conference on the Human Environment (Stockholm, June 1972) noted that environmental concerns have increasingly become the subject of mainstream socio-economic policies, both at the national and international level. In the following years there was little or no change with regards to environment concerns. The World Commission on Environment and Development was to develop new ideas on how to improve environment. In their report “Our Common Future”, (Brundtland Report) it was recommended to focus both on environment and on economic development. One of the consequences was the United Nations Conference on Environment and Development (UNCED) (Rio de Janeiro, June 1992). In this conference a consensus, that strategies for sustainable development should integrate environmental issues into development plans and policies, was reached. The major outputs were the “Rio Declaration on Sustainable Development”, “Agenda 21” and several conventions. These are as summarised in the Figure 2.1.

2.3 **OPERATIONALISING SUSTAINABILITY- DICHOTOMY OF APPROACHES.**

2.3.1 **Definition**

It is worth noting that although there have been global attempts to address issues of sustainable development, there is no consensus on the definition. The popular definition of sustainable development by World Commission on Environment and Development is stated as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland Report). The following limitations in operationalising popular definition were observed:

- The needs are not identified nor quantified;
- The time horizon of future generation is not specified; and;
- The role of the environment has not been indicated.
2.3.2 Dichotomy of Views

In operationalising sustainability two views emerge which can be crudely categorised as “economists” and “environmentalists”. The “economists”, in operationalising sustainability, treat the environment as scarce goods and services which can be monetised or valued. The premise of “economists” is that the environment is treated as a commodity because this is how people perceive it.

The environmentalists, particularly the “deep”\(^1\) kind, contest the notion that the environment should be treated as a commodity. They believe that people should rather see environment as an indivisible good to which a price should not be tagged.

The divergent views have therefore led to a lack of consensus in the quantification of sustainable development. The “economists” therefore are in the processes quantifying sustainability

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\(^1\) Deep ecologists emphasise the need for a “comprehensive religious and philosophical world view” and the intrinsic equality of all species.
more in terms of monetary measures whereas the “environmentalists” develop methods of quantifying sustainability in terms of indicator systems and frameworks
Figure 2.2 shows a broad conceptual framework and possible indicators of sustainable development. The measures that can be quantified from the economic viewpoint are in shaded boxes. Whereas those in white boxes indicate the physical or non-monetary concepts and measures. The framework further categories sustainability in terms of supply, use and users, referring to a possible distinction between the sustainability of economic supply and use and human (users/populations) developments. The distinction is a useful reminder that the ultimate objective of sustainability is not human activity but of human beings themselves as well.

**Figure 2.2 Sustainability Concepts and Measures**

<table>
<thead>
<tr>
<th>Sources</th>
<th>Supply</th>
<th>Use</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature</td>
<td>ES, EI NRA</td>
<td>ES, EI NRA</td>
<td>EF CC</td>
</tr>
<tr>
<td>Economy</td>
<td>EDP, NDP</td>
<td>ENI, NI GS.</td>
<td>ENI, NI</td>
</tr>
<tr>
<td>Social System</td>
<td>Social values and amenities</td>
<td>SI</td>
<td>SI QOL</td>
</tr>
</tbody>
</table>

**Flows of goods, services and amenities**

<table>
<thead>
<tr>
<th>CC</th>
<th>Carrying Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDP</td>
<td>Environmentally Adjusted net Domestic Product</td>
</tr>
<tr>
<td>EF</td>
<td>Ecological Footprint</td>
</tr>
<tr>
<td>ENI</td>
<td>Environmentally adjusted National Income</td>
</tr>
<tr>
<td>EI</td>
<td>Environmental Indicators</td>
</tr>
<tr>
<td>ES</td>
<td>Environmental Statistics</td>
</tr>
<tr>
<td>GS</td>
<td>Green Savings</td>
</tr>
</tbody>
</table>

**ENI** Environmentally adjusted National Income

**NDP** Net Domestic Product

**NEW** Net Economic Welfare

**NRA** National Resource Accounting

**QOL** Quality of Life (indicators)

**SI** Social Indicators

**GPI** Genuine Progress Indicators

**HDI** Human Development Index

**ISEW** Index of Sustainable Economic Welfare

**GS** Green Savings

**Figure 2.2 shows sustainability therefore in terms of environmentally adjusted national accounts aggregates as possible measures of economic sustainability. These include ENI (environmentally adjusted national income) and EDP (environmentally adjusted net domestic product). The non monetary measures of sustainability presented in the same Figure include carrying capacity of a territory, which measures human populations that can be sustained by a particular geographic area. Other attempts at capturing ecological sustainability include the development of frameworks or lists of social and environmental indicators to measure significant aspects of economic and ecological sustainability.**
One way of operationalising sustainability is by defining what is not sustainable as shown in box 2.1

**Box 2.1 Indicators of non-sustainability**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>1-3.5 °C global warming (2100)-caused by the emission of CO₂ and other greenhouse gases (1995) assessment by the Intergovernmental Panel on Climate Change. [business-as-usual might produce catastrophic consequences for socio-economic structures-UNEP 1992]</td>
</tr>
<tr>
<td>Ozone layer</td>
<td>30-40% decrease of ozone Column over Antarctica- resulting from use of CFCs and Halons as propellants in refrigeration, insulation and packaging. [Cosmic holes indicate damage to our life support system- Goodland 1991]</td>
</tr>
<tr>
<td>Land degradation and Desertification</td>
<td>500 billion tons of top soil lost since 1972; 10 million environmental refugees from degraded lands; 5 Million hectares lost annually to desertification-caused by agriculture, forestry, and urbanisation [carrying capacity of the population exceeded in most developing countries-FAO, UNFPA, IIASA 1982]</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>1/4 of species in danger of extinction; 5,000 to 15,000 species lost annually due to destruction of biomas and habitat through agriculture, deforestation, pollution and other land uses. [will compromise the ability of future generations to meet their needs-UNEP 1992]</td>
</tr>
<tr>
<td>Deforestation</td>
<td>16.8 million hectares lost annually due to logging and land clearance for agriculture and settlement [approaching the limits of wood consumption - UNEP 1992]</td>
</tr>
<tr>
<td>Energy</td>
<td>90 years of proved recoverable (mineral reserves), 243 years of proved reserves in place, and 800 year of total (including additional estimated) reserves left. [meeting the burgeoning demand for conventional fuel is quite feasible, at least for the next few decades - WRI et. al 1996]</td>
</tr>
</tbody>
</table>

Box 2.1 describes phenomena typically presented when arguing “non sustainability” of current patterns of production, consumption and economic growth. It was observed that answers cannot be found by simply listing disparate indicators, expressed in so many centimetres of sea-level rise, degrees of global warming or hectares of advancing deserts. An operational definition of sustainability which is capable of combining or comparing all these phenomena among each other with the costs and benefits of related economic activities is needed. It was noted, however, that indicators on non-sustainability have an alert and/or score keeping function if standards/targets have been set.
2.3.3 Data Linkage And Interaction Of Statistical Frameworks And Systems

![Data systems diagram]

Figure 2.3 Data systems
- SNA  System of National Accounts
- SAM  Social Accounting Matrix
- SSDS  System of Social and Demographic Statistics
- SEEA  System for Integrated Environmental and Economic Accounting
- FSDS  Framework for Social and Demographic Statistics
- PRED  Population, Resources, Environment and Development,
- FISD  Framework for Indicators of Sustainable Development
- FDES  Framework for the Development of Environmental Statistics

For the three main areas, namely the economy, environment and population, data frameworks or systems have been developed. The key data gaps are in linkage of all three aspects for development to measure sustainable development phenomena. Below is a brief description of the system framework identified and its status.

The System of National Accounts (SNA) is the internationally adopted system that not only provides a framework for accounting aggregates but is a tool used to calculate underlying statistics for the different fields such as industry, agriculture, finance or trade.

System of Social and Demographic Statistics (SSDS): An attempt was made to develop an accounting system for social and demographic concerns however due to the absence of natural numeraire and a comprehensive theory in the field, the system was soon abandoned.

Framework for Developing and Integrating Social and Demographic Statistics (FSDS): This framework was adopted because of its flexibility. However it is just a listing of “social indicators” under headings of “social concerns” taken from SSDS.

Framework for the Development of Environmental Statistics (FDES): Due to problems of data integration similar to those that were encountered in developing the SSDS, the United Nations, in 1984, was prompted to develop a framework rather than a system for the development of environmental statistics. Table 2.1 indicates the broad categories of these indicators.
**Social Accounting Matrix (SAM):** The SAM is a presentation of SNA accounts in a matrix which elaborates the linkages between a supply and use table and institution sector account. It is an alternative way of measuring national accounts aggregated with a view to assessing human capital and related concerns of employment, labour cost and income distribution. An attempt has been made by the Netherlands Central Bureau of Statistics to incorporate physical and monetary indicators of the environment into SAM without attempting to account for human capital, possibly, this approach could lead to a broader integrated accounting system.

**System of Integrated Environmental and Economic Accounting (SEEA):** The SEEA addresses the concern that the conventional national accounts neglect the role of natural capital in economic production and growth. This is done by costing fixed and natural capital consumption and by introducing broader concepts of capital and capital accumulation.

**Population, Resources, the Environment and Development (PRED):** is less developed than any of the systems /frameworks listed above. The Population Division of the United Nations is currently developing PRED data base which aims at capturing some of the relationships between environment, resources and population.

### 2.3.4 Proposed Operational Measures of Sustainable Development

The indicators described in Figure 2.2 and their parent systems Figure 2.3 also reveal the basic dichotomy in measuring sustainable development. The indicators are developed either on the basis of monetary or non-monetary terms which further stresses the two view points of “environmentalists” and the “economists” which are discussed in section 3.2

The monetary systems use monetary numeraire for aggregating diverse activities and results. However, on the other hand, the non-monetary or physical indicators resort to some kind of weighting to derive more aggregate indices.

Two operational definitions were suggested as a measure of sustainability in monetary and non monetary terms respectively.

### 2.3.5 Sustainable Economic Growth

Sustainable economic growth can be defined in operational terms as

“Increase in EDP, assuming that environmental cost allowances can be used for the maintenance of produced and natural capital and taking into account that past trends of depletion and degradation can be offset or mitigated by technological progress, substitution, discovery of natural resources and changes in consumption patterns”

### 2.3.6 Sustainable Development

Sustainable development on the other hand can be defined in operational terms as follows:

“The set of development programmes that meets the target of human needs satisfaction without violating long-term natural resource capacities and standards of environmental quality and social equity.”
2.4 OPPORTUNITIES FOR MEASUREMENT OF SUSTAINABILITY

2.4.1 System For Integrated Environmental And Economic Accounting (SEEA)

The system for integrating environmental and economic issues has arisen from the fact that various flaws of conventional accounts may have sent wrong signals to decision makers who may have set society on a non-sustainable path of development. In assessing cost and capital, national accounts have neglected, on the one hand, new scarcities of natural resources which threaten the sustained productivity of the economy and, on the other hand, the degradation of environmental quality and consequential effects on human health and welfare.

Several environmental organisations have argued that the traditional system of national accounts be replaced by green accounts. National accountants and mainstream economists disagree, pointing out that conventional accounts serve many short and medium term purposes of market observation and business cycle assessment. Moreover, these accounts are based on observable data whereas environmental accounting would require numerous and controversial estimations and valuations.

Therefore in absence of an international consensus the SEEA was developed as a satellite system of the 1993 SNA.

The main objectives of the SEEA can be summarised as follows:

• Segregation of all environment related flows and stocks of traditional national accounts, notably environmental protection expenditures;
• Linkage of physical natural resource accounts and indicators with monetary environmental accounts and balance sheets;
• Incorporation of environmental costs and benefits of natural resource depletion and environmental quality degradation in income and production of the SNA;
• Accounting for the maintenance of tangible wealth, extending the concept of capital to cover not only man-made but also natural capital; and;
• Elaboration and measurement of environmentally-adjusted indicators of cost, capital, income and production, and as the sum total, an Environmentally Adjusted Net Domestic Product (EDP).

Various components of the SEEA have been tested in several country studies and were found to provide a valuable information base for integrated (sustainable) development planning and policies. Integrated accounting can be used, in particular to assess the sustainability of economic growth and the structural distortion of the economy by environmentally unsound production and consumption patterns. Country projects have been carried out by UNSD in collaboration with the World Bank, UNEP and UNDP in Mexico, Papua New Guinea, Thailand, Indonesia, Colombia, Ghana, the Republic of Korea and the Philippines.

2.4.2 Pricing The Priceless: Method and Limits of Monetary Valuation.

Market Valuation: This kind of valuation focuses on the income generation capacity of natural assets whose products are sold the market irrespective of private or collective (public) ownership. The limitation of this method is that it deals with economic assets only and therefore excludes all other "environment" assets.

Maintenance Valuation: Environmental maintenance costs are defined as the cost that one would have had to incur in order to avoid the deterioration of the environment during the ac-
counting period. The maintenance cost concept reflect a conservationist view of the environment.

**Contingent Valuation:** This valuation method focuses on costs of environmental damage done. The information for this valuation can be attained through a willingness to pay survey. However this approach to valuation has not conventionally been used by national accounts.

#### 2.4.3 Framework For Indicators Of Sustainable Development

The framework for indicators of sustainable development combines the concerns of the Earth Summit’s Agenda 21 with an internationally endorsed data framework, the Framework for the Development of Environment Statistics (FDES). FISD is then used to present the “starter kit” of indicators. It is anticipated that this initial listing will eventually evolve into standard indicators for recurrent compilation and use at national and international levels.

Tables 2.1 and 2.2 shows the information categories and components of the FDES and FISD.

**Table 2-1 Framework of the Development of Environment Statistics (FDES)**

<table>
<thead>
<tr>
<th>Components of environment</th>
<th>Information Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social and economic activities, natural events</td>
</tr>
<tr>
<td>1. Flora</td>
<td></td>
</tr>
<tr>
<td>2. Fauna</td>
<td></td>
</tr>
<tr>
<td>3. Atmosphere</td>
<td></td>
</tr>
<tr>
<td>4. Water</td>
<td></td>
</tr>
<tr>
<td>freshwater</td>
<td></td>
</tr>
<tr>
<td>Marine water</td>
<td></td>
</tr>
<tr>
<td>5. Land/soil</td>
<td></td>
</tr>
<tr>
<td>a) surface</td>
<td></td>
</tr>
<tr>
<td>b) Sub-surface</td>
<td></td>
</tr>
<tr>
<td>6. Human settlements</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2-2 Framework for Indicators of Sustainable Development (FISD)**

<table>
<thead>
<tr>
<th>Agenda 21 clusters</th>
<th>FDES Information Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social and economic activities</td>
</tr>
<tr>
<td>Economic issues</td>
<td></td>
</tr>
<tr>
<td>Social/ Demographic issues</td>
<td></td>
</tr>
<tr>
<td>Air/climate</td>
<td></td>
</tr>
<tr>
<td>Land/Soil</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Other Natural resources</td>
<td></td>
</tr>
<tr>
<td>Waste</td>
<td></td>
</tr>
<tr>
<td>Human Settlement and Natural Disasters</td>
<td></td>
</tr>
<tr>
<td>Institutional Support</td>
<td></td>
</tr>
</tbody>
</table>
2.5 DATA USE
The lecturer pointed out that environmental accounting and indicators for sustainable development are both relatively new methodologies. They have been tested in a few concrete cases but experience with their use and usefulness in decision making is still lacking. This is because, on one hand, there is not yet full consensus on concepts, classifications and methods of compilation and, on the other hand, statisticians are typically quite reluctant to enter the less objective arena of policy analysis. However, some theorising on potential uses and applications might open the door to further explorations of how integrated data systems and frameworks can support rational policies of sustainable development.

Integrated accounts, on the one hand, can specifically be used to assess two majors aspects of economic policy. These are the sustainability of economic growth as conventionally measured and the structural distortion of the economy by environmentally unsound production and consumption patterns. Indicators for sustainable development, on the other hand, assess sustainable development in comparison to standards and targets set and therefore can be used for environmental management.

2.6 CONCLUSION
To strengthen the understanding of the concepts embedded within sustainable development two participants from Uganda and Surinam made presentations. These were entitled “The Role of Environmental Economics in Implementation of the NEAP in Uganda” by Eugene Muramira and “Sustainable Utilisation of Forests in Surinam” by Winston Wirht. The main reinforcing issues of the presentation from Uganda to the topic were

- “Polluter pay principles” in environmental policy costs are also defined in the SNA; and;
- Cost benefit analysis can be done at micro level. This analysis is, however, not clearly defined in SNA accounts and therefore does not necessarily apply at the aggregate level.

The main reinforcing issues from the presentation from Surinam to the topic were

- Depletion can be exported to other countries;
- There are different uses of forests both economic and non-economic;
- Transfer pricing affects economy and environment impacts and the exporting/developing country does not necessarily stand to gain;
- Environmental issues have high political pressures; and;
- Informal sector, which is largely unaccounted for, sometimes has serious environmental issues.

To conclude the course topic, the paradigms that can be utilised in quantification of sustainable development were highlighted. These were, sustainability as an overarching process which combines the functioning of a market in the process of conventional economics; ecological economics (Economics) which emphasises that the market has a role to play in behaving in a more environmentally sound way; and; eco-development which takes into account the geographical aspects of sustainability and people’s participation, sometimes referred to as the bottom up approach to development.
2.7 REFERENCES


Bartelmus P., “Greening the National Accounts”, 1996


3. USE OF MICRO COMPUTING FOR ENVIRONMENTAL STATISTICS

by Harold Kronester
CIB, Munich
(March 17 - 21, 1997)

3.1 INTRODUCTION

Microcomputing is a basic tool required for a statistician to fulfil his functions. The aims of introducing the course topic was to enable participants to gain an understanding of the use of Microcomputing operation system and also to be familiar with modern word processing and spreadsheets.

The main contents of the course topic were

- The use of the windows programme as an operating system;
- Microsoft Word as a word processing language; and;
- Microsoft Excel as a spreadsheet programme which utilises the windows operating system.

3.2 WINDOWS

There was a brief introduction to “Windows” and its advantages over DOS were explained. However, it was also pointed out that Windows could not operate without the presence of DOS. The usage of the mouse (and the various types of pointers the user is likely to encounter) was considered one of the more important things to learn when operating within Windows. There are alternative keyboard punches but this is considerably more cumbersome and time consuming. The importance of the applications, accessories and programs in the various groups were also explained.

The next step was file management and organisation which was done with the “File Manager”; one of the items in the “Main” group in Windows. File manager mainly is used to move and copy files. Formatting diskettes is also done in this aspect of Windows.

The definition and the uses of “Icons” were given to the participants. They were also shown how to create new groups and how to put new items in these groups.

Accessing and organising directories were also covered. File structures (directory and sub-directory) were introduced and the recognition of windows and non-windows files was also touched on. The different file types, their extensions and how they can be used to execute programs (in the absence of icons) were also explained.

3.2.1 Why Use Windows

There are many advantages to using windows. Some of these are:

- Usage of the mouse (makes moving around the screen very easy);
- Completely menu-driven (every command that is available in windows is accessible through the menu);
- Multi-tasking (simultaneous use of many programs);
- On-line help system (provides help for every command);
• Copy, cut and paste commands (allows the user to copy or move parts of a document to other part of the document or other documents; whole document can also be copy or moved to other documents);
• Drag and drop capabilities; (parts of or whole documents can be copied or moved by marking them with the mouse, holding them, dragging them and dropping them to the desired location in the document.
• Scroll bars; (allows the user to go from line to line or page to page of a document by just pressing a button with the mouse pointer).
• Alternate keyboard punches (most of the tasks that can be done with the mouse, windows offer alternate keyboard punches that allow the user to complete the task; most of these require the pressing of two keys [some key + the CTRL, ALT or Shift keys] or the use of the functions key).

The main advantage of windows, however, is multi-tasking (the ability to simultaneously run several applications/programs). This ability was discussed and demonstrated. In addition all windows based software have the same structure therefore once one is introduced to the windows environment it easy to adopt to various software that are windows based if the initial windows logic has been well understood. It was indicated that windows makes the use of the micro-computer simpler and more powerful.

3.3 WORD PROCESSING (WINWORD)

This session started out with explanations about the contents of the “WINWORD” screen. The different bars, buttons and menus were introduced. The advantages of using the toolbar and the buttons, as opposed to using the menus, were explained.

Typing and formatting text came next. Instructions for formatting the page, paragraphs, margins and frames and tables were also given. There was an introduction to a new tool call “Auto Correction”. This tool allows for the correction of words, punctuation and capitalisation as the user types. For example, the user is allowed to add commonly used words to the existing list of words that will be automatically corrected by Word. Deletions from this existing list is also allowed. There is also the possibility of including special characters to documents. Word displays a ruler in the top border of the screen. The grey area of this ruler indicates the border area (margins) while the white area shows the text area. These areas can be adjusted by using the mouse to drag them in any direction. This approach represents a faster alternative to setting margins from the menu.

By the end of the session the participants were familiar with the following concepts about word processing in the Microsoft word environment;
• Writing a text;
• Saving a text;
• Copying text;
• Formatting the text and changing the fonts;
• Formatting paragraphs;
• Inserting frames; and;
• Inserting page numbers, data and time.

To ensure that all these concepts had been adequately understood each of the participants was required to reproduce the letter.
3.4 MICROSOFT EXCEL

Microsoft Excel is a spreadsheet package that has various functions ranging data entry to data analysis such as calculation of sums, percentages and regression analysis. The package has the capability of generating graphical presentations as well.

The session started with explanations of the different tool bars. The main concepts of columns and rows in the excel environment were explained. Many of the useful tools in Excel were explored as follows:-.

- Multiple sheets (many sheets available that can be selected with a click of the mouse; useful for organising work - i.e. data can be in one sheet, tables in another, and graphics in another; all sheets can be named for easier recognition).
- Copy cell (cells could be copied in sequence by just selecting the right corner of the source cell [the pointer assumes the shape of a cross] and dragging to select the appropriate number of cells to which you want the contents of the source cell copied);
- Copy and paste (can copy cells contents to other locations on the spreadsheet);
- Paste special (can copy all the cells contents, just the formulas, or just the values);
- Drag and drop (with the mouse, a cell, selection of cells, table or graphics can be copied, moved to anywhere in the document, to another sheet, another spreadsheet, or another document);
- Formulas (simple formulas could be typed directly into the cells)

The participants were taught how to enter data in the excel environment through a practical entry of data which was later utilised to learn some of the aspects mentioned above in addition to drawing graphs. One of the graphs (namely pyramid) was introduced to the participants. This required entry of data in a special format to enable the chart wizard turn the ordinary bar graph to a pyramid. Below is an illustration of a pyramid.

Figure 3.1 Population Pyramid as Produced by Excel

\[\text{Illustration of a pyramid}\]

\[\text{Note: The male figures were changed to negative and the gap width between the bars changed to zero and the overlap to 100.}\]
By the end of the session participants were able to:

- Select cells and choose commands;
- Create formulas and use relative and absolute references;
- Create charts; and;
- Sort and filter data.

### 3.5 REFERENCES

Microsoft “Microsoft Word Users Guide”, 1994
4. MAIN APPROACHES TO MONITOR ENVIRONMENT
by Oswald Angermann
Federal Statistical Office Germany
Wiesbaden
(March 24 - 25, 1997)

4.1 INTRODUCTION
The main aim of introducing the course topic on “main approaches to monitor the environment” was to enhance the understanding monitoring environmental changes and their statistical implications. An overview to cover the main approaches of monitoring was given over a two day period. The course covered the following main areas national accounts as a measure of welfare and its deficiencies, the three approaches to monitor environment (i.e. OECD, Pressure-State-Response, the UN system of environment accounting) and resource accounting. The topic was concluded by discussing the concept of sustainability as a basic principle to be utilised in environmental monitoring.

4.2 NATIONAL ACCOUNTS AS A MEASURE OF WELFARE
National Accounts was introduced so that all participants would have a common understanding before introducing the monitoring approaches. National accounts was described as “a system to measure stocks at the beginning of the year (or an accounting period), the flow of goods and services between the different sectors of the economy in the course of the year, and again to measure stocks at the end of the year”. It was emphasised that the national accounts restrained itself to accounting only the measurable part of the national economy which is expressed or can be expressed in money terms.

The main deficiencies of the present system of national accounts were identified as the non valuation of stocks and flows coming from environment as a public good and exclusion of external effects of economic activities which concern environment.

The concept of economic metabolism was briefly given in terms of considering all that goes into the economy both monetary and non-monetary and all that comes out of an economy including the emissions and wastes apart from the economic goods and services.

4.3 OECD PRESSURE -STATE - RESPONSE (PSR)
The OECD PSR approach is a framework that classifies indicators according the key environmental issues in the OECD countries by type of indicator (a pressure, state or response). Pressure indicators show the extent to which human activities exert pressure on the environment. The state indicators depict the condition of the environment while the response indicators are measurements which show to what degree society has been responding to environmental changes and concerns.

The OECD approach was described as having the following main features;

- A range of the most important environment themes.
- A set of indicators which seem to represent a clear picture of the situation of a special topic in a given country which is suitable to show both, the level as compared to other countries and the development of the environmental state in one country.
- Indicators would also include information on the driving forces which induce the pressure on the environment. Here also OECD tries to connect environmental problems to the traditional sectors of the economy.
A set of indicators to give a general view of the responses given by governments, private enterprises and households to the pressures, e.g. measures taken to avoid environmental problems from the beginning (expenses and investment in end–of–pipe technologies).

The Figure 4.1 below shows the structure of indicators by Environmental issues.

**Figure 4.1 Structure of Indicators by Environmental Issue**

<table>
<thead>
<tr>
<th>Issues</th>
<th>PRESSURE</th>
<th>STATE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicators of environmental pressures</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicators of environmental conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indicators of societal responses</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Climate change</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Ozone layer depletion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Eutrophication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Acidification</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Toxic contamination</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Urban environmental quality</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Biological diversity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Landscape</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Waste</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Water resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Forest resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Fish resources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Soil degradation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(desertification and erosion)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 General indicators,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>not attributable to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>specific issues.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The OECD approach was further outlined as one which utilised indicators which are easily available in each of the member countries, represents the environmental problem well and in addition gives information on the measurability of the indicator.

The limitations of the OECD approach were pointed out as follows:-

- Aggregation and prioritisation of indicators is not done, hence it is very difficult for policy makers to set priorities;
- The system concentrates only on the environment and does not include social and economic issues; and;
- Different countries have different problems.
4.4 ECONOMICS AND ENVIRONMENTAL ACCOUNTING

Three systems which utilise economics and environmental accounting were discussed and these included the SEEA, NAMEA and the German System of Environment and Economic Accounting.

4.4.1 Satellite System for Integrated Environmental and Economic Accounting (SEEA)

The Satellite System for Integrated Environmental and Economic Accounting was further discussed as one of the approaches that can be utilised for environmental monitoring.

The steps in inclusion of environmental topics were outlined as shown below:-

- Additional disaggregation of conventional national accounts to adjust it for the inclusion of environmental topics;
- Collection of physical data on environment-relevant production and consumption processes and on the exchange of goods and services between environment and economy;
- Additional valuation of the economic use of the environment; and;
- Extension of the production boundary of the SNA.

On the one hand the main advantage of the SEEA system was noted to be the complete system of environmental accounting and the aggregation of environmental issues. On the other hand, however the main limitation of the SEEA system was noted to be that not all four steps could be developed together.

4.4.2 The Dutch -National Accounting Matrix including Environmental Accounts (NAMEA)- Approach

It was noted that the NAMEA approach was developed by the Central Bureau of Statistics (CBS) of the Netherlands. The NAMEA is a model which shows the interaction between environment and economy. The core part of the model is the Netherlands Input–Output–Table extended by information of emissions by sectors of the economy as defined in the SNA and factors which connect specific emissions to environmental problems. By defining sustainability standards for different environmental problems, the system allows (under many assumptions) to evaluate how the economic activity of a sector has to change in order to fulfil the standards in a given span of time.

4.4.3 German system of Economic and Environmental Accounting

The German System tries to integrate the different approaches (SEEA, OECD, EUROSTAT) in a complete system, but is far from being complete in all subject matters. It is intended to give, also with partial results, support to political and economic decision makers.

Similar to the Dutch NAMEA approach, one main feature is the collection of information in physical terms, mainly emissions by economic sectors, which allow to connect economic activities to environmental problems. But, as in Germany there is no commonly accepted set of environmental standards, the complete NAMEA model can only be accomplished by defining additional standards. This task is carried out by different scientific research institutions with interesting results. The German approach exceeds in many aspects the mere collection of physical data. There are five main topics that are covered in the system include;
• Material and energy flow accounts, including use of natural resources and emissions by sectors;
• Use of land and space;
• Environmental indicators;
• Measures to protect environment (investment and current expenditure); and;
• Avoidance cost calculations.

4.5 RESOURCE ACCOUNTING

In some countries, mainly those larger natural resources, it was noted that resource accounting has been developed very early as a means of getting an information on the depletion of resources and answers on whether resource use is sustainable. Two kinds of resources are to be distinguished, these are, exhaustive resources, e.g. coal, oil, gas and minerals, and self-renewable resources like forests or water.

A country with a highly developed system of resource accounting is Norway. A survey of the methods and results can be found in LONGVA. The main problems that need to be resolved by resource accounting are:

• Valuation of stocks by current selling prices less exploration and extraction costs;
• New explored reserves have to be added to the stock of the current year and all previous years; and;
• Exploration cost is investment which has to be depreciated in the extraction period.

Environmental statistics is a basis for environmental accounting, the statistics on environment apply mainly to four fields namely; waste; air pollution; water and sewage; and; economic data (expenditure and investment for environmental protection).

Designing statistical data collection requires decisions on three main questions:

• Who is respondent and how many should be included (full survey or sample)?
• How many items should be asked and in what detail?
• How often should the data be collected (periodicity yearly, more or less)?

4.6 SUSTAINABILITY

The interpretation of sustainability mostly reflects the economical, political and social interest of the interpreter of sustainability. That can be shown by subdividing environmental pressures in three main components:

\[ U = A \times k \times e \]

- \( U \) = total environmental process
- \( A \) = number of human actors
- \( k \) = activity level per capita
- \( e \) = emission per activity unit

Industrialised countries have an activity level per capita far above world average and consume with this high level of activity a larger part of natural resources. On the other hand, the number of actors, the population, is relatively stable and the emissions per activity unit are, due to environmentally adjusted and efficient techniques, lower than in developing countries.

In developing countries the main reasons for the increasing environmental problems are the high population growth rates and less efficient technologies which stress the environment.

Global environmental policies have to concentrate on these deficiencies. In developing countries it is clear that population growth and poverty go hand in hand, and that there is a strong interdependence between development and environmental problems.

4.6.1 Practical recommendations

STAHMER, one of the co-authors of the United Nations SEEA handbook interprets sustainability in three dimensions: economic, environmental and social. He defined some very simple rules on how to obtain sustainability which are listed under the three dimensions as follows:

Environmental Sustainability Rules
- Minimise extraction of mineral resources;
- Substitute fossil by renewable energy sources (wind, water, solar);
- Stop decreasing groundwater level;
- Balance growth and depletion of biological resources (plants, fish, forest);
- Save ecosystems and biodiversity;
- Care for agricultural land quality to avoid soil erosion;
- Reduce wastes by prolonging lifetime of products (recycling); and;
- Respect the absorption limits of pollutants in water, air, soil.

Economic Sustainability Rules
- Support small or medium sized enterprises of the region;
- Prefer regional products;
- Travel - if possible - by foot or bicycle;
- Avoid unemployment by planning the right degree of labour productivity;
- Support progress in basic and applied sciences;
- Minimise price increases;
- Balance public budgets for avoiding public debts; and;
- Balance foreign trade for avoiding foreign debts.

Social Sustainability Rules
- Reduce population growth and balance rural / urban population distribution;
- Strengthen informal social networks and family life;
- Achieve same rights for men and women;
- Reach high level education standards;
- Create optimal health conditions;
- Keep high security standards;
- Balance equal income and wealth distribution; and;
- Save cultural heritage and traditions.

4.7 CONCLUSION

One of the participants, Fatty Lamin, presented a paper entitled “Gambia Environment Action Plan: Monitoring and Assessment Strategy”. Key to the process of evolving a monitoring and assessment strategy for Gambia it was observed the a multi-sectoral approach was used, and various sources of information for evolution of indicators was necessary. The second aspect was that the framework of monitoring was based on the environmental action plan.
4.8 REFERENCES
Mark de Haan, Steven J. Keunin and Peter R. Bosch, “Integrating Indicators in National Accounting Matrix Including Environmental Accounts, NAMEA”, 1993

5. DATA DISSEMINATION

by John Wright
(March 27 - 28, 1997)

5.1 INTRODUCTION
The targets set for the course topic on data dissemination were; to enable participants to under-stand the aim of data dissemination; to be familiar with the options for dissemination and to produce user friendly documents. In order to meet the above mentioned targets, the course was discussed under the topics of dissemination for national statistical offices, presentation of dissemination plan and dissemination using the news media.

5.2 DISSEMINATION FOR NATIONAL STATISTICAL OFFICES
Why Disseminate? It was noted that national statistical offices disseminate information because it justifies their existence, it is a public duty, safeguards their independence, it is obligatory and is a vital barometer for the efficiency of such an office.

What to disseminate? The characteristics of information that needs to be disseminated were highlighted. In this regard, it was noted that such data may have economic and social implications which affects the lives of ordinary people and should be obvious and newsworthy e.g. effects of industry on people’s health. In other words, the information should not be boring.

How do you disseminate? The key elements on the methodology of disseminating were noted to be, keep it simple; user friendly and remember your audience. The participants were reminded that if the statistics affect the lives of ordinary people, they are probably worth disseminating because they will be of interest to ordinary people. The ways of disseminating were identified as follows: news releases, short bulletins or rapid reports; key data cards e.g. country in figures; and; electronic media, major publication in print, on disk, or on-line e.g. statistical year book, broad mass of basic output available to public typically on databases. It was observed that the criteria for selection of dissemination method should include a pricing and marketing strategy.

5.3 MAKING A DISSEMINATION PLAN
In making a dissemination plan, it was pointed out that it is important to start from basic and simple questions for example “why are we doing this?” The following key points in making a dissemination plan were identified

• Keep the plan simple;
• Keep the product simple and user friendly;
• Remember your audience; statistics that are not of interest to people or of use to them are not worth disseminating.
The key elements of a dissemination plan, therefore, are as highlighted in box 5.1.

**Box 5.1 Key Elements of a dissemination**

<table>
<thead>
<tr>
<th>AIM</th>
<th>METHOD</th>
<th>MARKETING AND PUBLICITY</th>
<th>MEASURING SUCCESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target audience?</td>
<td>Electronic</td>
<td>Bulletin or rapid report</td>
<td>News release</td>
</tr>
</tbody>
</table>

**5.4 DISSEMINATION USING THE NEWS MEDIA**

The reasons for ensuring that statistics office get it right were listed as follows:

- Official statistics record matters of great significance to the nation and to individuals;
- It is one way ordinary citizens can judge the state of their nation and how well (or badly) the Government is running things;
- It is objective;
- Politicians are wary of statistics, which is a good thing, and therefore, it is worth noting that “unacceptable” statistics are suppressed;
- Politicians unease about official statistics underline their importance for the public good, but the public often finds them boring or difficult to understand. The media tend to reflect this attitude. Newspaper don’t sell by boring people. This can make it easier for politicians to avoid publicity for “difficult” statistics.

The major aim of utilising the media for dissemination through news was pointed out as to show the public, through the news media, that statistics are important by making them interesting and exciting.

It was noted that it is a prerequisite to ensure that statistics are free from political manipulation. This ensures that people believe in them. To this effect, two quotations were made:

“*If the Government tried to change the rules this would create a debate that would make it impossible*” Jan Carling, Director General

“*independence from the political processes one of the basic principles in this kind of work in all western countries*” Tim Relander, Director General Statistics Finland.
The key elements required for utilising the media were outlined as follows:

- Statistics should be highest quality;
- Clear separation between statistics and the political process;
- Clear rules for release of data to news media e.g. A statistics act;
- A Director-General recognised as independent with access to the head of government and is prepared to resign if the integrity of statistics is threatened;
- A culture in which there would a public outcry if the above happened;
- Statistical advisory committee- for added protection;
- No connection between statistical news releases and political comment;
- High standard of professionalism in dealing with the news media; and;
- An appreciation that the best way of protecting the integrity of official statistics is by publicising them as much as possible through the news media.

Therefore the following are crucial to disseminating through the news media.

**RIGHT PRODUCT**

**RIGHT WAY**

**RIGHT PLACE**

**RIGHT TIME**

5.4.1 Establishing an effective news media

In establishing an effective news media it was noted that the media personnel look for a “story” and if everything is given to them without “signposting”, they have problems finding a story. In addition they may not be sure of the messages given by all the data because they are too busy to bother finding the story and even if they do find the story it might not be the best result. To avoid such occurrences statisticians were advised to ensure that articles are attractive and to utilise a journalistic judgement in doing so.

5.4.2 How are you going to release your product to the news media

The news release was noted to be the best procedure for disseminating through the news media. The main methods of using news release was noted as briefing/news conference; electronic transmission; advance notice of release date and timing of release.

The factors to consider in writing a press release were highlighted as follows:-

- Who should write the news release? Is it the press officer or statistician?
- Who answers media question? There should be prompt response and ease of contact.
- How will release be produced/distributed?
- Press briefing; News conference; television and radio; photographs; creating a media event.

5.4.3 Characteristics of a good news release

A good news release was noted to have the following characteristics

- Attracts a journalist’s attention immediately;
- Has colourful headed paper with logo;
- Says it is a news release;
Chapter 5 Data Dissemination

• Is uncluttered;
• Has a date/serial number;
• Has an eye catching headline;
• Carries main point in headline/first paragraph;
• Is short;
• Is written in language of ordinary people;
• Has figure presented in simple way; and;
• Give follow up contacts.

A classical example of a short news release was quoted as follows:

“Veni, vidi, vici” (I came, I saw, I conquered) (Julius Caesar)

5.5 CONCLUSION
One of the participant namely Ah Poe presented a short paper of the experience in Western Samoa entitled “State of the Environment Report in Western Samoa”. The participants were also divided into four groups and given an exercise to come up with a plan for disseminating data on the environmental audit of a hypothetical country of their choice. It was noted that the plan had to have maximum dissemination of data collected because it is considered an important event. As part of the plan the groups were required to produce a press release of the country which had some key characteristics. The participants utilised the knowledge which had been acquired during the two day period and Box 5.2 gives the results of the news release that was prepared by the lecturer.

5.6 REFERENCES

First ‘green audit’

ELEPHANT SPIDER ALIVE AND KICKING
-IT’S OFFICIAL

wide distribution of environmental data planned.

A ‘green’ or environmental statistical ‘audit’ of [country] has been conducted for the first time by CSO.

Here is a taste of some key findings

• The elephant spider- symbol of national pride- is now thriving. In 1985 it was nearly extinct. In 1995 Sunshine Province reported 100 breeding couples.
• [Country] has three of the most pollution-free rivers in the world. On, the Fruit River, is the only known habitation of the giant pear fish.
• Between 1985 and 1995 we lost 20% of our forests
• 70% of goods are now transported by road
• Number of private cars rose by 55% between 1985 and 1995
• Garbage per person now equals Germany!

The CSO plans to produce summary findings of the ‘green audit’ in [form] [time scale]. A major publication is planned for [   ]

Mr. [  ]. Head of CSO, says: “this is a major statistical development for the country. I want as many people as possible to see the figures.”

Further detail from [contact]

Issued by etc. etc.
[name/phone & fax number]
6. GEOGRAPHIC INFORMATION SYSTEMS

by Tilmann Schulze-Wolf,
IFB - Hannover
(April 1 - 4, 1997)

6.1 INTRODUCTION
Geographic information systems tool was introduced to the participants to enable them to gain an understanding of its functioning and use in decision making on environmental issues. The main areas that were covered in the topic were itemised as follows:

- What is a geographic information system;
- Basics of data processing;
- Acquisition and availability of spatial data;
- Decision making; and;
- Sample project.

6.2 WHAT IS A GEOGRAPHIC INFORMATION SYSTEM?
The geographic information system was defined as “a computer based system that is capable of managing, analysing and reproducing large amounts of spatial data and thematic attributes”. Muhar 1992. The different elements of geographic information were itemised therefore as: hardware, software, data and personnel.

6.3 BASICS OF SPATIAL DATA PROCESSING.
The basic principles underlying the spatial data processing were introduced under the topics of thematic mapping and basic types of digital data. Thematic mapping was introduced as a concept that deals with different themes of maps. Examples of thematic maps were given as, streets, utilities, land use, surface water and soil maps.

6.3.1 Basic types of digital data
Two types of data were introduced and these were grid and the vector data. Vector data was described as data that is characterised by a co-ordinate, length and direction. Grid data one the other hand is characterised with grid lines. Vector data was noted to be more precise than grid data. It was also observed that grid data is usually converted to vector data.

The different forms of vector data were outlined as follows:

- Node: A point sometimes referred to as a knot.
- Line: Points between two nodes.
- Arc: A curved line between two nodes.
- Vertex: Connecting points on the same line.
- Polygon: The end point and beginning point are the same.

It was noted that only straight lines are available in a vector system; no lines overlap; every ground area is covered once (the borders of adjacent areas are stored once therefore any changes in one border will automatically change both ); the vertex connects the same line whereas a node appears at the beginning and at the end of one line. It was also pointed that vector data was concurrently stored in numerical forms as well.
To strengthen the understanding of GIS a short documentary on the origin of GIS was shown. This documentary emphasised that vast amounts of information, that require high levels of personnel and time, are easily stored and analysed with the GIS tool. It was pointed out that the geographical features that are normally described as longitude and altitude are stored as numbers in the GIS.

### 6.3.2 Data capture

Three elements of data were highlighted and these were:

- “Data take over” which is uses already existing information and converts it to the system or software being used.
- Scanning which provides grid data and is useful for background information and not for evaluation and analysis purposes.
- Digitising which uses devices such as the mouse to outline the main features of aerial maps or polygons to be entered.

Types of digitising were highlighted as; on screen digitising and remote sensing for background purposes followed by digitising.

### 6.3.3 Analysis of Data

Figure 6.1 below was introduced as the general framework for analysing information using the geographic information systems:

![Figure 6.1 Framework for Analysing Information with GIS](image)

### 6.3.4 CARTOGRAPHIC display and reporting

The different cartographic functions of a GIS system were listed as follows:

- Pre-defined polygons, lines and point symbols.
- User defined symbols
- Simultaneous presentation of vector and raster data
- Layout and placement of text
- Autolabel function e.g. names of cities etc.
- Sparing text and symbols.

### 6.4 GIS SOFTWARE

The distinctive features of a GIS system were noted to be the hardware and operating system; function and application and projects. The operating systems that distinguish the various the computer aided designs (CAD) and the GIS were pointed out as the UNIX, MSDOS/Windows and Macintosh.
6.4.1 Functions of a GIS

The functions of GIS were categorised as; vector based functions, raster based GIS, hybrid GIS and CAD based GIS. These are further outlined below:

Vector based GIS Functions: Digitising, overlay and intersection, buffers, vector topology and raster data for background purposes.
- Raster based GIS: Grid cell analysis, raster algebra, filtering functions, triangulated irregular network, 3 dimension, raster editor, raster/vector conversion utilities.
- Hybrid GIS: Full vector GIS functions, full raster GIS function, all functions are integrated in one, raster/vector conversion
- CAD based GIS: CAD data model, no topology, reduced vector and raster GIS functions, digitising.

6.4.2 Types of software

Some of the basic GIS software available were highlighted in different categories as shown below:

- Universal systems: ARC/INFO, SICAD OPEN, SPANS, MGE( Microstation Integraph), SmallworldGIS.
- Land registry, survey: ALK/GIAP, SICAD, GRIPS, gradis-gis, geo-graph, PROCART, STRINGS.
- Remote sensing and image processing: ERDAS, idrisi, grass, ER-mapper, EASI/PACE;
- Smaller projects: Atlas-GIS, Topol, polyplot, TNTmips, Winkat, GSMapper, PolyGIS.
- Cartography: MGE, Mapgrafiix, LANDCADD, GeoMap
- Desktop-Mapping, ArcView, MapInfo.

The GIS software were divided into major groups of software namely GIS, and Desktop Mapping Systems: The table below shows the distinguishing factors between the GIS and desktop mapping systems:

<table>
<thead>
<tr>
<th>Functions</th>
<th>GIS</th>
<th>Desktop Mapping Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data capture and processing</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Data base management</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Analysis</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manipulation of Maps</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Cartographic display</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Easy to learn and use</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Inexpensive</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Many customers world wide</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
6.5 ACQUISITION AND AVAILABILITY OF DATA
The various forms of data required for running a GIS system were pointed out

- Satellite data;
- Official data which includes, demographic data, cadastral data, geographical maps, topographical maps and survey from solid and geological surveys and administrative borders; and;
- Privately owned data such as marketing data and digital road maps.

The source of the various forms of data were identified as raster data which can be collected from satellite images utilising the remote sensing technique; vector data which can be retrieved from geological maps using the digitising technique or the scanning and automated vectorising technique; and; utilising already existing digital data.

The sources of satellite information on land use were identified as the digital chart of the world, internet and National Aeronautic Space Agency (NASA), Intelligent Address Matching, Customisation and Application Development Tools and Inter-Application Communications.

6.6 DECISION MAKING
Given the wide variety and different features of systems the participants were given some steps in ensuring that the right kind of software is selected depending on the functions that are intended to be achieved. The five steps in selection of software and setting up a GIS system were outlined as stock taking; system specification, pre-selection, calculation costs and decision making.

The stocktaking exercise was defined as the stage when all tasks required for the performance of a GIS and all available sources of GIS software listed. It was noted that it is important to list institutions utilising the GIS systems were of crucial sources of information on the disadvantages of various software programme. The various data sources including digitising both internal and external and their ability to be transferred to other noted as critical stages of stocktaking.

The system specification stage was noted as the stage whereby tasks are matched with available software and the required specifications such as for the computer equipment, manpower and data are set.

It was noted that the pre-selection is based on information obtained on the stock taking exercise and the system specification stage. Current market analysis of various items within the GIS system and the financial outlines were identified as critical elements of the pre-selection stage.

The decision making process was defined by the characteristics of evaluating the results of the pre-selection stage and calculating the cost of independent project before the final selection is done. Some of the broad points to help in decision making are as shown in Table 6.2.

<table>
<thead>
<tr>
<th>Software</th>
<th>Actual Prices</th>
<th>training Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workstation GIS</td>
<td>30 - 70,000 US$</td>
<td>6 - 12 months</td>
</tr>
<tr>
<td>PC-GIS</td>
<td>4 - 10,000 US$</td>
<td>4 - 8 months</td>
</tr>
</tbody>
</table>

Table 6-2 Key Factors to Consider in selecting GIS software.
Box 6.1 and 6.2 show samples of calculations utilised in calculating costs for beginning a GIS system. Example I shows the more expensive approach and example II shows the cheaper approach. The assumptions made for the examples are:

**Assumptions for Example I**
- Large amounts of data will be processed;
- In the beginning workplace 60% of the system administration costs will be used;
- There will be need for digitising; and;
- Full scale plotting.

**Assumptions for Example II**
- Small to mid range amounts of data;
- Outsourced gathering; and;
- Desktop mapping system will be used.

**Box 6.1 Example I**

<table>
<thead>
<tr>
<th>First Investment Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>5,000 DM</td>
</tr>
<tr>
<td>Software</td>
<td>3,000 DM</td>
</tr>
<tr>
<td>Peripheral equipment</td>
<td>6,000 DM</td>
</tr>
<tr>
<td>Training Courses</td>
<td>2,500 DM</td>
</tr>
<tr>
<td>Training on Job</td>
<td>5,000 DM</td>
</tr>
<tr>
<td><strong>Total Initial Funding</strong></td>
<td>21,500 DM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resultant Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional software</td>
<td>2,000 DM</td>
</tr>
<tr>
<td>Additional hardware</td>
<td>4,000 DM</td>
</tr>
<tr>
<td><strong>Total resultant costs</strong></td>
<td>6,000 DM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional investment costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td>5,000 DM</td>
</tr>
<tr>
<td>Further training</td>
<td>1,000 DM</td>
</tr>
<tr>
<td>Software maintenance</td>
<td>7,000 DM</td>
</tr>
<tr>
<td>Hardware Maintenance</td>
<td>400 DM</td>
</tr>
<tr>
<td><strong>Total current costs</strong></td>
<td>7,100 DM</td>
</tr>
</tbody>
</table>

**Box 6.2 Example II**

<table>
<thead>
<tr>
<th>First Investment Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>30,000 DM</td>
</tr>
<tr>
<td>Software</td>
<td>115,000 DM</td>
</tr>
<tr>
<td>Peripheral equipment</td>
<td>40,000 DM</td>
</tr>
<tr>
<td>Training courses</td>
<td>10,000 DM</td>
</tr>
<tr>
<td>Training on job</td>
<td>60,000 DM</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>255,000 DM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional investment costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional software</td>
<td>8,000 DM</td>
</tr>
<tr>
<td>Additional hardware</td>
<td>10,000 DM</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>18,000 DM</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Further education</td>
<td>72,000 DM</td>
</tr>
<tr>
<td>Software maintenance</td>
<td>8,000 DM</td>
</tr>
<tr>
<td>Hardware maintenance</td>
<td>6,000 DM</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>96,000 DM</td>
</tr>
</tbody>
</table>
6.7 SAMPLE PROJECT

An overview of how to utilise TNTmips PC based GIS software was introduced to the participants. TNTmips GIS software was described as one which could be used with any system ranging from the workstation to the ordinary PC. The TNT mips GIS introduced has a graphical interface like windows and hence is more user friendly. The lecturer guided the participants through a sample project which is shown in box 6.3

Box 6.3 Sample project exercise

In Southern Africa there are plans for a larger border crossing a highway project. With this highway the countries of South Africa, Swaziland, Mozambique and Lesotho are going to be connected. It is planned that the cities of Johannesburg, Pretoria, Baberton, Mbabane, Maputo, Durban, Pietermaritsburg and Maseru shall get direct access to this highway. In the sample project the influences on the natural resources have to be evaluated.

Besides dry and inhabited zones probably valuable wetlands and inundation areas will crossed by the highway. The following influences on the natural resources are expected:

- Destruction of nature because of highway traffic and construction activities.
- The highway has a width of 40 meter an the destruction of natural resources takes place in an are of 200 meters all together.
- Traffic fumes and traffic noises pollute an area of 1400 left and right to the highway.
- Big game reservations and National parks will be cut through the minimal size big game reservations and national parks is due to the migration habits of the animals 170 sq. km.

The questions are

- How many sq. km of land will be covered by the highway itself?
- How many sq. km of wetlands and big game reservations will be destroyed by the building of the intended highway?
- Will there be any big game reservations but through by the planned highway?
- If so: Are the resulting parts large enough for developing wildlife?

ArcView is a desktop mapping software which was introduced to the participants to have an idea on how it works. A sample project was analysed utilising data that had been manipulated using the TNTmips PC based GIS software system.

ArcView is a complete system for accessing, displaying, querying, analysing, and publishing your organisation’s data. ArcView links traditional data analysis tools, such as spreadsheets and business graphics, with maps for a completely integrated analysis system. ArcView can be used as a stand-alone project system, or extended into an entire department, division, or organisation.

6.8 CONCLUSION

The GIS was a topic treated only to give the participant an insight of geographical information systems as another tool for managing spatial data which is crucial to environmental statistics. The importance of selection and key points to consider for further training were points of training. The 4 day session was by no means meant to equip participants with the ability for the GIS software.
7. INFORMATION SYSTEM ON LAND USE

by Pratap Narain
FAO-Rome
(April 7 - 8, 1997)

7.1 INTRODUCTION
Information on land use is basic to the development of an environment information system. The aim of introducing information systems on land use was to create an understanding of the dangers resulting from non-sustainable land use in order to provide essential information to decision making. In addition there was need to develop the capability to provide up-to-date information on soil and land.

To achieve the targets for the course the main areas covered were;

- Concepts and overview;
- Classification of land and soil;
- Data needs for an information system on land use; and;
- Collection of statistical data.

7.2 CONCEPTS AND OVERVIEW

7.2.1 Land Use Information System
An information system is defined as a group of different data bases and other documentation put together in a systematic manner for transfer of knowledge and communication of data on any subject. Such a system is generally created to identify and analyse problems, set priorities and formulate policies and programme, and monitor and evaluate policies and programme performance.

Therefore an information system on land use should have information on

- Land use;
- Land cover;
- Associated land-soil-water data bases giving its agro-climatic and agro-ecological characteristics;
- Social and demographic data to know the overview of needs of the region; and; scientific and technical data for all activities in general and detailed data on economic activity of specific interest.

7.2.2 Land
There are two main ways in which land is defined. The first definition is based on national accounts and the second is based on Agenda 21.

According to the System of National Accounts land is defined as an economic asset for clear evaluation in value terms so that it can be included along with other physical and financial assets and used for making macro-economic analysis along with other economic data such as output, input, labour. According to the 1993 SNA, land is defined in the system as the ground itself including the soil covering and associated surface water but excluding:
• Buildings or other structures constructed on the land or through it e.g. roads, offices, buildings, tunnels, etc.;
• Vine yards, orchards, or other plantations of trees and any growing crops etc.
• Subsoil assets;
• Non-cultivated biological resources; and;
• Water resources below the ground.

According to the Agenda 21 “land is normally defined as a physical entity in terms of its topography and spatial nature; a broader integrative view also includes natural resources: the soil, mineral, water biota that the land comprises. These components are organised in ecosystems which provide a variety of services essential to the maintenance of life-support systems and the productive capacity of the environment”.

The holistic approach of as used by the Agenda 21 has many functions and these include the production function; environmental function; climate regulative function; hydrologic function; waste and pollution control function; space function in terms of human settlements; archive or heritage function whereby land is a medium to store and protect the evidence of cultural history of mankind; and; the connective space function in terms of providing space for transport of people, goods and services and for movement of plants and animals between discrete areas of natural resources.

The integrated approach is the most ideal for building an information system on land use, however, to develop a comprehensive and exhaustive system would have a very large scope. Hence, subsystems using concepts and definitions which interlink through a framework is recommended. A purely sectoral approach is not recommended for it can easily lead to irreversible degradation.

Figure 7.1 below gives an overview on building an information system for land use. In this figure there are two approaches which can be used to develop an information system the first is based on economic theories and models while the second is based on issues that are actually at hand. In either system there are performance measures for analysis and monitoring purposes. The figure shows the rest of the key factors to consider in building and information system on land use.
7.2.3 System of Economic Accounts for Food and Agriculture (SEAFA)

The SEAFA is a specific application of System of National Accounts (SNA). It is designed to meet the requirements of analysts, policy makers and planners dealing with food and agriculture. It provides concepts, definitions, classification and accounting framework. It can be systematically related to social, scientific and technological data.

The system of accounts for SEAFA consists of three types of tables for food and agriculture:

- **Part I** Selected accounts for Agriculture defined as a sector of the total economy including, in particular, production and primary income accounts for the sub-sector of the SNA household sector consisting of Agricultural Households, and also their capital formation;

- **Part II** Production and generation of income accounts for all establishments whose principal activity is agricultural production; also goods and services accounts for food and agricultural products;

- **Part III** Satellite accounts and supplementary tabulations relating to food and agriculture.

With regard to the economic models it was noted that two types of modal exists one is the income approach and the second is the Nutrition approach. One useful way of aggregating economic information on land use was noted to be the SNA. In this regard an example of the system of economic accounts for food and agriculture was discussed.
7.3 CLASSIFICATION OF LAND AND SOIL

7.3.1 Land Cover Classification

Land cover classification corresponds to bio-physical description of land giving details such areas under vegetation (tree, bushes, fields, lawns), bare soil and hard surfaces (dunes, rocks, buildings), water bodies, etc. Land cover classification provides physical features of land for study of environment. The types of information it provides can be seen by looking at the “Coordination of information on the environment”. (CORINE) program of the European Commission which includes information on land cover.

The classification of total land area is a systematic arrangement for grouping together different pieces of land based on similar characteristics for identifying and understanding their utilities. Such classifications take into account issues such as present use, the purpose for which it is being used or technical attributes reflecting differences in soil profile, soil texture and factors connected with environmental and agro-climatic issues. The first level (five items) indicates major categories (abstract to greater or lesser degree) of land cover. The second level (15 items) and third level (44 items) provides further details and depends on use of scale for mapping the area. The theoretical land cover classification used in the CORINE project is outlined below:-

- Earth
  - Water
    - Ocean, Sea
    - Continental water
      - Rivers
      - Water bodies
  - Land
    - Without plant cover
      - Bare rock or ground
        - Outcrops
      - Open cast mines, dump sites, construction sites
        - Artificial surfaces
    - With plant cover
      - Permanent
      - Seasonal (arable land)

7.3.2 Land use classification

Land use classification corresponds to the description of the land in terms of their socio-economic purpose. Such information is required at three level: local level - physical planning & management, national level - overall resource policy and management, planning for future use of land and for protection of environment and international level - comparative descriptions and analysis of national patterns, extending and monitoring assistance programs. The Economic Commission for Europe (ECE) released a Standard Statistical Classification of land use mixing some categories of land cover and taking into account economic activities. This effort was made in 1989 while developing the set of ECE environmental indicators. The recommended ECE classification of land use is given below:-

Agricultural land
- Arable land
- Land with permanent crops
- Land under permanent meadows and pastures
• Other agricultural land, n.e.s.
• Total agricultural land of which: Fallow agricultural land

*Forest and other wooded land*
• Total land under forest and other wooded land of which: stands of exotic species; Particularly fire-prone stands
• Land under coniferous forest
• Land under non-coniferous forest
• Land under mixed forest
• Other Wooded land

*Built-up and related land (excluding scattered farm building)*
• Residential land
• Industrial land (excluding land under 3.3)
• Land used for quarries, put, mines and related facilities
• Commercial land
• Land used for public services (excluding transport, communication and technical infrastructure)
• Land under mixed use
• Land used for transport and communication
• Land used for technical infrastructure
• Recreation and other open land

*Wet open land*
• Mires (swamps)
• Wet tundra
• Other wet open land, not elsewhere specified (n.e.s)

*Dry open land with special vegetation cover*
• Health Land
• Dry tundra
• Mountainous grassland
• Other, n.e.s

*Open land without or with insignificant vegetation cover*
• Bare rocks, glaciers, perpetual snow
• Sand beaches, dunes, other sandy land,
• Other n.e.s

Data on land use available in FAO’s data bank (the statistics division) relate to the following categories
• Total area (i.e. area including area under inland water bodies)
• Land area (i.e. area excluding are under inland water bodies)
• Arable land
• Land under permanent crops
• Permanent meadows and pastures
• Forest and woodland
• Other land (includes built-on area, roads, barren land, etc.)

This data is published regularly and is based on questionnaires sent to the national offices. The data base is not always up-to-date for several reasons. In many countries there is no established statistical system to generate such data. In some cases the primary sources go back more than twenty years. It is also clear that no single source can provide all the data required to study land use patterns which introduces additional problems of consistency.
Other problems include non-reporting (in a given year only about two thirds of countries are providing some data on land use), incomplete coverage (in particular data on fallow areas, pasture, forest and shifting cultivation are very rarely available) and there no universally accepted standards or definitions for some of the classifications hence making it difficult to come up with aggregate figures.

7.3.3 Agro-climatic and Agro-ecological Zones

The agro-ecological zones (AEZ) is a system which aims at more scientific utilisation of resources, both natural and man made. The conceptual framework for agro-ecological zones is as stated below:

- Characterisation of environments and land utilisation practices;
- Quantification of the extent to which specific AEZs can support defined land utilisation practices;
- Quantification of susceptibility of the environment to the impacts of given land utilisation practices; and;
- Identification of optimum land use patterns which meet specified social or technical goals.

Since the AEZ is often used as a tool to explore the sustainability of land uses, AEZ studies usually incorporate environmental degradation assessment. It may also be mentioned that while land use suitability/constraint are made at the level of individual cells using agro-climatic factors, optimum land use allocation within larger administrative/political regions has always been an AEZ application priority which has become possible now with the advancement in mathematical programming and use of computers.

7.3.4 Classification of soil degradation

Soil degradation can be described as a process by which one or more of the potential ecological functions of the soil are harmed. These functions relate to biomass production (nutrient, air and water supply, root support for plants) to filtering, buffering, storage and transformation (e.g., water, nutrients, pollutants), and, to biological habitat and gene reserve. Two categories of soil degradation process are recognised, viz., displacement of soil material (e.g., soil erosion by water forces or by wind forces) and in-situ soil deterioration covering chemical or physical soil degradation. Classification of soil degradation types, subtypes and symbols for use are given below:

**W: Water erosion**
- Wt: Loss topsoil
- Wd: Terrain deformation/mass movement
- Wo: Off-site effects
  - Wor: Reservoir sedimentation
  - Wof: Flooding
- Woc: Coral reef and seaweed destruction

**E: Wind erosion**
- Et: Loss of topsoil
- Ed: Terrain deformation
- Eo: Over-blowing

**C: Chemical deterioration**
- Cn: Loss of nutrients and/or organic matters
- Cs: Salinization
- Ca: Acidification
- Cp: Pollution
- Ct: Acid sulphate soils
Ce: Eutrification

**P: Physical deterioration**
Pc: Compaction, sealing and crusting
Pw: Water-logging
Pa: Lowering of water table
Ps: Subsidence of organic soils
Po: Other physical activities such as mining and urbanisation

**B: Degradation of biological activity**

**7.4 DATA NEEDS FOR AN INFORMATION SYSTEM FOR LAND USE PLANNING FOR SUSTAINABLE AGRICULTURE:**

There are five basic principles fundamental to any sound evaluation of land, namely: land suitability, sustained use, evaluation, economic implications of different kinds of land use and the need for a multidisciplinary approach. The possible composition of the data bank which needs to be created for comprehensive land use plan for agriculture is given below:

**A: Atmospheric qualities**

A1. Atmospheric moisture supply: rainfall, length of growing season, evaporation, dew formation.
A2. Atmospheric energy for photosynthesis: temperature, day length, sunshine condition.

**C: Cover quality**

C1. Value of standing vegetation as “crop” such as timber.
C2. Value of standing vegetation as germ plasma: biodiversity value (inter-specific variability and number of species).
C3. Value of standing vegetation as regulator of local and regional climatic conditions.
C4. Value of standing vegetation at introduction of crops and pastures: the land development cost.
C5. Incidence of above ground pest and vectors of diseases: health risk to humans and animals.

**T: Land surface and terrain qualities**

T1. Surface receptivity as seedbed: the tilth condition
T2. Surface tradability: the bearing capacity for cattle, machinery, etc.
T3. Surface limitations for the use of implements (stoniness, stickiness, and arability).
T4. Spatial regularity of soil and terrain pattern, determine size and shape of field with a capacity for uniform management.
T5. Surface liability to deformation: the occurrence or hazard of wind and water erosion.
T6. Accessibility of the land: the degree of remoteness from means of transport.
T7. Surface water storage capacity of the terrain: the presence of potential of pounds, on farm reservoirs, bunds, etc.
T8. Surface propensity to yield runoff water for local water harvesting or downstream water supply.
T9. Accumulation position of land: degree of fertility renewal or crop damage by overflow or overblown.

**S: Soil profile qualities**

S1. Physical soil fertility: the net moisture storage capacity in rootable zone.
S2. Physical soil toxicity: the presence or hazard of water logging in rootable zone.
S5. Chemical soil toxicity: salinity or salinization hazard; excess of exchangeable sodium.
S5 Biological soil fertility: the N-fixation capacity of soil biomass; and its capacity for soil organic matter turnover.

S6 Biological soil toxicity: the presence or hazard of soil-borne pests and diseases.

**U: Substratum or underground qualities**

U1 Groundwater level and quality in relation to (irrigated) land use.

U2 Substratum potential for water storage (local use) and conductance (downstream use)

U3 Presence of unconfined freshwater aquifers.

U4 Substratum (soil profile) suitable for foundation works (buildings, roads, canals, etc.)

U5 Substratum (soil profile) as source of construction materials.

U6 Substratum (soil profile) as source of minerals.

### 7.4.1 Land use planning using crop production approximation

The data required for making a detailed land use plan for sustainable agriculture requires a large amount of resources for collection of data. However, in general the exercise could be initiated by making a first approximation of the present and potential use of land with available data. This is illustrated by taking the crop production example.

The first step requires getting basic data maybe through a land survey to delineate and/or demarcate parcels and provide information on parcels. Delineation of land provides an approximate geographic description of the parcel; distinguishes the parcel and it describes the dimensions including area of parcel. The second set of information required is related to crops. This information includes growing period, growing season, input cost, amount of inputs used for important crops. The third major set of data relates to climate inventory of the area. This data includes rainfall, temperature, sunshine hours.

Combining of the climatic and soil requirements of crops, with the climatic condition of the agro-ecological zones, is the basis of the suitability assessment. The agro-climatic suitability for each crop can be assessed by comparing anticipated yields (available from agricultural universities/research stations) with the actual yield. The whole agro-economically possible yield can be classified in four classes defined in terms of percentage range of maximum attainable yield (MAY) without constraints for each major growing period. A general rule of thumb is given below:

<table>
<thead>
<tr>
<th>Growing period zones capable of yielding</th>
<th>Agroclimatic suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 percent or more of the MAY</td>
<td>very suitable;</td>
</tr>
<tr>
<td>between 80% to 40% of the MAY</td>
<td>suitable</td>
</tr>
<tr>
<td>between 40% to 20% of the MAY</td>
<td>marginally suitable</td>
</tr>
<tr>
<td>less than 20% of the MAY</td>
<td>not suitable</td>
</tr>
</tbody>
</table>

Such information when compiled for major agricultural land use can provide a first approximation to the land use planning. However, a detailed integrated plan needs to be constructed taking into account details listed above. A first approximation can the basic analysis to enable one to decide priority areas depending upon available resources.

### 7.4.2 Data need for monitoring and evaluation

**Measurement of Soil Degradation:**

The main data required for measurement of soil degradation depends on method utilised. The first method which was developed in the early 30’s and later updated by in 1968 utilises data on rainfall erosivity, soil erodability factors, length and steepness of slope to measure average annual soil lost.
The second method is based on economic assessments of the impact of degradation. Degradation costs have been measured as

i. The value of defensive expenditure on soil conservation works, drainage and irrigation systems, etc. required to prevent land degradation;

ii. The value of lost yield;

iii. The replacement costs where the cost of additional inputs (e.g. fertiliser) needed to maintain the same level of yield is taken as a measure of the sort of soil degradation which can be equated to the quantity of lost soil nutrients;

iv. Taking an income approach whereby an estimate is made for reinvestment of a share of income from land to maintain the same level of income; and;

v. The cost of rehabilitating the plot to its former productive condition.

Applied to soils, it would mean that a proportion of the profits made from exploitative land use which results in degradation of land, were reinvested in some other way, say in reclaiming coastal marshland to maintain the same level of income originating from the same land use. Each of these methods measure soil degradation from a different angle. Some of these methods can be used only for a particular type of degradation whereas some can be used universally. For example the fourth approach is not suitable to measure the sort of soil degradation when the water table of some land area has gone down.

The third approach is the maintenance valuation approach which is more appropriate for the System of Economic and Environmental Accounting (SEEA). When the soil is restored to its former condition three components to estimate depletion and degradation of are:

- Cost of replacing nutrients through additional inputs to maintain level of productivity;
- Cost of replacing soil organic matter (and thereby restore structure which could be done, for example, by allotting part of the land to a green manure crop and foregoing production); and;
- Cost of replacing the eroded soil.

**Land quality indicators**

The Pressure-State-Response framework is a way used to group land quality indicators as follows:

Group I: Pressure land quality indicators: This group consists of primarily national production of agricultural commodities (crop, animal, area, yield), inputs (use of fertilisers, pesticides and other inputs) and cultivation practices (land use, are harvested, irrigation, soil conservation practices (to derive indicators such as)

- Ratio of cultivation: arable land;
- Production yield: arable land;
- Soil conserving: soil degrading crops; and;
- Nutrient inputs: nutrient outputs

Group II: State land quality indicators; This indicator compared the anticipated yield to the actual yield. Generally since there is no valid concept for anticipated yield (i.e. yield which is free form all constraints such as soil condition, water availability, salinity, agronomically and economically feasible yields are taken to develop land quality indicators such as
actual yield: anticipated yield.

Such indicators can be aggregated by prominent types of soil degradation to monitor the policy impact. A large number of other indicators are available in this group which takes into account different agronomic attribute into consideration to measure the state of impact.

Group III: Response Land quality indicators: This group primarily involves adoption of soil conservation techniques, use of special inputs, crop rotation program, leaving field fallow for some time with reference to number of farmers adopting such techniques or extent of area covered.

7.5 COLLECTION OF STATISTICAL DATA

Four main methods of collecting data were highlighted as follows:

- Remote sensing technique;
- Cadastral mapping;
- Census of Agriculture; and;
- Sample surveys.
8. MANAGEMENT OF COMMUNICATION
by John King
Office for National Statistics
(April 9 - 11, 1997)

8.1 INTRODUCTION
Management of communication is a tool utilised in the collection, analysis and dissemination of data. It is even more important for environment data because it is multidimensional in nature and requires data from almost all fields to enable one to assess the extent to which the development process is sustainable. The main aims of introducing the course topic on management of communication were to familiarise participants with basic management concepts and their application in statistical units and to identify the different types environment data and environment data collection procedures for inclusion in an environment information network. To achieve the above mentioned objectives, the lecturer used experiences of participants in management of communication through group discussion, plenary presentations and lectures.

8.2 PROPOSAL FOR PRODUCTION OF STATISTICS ON ENVIRONMENT
The participants were divided into four groups. Each group was assigned to develop a proposal for the production of statistics on environment. The members of each group were treated as a syndicate group in charge of developing environment statistics and were required to report back to the director of statistics to discuss the plans.

When the participants first did this exercise the following observations were made; environmental statistics is an elephant, difficult to operationalise, therefore the presentations from each group are general in nature rather than specific and precise and wider context to environment issues with regard to their harmonisation at an international levels was a strong point of the group presentations.

8.3 MANAGEMENT
Management is defined as obtaining objectives/goals with specific resources in the most efficient way. Management is often seen as “getting the work done” or “meeting the targets” or “achieving results” or even “making decisions”. The key aspects of management are

• Accountability;
• Leadership;
• Defining aims and objectives;
• Organising and planning;
• Controlling and evaluating;
• Achieving results;
• Training and development of individuals; and
• Communication - written and spoken.

Most aspects of management may and should be delegate. Two aspects of management however should not be delegated. These are accountability and leadership.

8.4 PLANNING AND IMPLEMENTING A PROGRAMME OR STATISTICAL UNIT.
Planning is carried out so that appropriate resources in terms of money, people, time and equipment are found and efficiently and effectively managed. Planning advocates for proac-
tive approaches rather reactive approaches which are related to crisis management. Planning provides the knowledge on what has to be done, when, by whom and why. The steps involved in planning are:

- List the objectives (why are we doing the survey? Who are the users? What are their needs? When?) (it is very crucial to get this step right);
- List the tasks to achieve the objectives, timetable them;
- List the resources needed for the tasks, and when (people, equipment, money, etc. - all need to be timetabled);
- List the resources available, and compare this to the resources needed to see the resource gaps and when these occur - fill the gaps;
- Set up monitoring procedures; and
- Go - start the clock on the revised agreed programme; allocate tasks; monitor progress and use of resources, revise and improve.

Planning, managing and implementing are not static activities. There is therefore, the need to continuously review plans. This enables one to adapt to changes and succeed. The same considerations apply to implementing change and to improving quality. Figure 8.1 below describes the planning cycle.

Figure 8-1 Planning Cycle

8.4.1 Objectives

Objectives provide focus for work and should be set in all areas dealing with resources, activities, results. Productivity is equal to results/resources. Objectives are usually set by others such as one’s lines manager, or a client, particular user of data. They can also be set by the individual. Objectives should be S M A R T.

- S Specific
- M Measurable
- A Agreed
- R Realistic
- T Timebound.

Objectives are crucial for management information systems, for they provide the yardstick for measuring performance. The above mentioned principles also equally apply to objectives for
tasks and to those for people. The tasks of a senior manager may become the objectives for the next person in the hierarchy. The figure below shows the flow of tasks. It is worth noting that the kind of objectives set for people are behavioural (describe some form of behaviour). Objectives that are set for people are behavioural. In this respect they describe some form of behaviour.

Figure 8.2 Flow of Tasks

8.4.2 Tasks:
A complete list of tasks are required. A timetable is a key tool utilised in listing tasks it specifies how the tasks will be done by whom, and when.

An exercise (2) was given to the participants to specify objectives for the Environment Statistics Unit and draw up a task plan and timetable to meet these objectives. The participants were told to build upon the ideas that were discussed in the first exercise.

8.4.3 Resources Needed
We can build on the task (or activity) list and timetable to develop a resource plan and timetable. This will indicate the skills and knowledge needed for each task, and will show how many people (or man-hours) are needed. We should show what equipment, transport, consumables, accommodation, money etc. will be needed for each task; when each of these will be needed, and for how long.

8.4.4 Resource Gaps
We also need to draw up a list of what resources are available. (We may have to make assumptions about the basis for this or the budgets to be agreed, but these assumptions will be clear and can be checked subsequently). A comparison of the resources needed and those available will show the resource gaps: which resources are missing, and when. The gaps may be in money, time, people/ skills, equipment, etc., or some combination of these. The gaps need filling in one way or another: modifying the plans or objectives; finding resources from elsewhere; not doing something else; otherwise we will not be able to do the survey as planned.

Training may be a very important way of filling some of the human resource gaps. Again, an inventory of a person’s skills will be compared with the skill requirements of the task or job. A training programme is designed to fill these gaps. Note that the training programme thus has clear objectives, which should be agreed by the trainee, the line manager, and the trainers.
8.4.5 Monitoring
We need monitoring procedures to track what is happening and what is not happening; to get some advance indications of potential trouble areas. Information from the monitoring systems allows us to be in control, and to plan for changes. Together with the action plan/timetable we can see consequences of developments and adjust plans accordingly. The information from these systems should be shared widely: all those involved in the task (the team) need to know what is happening, so they can act.

8.4.6 Managing Change
We need to know how to manage change. We start with a vision of what we want the result to be - where we will be; what our unit will be, what our outputs will be, what our performance will be etc.. We need a clear vision of the “destination”. There will be some details, and the more that is known the better, but the picture has to be one that can be communicated simply and easily. It will provide motivation and inspiration.

We have to take stock of where we are, and then plan the route. We should concentrate on the destination, not on the present problems and difficulties (these are what we are moving away from, changing). The emphasis is on how to get there, not on how to leave here. Don’t worry about present constraints and obstacles; these will be dealt with in the action plan if they are relevant.

How to get there? List the things working in our favour, and those that might hold up progress to the vision. How can these be used to our advantage? How can we step over the obstacles or remove them? There will be budgets and equipment to include under this analysis. A useful tool in achieving this analysis is the SWOT chart (Strengths, Weaknesses, Opportunities and Threats. The Table below shows the results of a discussion held on strengths and weakness in setting up an environment statistics unit.

<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>National obligations</td>
<td>Lack of experience</td>
</tr>
<tr>
<td>International obligations</td>
<td>Clear specifications agreements</td>
</tr>
<tr>
<td>Legislation</td>
<td>No common objective</td>
</tr>
<tr>
<td>Desirable activity</td>
<td>Lack of transparency (unwillingness to declare existing problems)</td>
</tr>
<tr>
<td>Relevant</td>
<td>Bureaucracy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deal with current problems</td>
<td>Treading on others toes</td>
</tr>
<tr>
<td>Influence current policy</td>
<td>Transparency (Fear of loss of political power in event of poor performance statistics)</td>
</tr>
<tr>
<td>Current interest world wide</td>
<td>Competition between agencies</td>
</tr>
<tr>
<td>Gain resources because it is topical</td>
<td>Hostile reactions</td>
</tr>
<tr>
<td>Better use of data at the CSO.</td>
<td>Proliferation/competition between agencies</td>
</tr>
<tr>
<td>Transparency (more awareness)</td>
<td></td>
</tr>
</tbody>
</table>

There will also be people to consider, and not just those who will be doing the changes. Other people will be affected: our users, other parts of the office, our suppliers (people and firms who provide data). The interested groups, people, organisations - both internal and external to the organisation. These are sometimes referred to as the stockholders. Stockholders are those who affect and who are affected by the unit’s or organisation’s activities and policies. We need to think
of their attitudes: will they be for, against or indifferent? Again, we need to plan how to handle them: to encourage them, enlist their support, persuade them, and neutralise them. The Figure 8.3 shows the diagram that was discussed during plenary indicating the stockholders in the area of environment statistics.

**Figure 8-3 Stockholders Analysis**

![Figure 8-3 Stockholders Analysis](Image)

Draw up an action plan showing the route, the difficulties and traps, the side-roads, leading to the destination. Determine how to navigate through to the destination; the time scale, the timetable and the actions you will have to take at each point.

**8.5 USERS AND PRODUCERS OF STATISTICS**

In statistical work, the objectives are, almost always, set by the users of the statistics. They will specify what they want and when they want it. Producer-User relationships and communication are thus essential if the tasks (e.g. the survey) are to be well and clearly specified, and the users’ needs met.

The objectives should specify in some detail the output of the survey and a timetable for this. Then we know: why we are doing the survey, who the main users are, and what are their needs. The users know clearly what they will get and when, and it has been agreed. (One of the golden rules of questionnaire design is, “start with the tables, then see the questions to be asked”. So, this discussion will set some of the objectives).

Discussions between users and producers should start at the beginning of the survey and go on past the end. These communications and relationships don’t start with a dissemination workshop, or when something goes wrong with the survey (e.g. delays). Users are an integral part of the survey team. They may be helpful in many ways at different stages of the survey. In some instances, they may even provide some resources for the completion of the survey. Remember that they are the customers.
8.6 COMMUNICATION AND NETWORKING

Communications may be formal or informal (and are usually a mixture of both) and can be at different levels depending on the nature of the communications. There are occasional high level forms of communication, dealing with strategic aspects through a Steering or Management Committees. At a lower levels, there are more frequent formal meetings to monitor progress and to deal with more routine matters, through Liaison Committees. Informal communication (often called networking) is also very important. It allows people to be consulted and to influence decisions before reach decision making levels. On the other hand, they help contributors to form their own views before formal encounters. Many matters going to formal meeting will have been discussed, and possibly resolved, in this way beforehand, informal communication can help to defuse potential clashes and can help to encourage others to co-operate.

8.7 CONCLUSION

To conclude the course topic the participants were given the same exercise as the first one. It was clear from the presentations that the important aspects of management of communication had been grasped. It was also noted the time spent by each of the participants in the room amounted to 2 to 3 weeks emphasising the need for team building in order to achieve the stated goals.
9. INFORMATION SYSTEM ON SUPPLY
AND USE OF ENERGY

by Helmut Mayer
Federal Statistics Office of Germany
Wiesbaden
(April 14 - 16, 1997)

9.1 INTRODUCTION

Information systems on supply and use of energy answer key questions such as: Do we have the energy we need? Are the sources adequate? What are the prices?. Energy information systems are also an input into environmental data bases especially in the estimation of air pollution. The aim of introducing this course topic was to enable participants to be familiar with information systems, to monitor and assess stocks and use of energy and materials. The construction and use of energy balance sheets as a tool for monitoring and assessing was also introduced. This topic was supplemented by a tutorial to enhance the understanding of balance sheets. In addition an exercise on construction of balance sheets was carried out using the spreadsheet package EXCEL.

9.2 THE NEED FOR AN ENERGY INFORMATION SYSTEM

The energy information system is essential for economic reasons. There is need to account for how much income has been earned from energy as a sector and also how much energy is used by the different sectors of the economy. The information system is also important for environmental assessment. Production and transformation of energy is regarded to be the main source of pollution. In this respect, the emission of carbon dioxide and formation of acid that is mainly connected to the combustion of fuels. Another example of an environmental impact related to use of energy is the danger of radiation connected with nuclear power plants. It is important to note that the impacts of production and transformation of energy are at the various levels, namely global, regional and local.

The impacts at a global level include issues such as the greenhouse gases which lead to the depletion of the ozone layers. The local level issues include land use changes e.g. in setting up uranium mines the land used may change from forestry to the industry. The construction of roads is another land use change which is directly related to use of energy in transportation. The atmosphere is warmed up by transformation of energy from chemical to mechanical rather than consumption that is why we have global warming. Table 9.1 shows the various pollutants/emissions and the level at which the impact on environment is most evident. Table 9.2 shows the effect and source of pollutant.

<table>
<thead>
<tr>
<th>Table 9.1 Level of Environmental impact for Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollutants/Emissions</strong></td>
</tr>
<tr>
<td><strong>Level</strong></td>
</tr>
<tr>
<td>Local</td>
</tr>
<tr>
<td>Regional</td>
</tr>
<tr>
<td>Global</td>
</tr>
</tbody>
</table>

Statistics for Environmental Policy, 1997
Table 9.2 The Effects of Different Pollutants/Emissions and Their Sources

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effect</th>
<th>Caused by</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>Affects the health of the population</td>
<td>fossil fuels, gas and coal</td>
</tr>
<tr>
<td>CO₂</td>
<td>Leads to global warming</td>
<td>diesel oil</td>
</tr>
<tr>
<td>SO₂</td>
<td>Formation of acid rain</td>
<td>diesel oil</td>
</tr>
<tr>
<td>NOₓ</td>
<td>Global warming</td>
<td>diesel oil</td>
</tr>
<tr>
<td>Particulate</td>
<td>Toxic substances which affect human health</td>
<td>Diesel oil</td>
</tr>
<tr>
<td>VOC</td>
<td>Ozone layer depletion</td>
<td>Petroleum products</td>
</tr>
</tbody>
</table>

Some of the key questions which need to be answered in formulation of an energy information system are:

- What will be the land use changes in construction for hydroelectric plants?
- What are the energy demands for fuelwood and to what extent can these be met from the available forest resources?
- Can the environmental impacts be reduced by change in energy sources?

### 9.3 BALANCE SHEETS

Balance sheets are principally constructed for various uses. These include simulation which is utilised for forecasting. For instance what would happen to the energy sector if imports went up. The balance sheets are also utilised to determine which form of energy is most efficient. Each kind of energy produces some form of air pollution so balance sheets can be utilised to estimate air pollution that is caused by the different sectors of the economy. Finally balance sheets are utilised in construction of input output tables which are utilised in the production of national accounts.

Table 9.3 shows an example of the balance sheet constructed for Germany in an aggregate form. Table 9.4 shows the actual distribution of each sector by type of energy sources.

In order to formulate the balance sheet the following assumptions are made: Each type of energy generated has an input however potential power is not calculated. Therefore, for hydroelectric power one assumption is that input is equal to output. Another assumption is that hydroelectric power has useful energy coefficients of 1:3. The assumption made for hydroelectric power are the same as those that can be made for nuclear energy.

A source of energy is either primary or is transformed. Hot steam water is not considered as a primary source but rather another source of energy. The outcome of nuclear energy is mostly electricity and hence not a primary resource. For hydroelectric power there is no transformation output because it is a primary source of electricity. This is also the case for natural gases. Oil has transformation figures both in the transformation output and primary production because of aggregation. Some types of oil are primary and others are transformed. In this regard raw petroleum is a primary source whereas diesel, gasoline, kerosene, heating oil are all transformed sources of energy.

### 9.3.1 Units Utilised in Presentation of Energy Statistics

In order in come up with table 9.1 and consequently table 9.2 there is need to convert the various sources of energy into one unit the terajoule which is the most commonly used unit. The relationships between the units is highlighted below:

$$
1 \text{ joule/sec} = 1 \text{ watt} = \text{ Volt} \times \text{ ampere}
$$

$$
1 \text{ joule} = \text{ watt second}
$$

$$
\text{ Kilo} = 10^3
$$
Mega  =  $10^6$
Giga  =  $10^9$
Tera  =  $10^{12}$
Peta  =  $10^{15}$
Exa  =  $10^{18}$
1 kwh  =  3,600,000 watt seconds
1 kcal  =  4.1868 kilojoules
1 kcal/h  =  0.27778 cal/s  =  1.163 watt
1 ws  =  1j  =  0.239
1 kwh  =  3600kj  =  860 kcal
1w  =  1 j/s  =  0.239 cal/s  =  0.86 kcal/h

The calorific values for the various sources of energy are as listed below:-

<table>
<thead>
<tr>
<th>Item per 1000 tonnes</th>
<th>Terajoules (TJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard coal</td>
<td>29.767</td>
</tr>
<tr>
<td>Lignite</td>
<td>8.743</td>
</tr>
<tr>
<td>Hard brown coal</td>
<td>14.95</td>
</tr>
<tr>
<td>Hard brown coal briquettes</td>
<td>19.46</td>
</tr>
<tr>
<td>Lignite coke</td>
<td>29.935</td>
</tr>
<tr>
<td>Fuel wood (in Germany)</td>
<td>14.654</td>
</tr>
<tr>
<td>Crude oil</td>
<td>42.75</td>
</tr>
<tr>
<td>Motor gasoline</td>
<td>42.733</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td>40.614</td>
</tr>
<tr>
<td>LPG</td>
<td>45.987</td>
</tr>
</tbody>
</table>

9.3.2 Construction of Balance sheets

Having transformed all energy into one common unit then the balance sheets are calculated based on the theories in national accounts as represented in the following formula:

\[ P = IC + Cpr + Cpu + Inv + Ex - Im \]

whereby

IC  Intermediate consumption
P  Production
Cpr  Private consumption
Cpu  Public consumption
Inv  Investment
Ex, Im Exports and Imports respectively.

For example for steam hot air: Total transformation output of steam (199260) = Consumption of energy sector (13480) + distribution losses (15830) + industry (36,930) + transport (150) + households commerce and public authorities (125870).
Hence box 9.1 below highlights the formula that is utilised based on the principle of national accounts

**Box 9.1 Formular Utilised for Construction of Balance Sheets in Germany**

<table>
<thead>
<tr>
<th>Production (primary source)</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Imports (Primary sources and derived energy)</td>
<td>2</td>
</tr>
<tr>
<td>+ Withdrawals form stocks (primary source and derived energy)</td>
<td>3</td>
</tr>
<tr>
<td>= <strong>Total domestic supply (primary sources and derived energy)</strong></td>
<td>4</td>
</tr>
<tr>
<td>- Exports and ship’s bunkers (primary sources and derived)</td>
<td>5,6</td>
</tr>
<tr>
<td>+ Increase in stocks (primary sources and derived energy)</td>
<td>7</td>
</tr>
<tr>
<td>= <strong>Gross domestic use of primary sources (primary sources and derived energy)</strong></td>
<td>8</td>
</tr>
<tr>
<td>- Transformation input (primary sources and derived energy)</td>
<td>22</td>
</tr>
<tr>
<td>+ Transformation output (derived energy)</td>
<td>36</td>
</tr>
<tr>
<td>- Energy consumption with energy branches</td>
<td>45</td>
</tr>
<tr>
<td>- Distribution losses, etc.</td>
<td>46</td>
</tr>
<tr>
<td>= <strong>Energy available for final consumption (primary sources and derived energy)</strong></td>
<td>47</td>
</tr>
<tr>
<td>- Non-energy consumption (primary sources and derived energy)</td>
<td>48</td>
</tr>
<tr>
<td>+/- Statistical discrepancies (primary sources and derived energy)</td>
<td>49</td>
</tr>
<tr>
<td>= <strong>Final energy consumption (primary source and derived energy)</strong></td>
<td>50</td>
</tr>
</tbody>
</table>
# Table 9.3 Energy Balance Sheet for Germany 1980 in Terajoules

<table>
<thead>
<tr>
<th>ENERGY BALANCE SHEET 1980</th>
<th>Germany Terajoule</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PRODUCTION</strong></td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>1 2585932</td>
</tr>
<tr>
<td>Lignite</td>
<td>2 197383</td>
</tr>
<tr>
<td>Other solid fuels</td>
<td>3 613786</td>
</tr>
<tr>
<td>Oil, Petroleum</td>
<td>4 94171</td>
</tr>
<tr>
<td>Prod. gas</td>
<td>5 1367586</td>
</tr>
<tr>
<td>Nat. gas</td>
<td>6 184675</td>
</tr>
<tr>
<td>Electric energy</td>
<td>7 0</td>
</tr>
<tr>
<td>Hydro electric power</td>
<td>8 0</td>
</tr>
<tr>
<td>Nuclear energy</td>
<td>9 0</td>
</tr>
<tr>
<td>Steam hot water</td>
<td>10 0</td>
</tr>
<tr>
<td><strong>TOTAL DOMESTIC SUPPLY</strong></td>
<td>11 2939216</td>
</tr>
<tr>
<td></td>
<td>12 1166523</td>
</tr>
<tr>
<td></td>
<td>13 59310</td>
</tr>
<tr>
<td></td>
<td>14 6063501</td>
</tr>
<tr>
<td></td>
<td>15 19975</td>
</tr>
<tr>
<td></td>
<td>16 1981354</td>
</tr>
<tr>
<td></td>
<td>17 184675</td>
</tr>
<tr>
<td></td>
<td>18 0</td>
</tr>
<tr>
<td></td>
<td>19 0</td>
</tr>
<tr>
<td></td>
<td>20 0</td>
</tr>
<tr>
<td><strong>GROSS DOM. USE OF PRIM. SOURCES</strong></td>
<td>21 2259058</td>
</tr>
<tr>
<td></td>
<td>22 1148380</td>
</tr>
<tr>
<td></td>
<td>23 56363</td>
</tr>
<tr>
<td></td>
<td>24 5443227</td>
</tr>
<tr>
<td></td>
<td>25 -562</td>
</tr>
<tr>
<td></td>
<td>26 1886939</td>
</tr>
<tr>
<td></td>
<td>27 55323</td>
</tr>
<tr>
<td></td>
<td>28 166622</td>
</tr>
<tr>
<td></td>
<td>29 0</td>
</tr>
<tr>
<td></td>
<td>30 0</td>
</tr>
<tr>
<td></td>
<td>31 0</td>
</tr>
<tr>
<td></td>
<td>32 0</td>
</tr>
<tr>
<td></td>
<td>33 0</td>
</tr>
<tr>
<td></td>
<td>34 0</td>
</tr>
<tr>
<td></td>
<td>35 0</td>
</tr>
<tr>
<td><strong>OTHER GENERATION OF ENERGY</strong></td>
<td>36 2530665</td>
</tr>
<tr>
<td></td>
<td>37 1145384</td>
</tr>
<tr>
<td></td>
<td>38 42240</td>
</tr>
<tr>
<td></td>
<td>39 4776347</td>
</tr>
<tr>
<td></td>
<td>40 134723</td>
</tr>
<tr>
<td></td>
<td>41 586538</td>
</tr>
<tr>
<td></td>
<td>42 6368</td>
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**Chapter 9**

**Information System on Supply and Use of Energy**

**Statistics for Environmental Policy, 1997**
Table 9.4 Composition of Total Domestic Supply and Percent Distribution of Final Energy Distribution by Sector

| I. Composition of Total Domestic Supply | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| PRODUCTION                             | 1 | 88.3| 95.1| 100.0| 3.3| 0.0| 31.0| 0.0| 100.0| 0.0| -/0!
| IMPORTS                                | 2 | 10.7| 4.8 | 0.0 | 96.1| 97.5| 69.0| 100.0| 0.0 | 100.0| -/0!
| WITHDRAWAL FROM STOCKS                 | 3 | 1.0 | 0.1 | 0.0 | 0.6 | 2.5 | 0.0 | 0.0  | 0.0 | 0.0  | -/0!
| TOTAL DOMESTIC SUPPLY                  | 4 | 100.0| 100.0| 100.0| 100.0| 100.0| 100.0| 100.0 | 100.0| 100.0| 100.0|
| PRODUCTION                             | 1 | 54.6| 23.4| 1.3 | 4.2 | 0.0 | 13.0| 0.0 | 3.5  | 0.0 | 100.0|
| IMPORTS                                | 2 | 3.8 | 0.7 | 0.0 | 71.2| 0.2 | 16.7| 2.3 | 0.0  | 5.1 | 0.0  | 100.0|
| WITHDRAWAL FROM STOCKS                 | 3 | 44.1| 1.6 | 0.0 | 53.6| 7.7 | 0.0 | 0.0 | 0.0  | 0.0 | 0.0  | 100.0|
| TOTAL DOMESTIC SUPPLY                  | 4 | 22.6| 9.0 | 0.5 | 46.7| 0.2 | 15.3| 1.4 | 1.3  | 3.2 | 0.0  | 100.0|

II. Composition of Final Energy Consumption

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9.4 IMPORTANT INDICATORS ON ENERGY CONSUMPTION

Some of the important indicators constructed from energy balance sheets are listed below as follows:

**Total domestic supply of energy**
- Level of total domestic supply of energy which can be presented as joules or coal units or oil units;
- Specific energy consumption which can be presented in monetary units and presented as a proportion of GDP; and;
- Specific energy consumption which can be presented as a per capita units; and;
- Total domestic supply of energy can further be disaggregated by domestic sources, different energy carriers (coal, gas, oil, hydro-power, nuclear power), renewable sources and by broad categories of use such as consumption within the energy branches, non-energetic use and final energy consumption.

**Final energy consumption**
- Level of final energy consumption in joules or coal units or oil units;
- Composition of different energy carriers (solid fuels, petroleum, gas, electricity, heat) by branches (industry, traffic, households and other commercial uses)
- Use categories of energy such as heat into industrial processes (electrolysis, furnaces, cracker), space heating, power, traffic, lighting.

**Energy content of goods and services**
- Total energy content presented in input output tables;
- Net energy content (primary sources); and;
- Breakdown of resources into sources (domestic generation, directly imported, energy content of imported commodities) breakdown of use categories (consumption, capital formation, exports) and breakdown into commodities (of final domestic use).
9.5 **SOURCE OF ENERGY STATISTICS**

The main sources of energy statistics in Germany include:

- Survey for establishment and enterprises of electricity, gas, steam and water supply.
- Survey with in mining and manufacturing for establishments on consumption and stocks of fuels (quarterly) on purchases and use of electricity and on production (amounts and values) and survey for enterprises on costs of energy inputs on a yearly basis and on input of raw materials every 4 years.
- Other statistics, such as petroleum products and taxes on them, statistics on trade exports and imported and are collected from the specific government ministries responsible.
- Statistics on private consumption are derived from household surveys which are carried out at various intervals (quarterly, yearly and 5-yearly basis).

9.6 **PROPOSALS TO SAVE ENERGY**

The proposal to save energy were drawn from the participants using cards. The following were the recommended

**Developed countries:**
- Stop using nuclear power and start using solar energy;
- Start using solar driven cars;
- Change consumption patterns and promote public transport; and;
- Adopt decentralised energy systems.

**Developing countries:**
- Promote use of solar energy and hydro power;
- Change attitudes and perceptions about energy used;
- Changes in technology; and;
- Utilise economic techniques, such as taxes and pricing, to save energy.

9.7 **CONCLUSION**

A paper entitled “The Energy Sector in Swaziland” was presented. In this paper the balance sheet of Swaziland and the actions, projects and programmes that were currently being undertaken were presented. This example enhanced the understanding and applicability of energy statistics in developing countries.
10. ENVIRONMENT MODELLING

by Sui San Lim
ÖKO INSTITUTE OF ECOLOGY
DARMSTADT
(April 17 - 18, 1997)

10.1 INTRODUCTION
Environmental modelling is the estimation of environmental changes including forecast under different scenarios (with or without environmental measures). An example of a computer based environmental modelling package namely “Environmental Manual” was introduced. EM is package utilised for modelling energy options for power development. It has been developed by the ÖKO Institute for Applied ecology for the German Government with sponsorship through GTZ and co-ordinated by World Bank. Other donors include DFID (ODA) and Bank of German (KFW).

10.2 THE ENVIRONMENTAL MANUAL
The environmental manual is a new tool for energy and environmental planning and cost analysis in developing countries. It is a database system which contains information on costs and quantitative environmental impacts of energy system. The EM is also an analysis system which determines life-cycle costs and emissions whereby a cycle is the process from extraction, transportation conversion of energy, combustion and end use. The EM is an evaluation tool used to decide the trade-offs between impacts, and helps to address uncertainty. It utilises a self explaining windows interface.

Countries which do not have adequate data can utilise the generic data offered by the EM to make preliminary estimates for power development. EM also provides the possibility to utilise own data. In this regard therefore a pragmatic approach can be adopted in developing a system for finding the most appropriate energy sources. Hence building a data base system using a step by step procedure.

EM enables one to carry out consistency checks of data by comparing with generic data bases and computation of fuel dependent emissions. It offers various analytical options e.g. the breakdown to local/global impacts, contributions of individual powerplants to results of larger system.

10.3 QUESTIONS THAT CAN BE ANSWERED BY EM
There are different kinds of questions that can be answered by EM and these are as stated below:

Utility
- Alternative to cover demand for power?
- What are the least cost options?
- What options comply with emission standards?

Ministry of energy
- What are the economic, environmental and social effects of the alternatives?
- What long term environmental effects of the supply options ?
- Which power sources fits into national strategy’?
- What are the emission standards required by lending agencies?

Lending agencies
- What are the long term environmental effects of strategies/options?
- What alternatives comply with own standards?
- What are internal/external costs of alternatives?
- What are the financing options for global warming benefits?

**Local Authorities, NGOs**
- What are the direct/indirect local environment effects of alternatives?

### 10.4 DATA CONTAINED IN EM

The EM data base contains data on the different types of energy and materials. For each energy source EM contains data on: processes of extraction by technology type, different means of transportation used for energy extraction, conversion technologies, end uses and cost data. It also contains data on the types of emissions, land use effects and material use. The EM data contains generic data which can be changed with country and technology specific information for the country or region in question. Figure 10.1 below shows the areas and type of results expected from EM

#### Figure 10.1 Results of EM

**Qualitative Data**
- (Biodiversity, ecosystems, socio-culture, Human Health)

**Quantitative Data**
- Cost impacts
  - Internal
  - External
  - Net Present Value

**Environmental Impacts**
- Airborne emissions
  - \( O_2 \), \( NO_x \), Particulates, \( HCl \), \( HF \)
- Greenhouse gases
  - \( CO_2 \), \( CO \), \( CH \), \( NMOVOC \), \( N_2O \), \( CFC \)
- Heavy Metals
  - (such as \( Cd \), \( Hg \), \( Pb \))
- Solid wastes
  - (bottom/fly ash, FGD residuals)
- Liquid effluents
  - (user defined)
- Land use

**Other Data**
- Compliance with environmental standards

### 10.5 SCENARIOS

The EM is a demand driven bottom-up approach. In other words EM scenarios start with the demand, then the supply options are defined which deliver electricity and or heat. The supply side includes different forms of power including steam turbine power plants (coal), steam
turbine (oil), wind turbine, cogenerator, boiler, stove, hydro plant and combined cycle power station.

10.6 CURRENT ACTIVITIES OF EM
The current activities of EM are as outlined below:-

- An ongoing case study for Morocco on the effects on environmental standards;
- EM applications in World Bank District Heating Study on project evaluations in Central/Eastern Europe; and;
- EM user Network in the internet.

The activities that are planned include:

- Support for EM applications in (China, Southern Africa);
- Database extensions (industry, transport); and;
- Model and data base extensions/updates.

10.7 EXERCISES
To have an understanding of the functioning of EM the participants were given a step by step procedure for using EM. This entailed working with a generic database in order to learn how one can adjust fuel and process records, and how to create scenarios to compare energy options. The participants also worked through an exercise to answer the question “Is it more economical and more effective to buy a low sulphur coal and burn it in a power plants with no emission control device for sulphur dioxide or burn high sulphur coal in a more expensive power plant equipped with emission control technologies to reduce sulphur dioxide?”

Three types of sulphur were identified these were models burning high sulphur coal in a power plants equipped with emission control technologies, a second option which burned low sulphur coal which is not equipped with any pollution control devices and an option base case which represents original generic data.

The results of the exercise were that while an environmental friendly power plant is certainly more expensive because of additional investments in pollution control devices, it may be the least cost solution for internal and external cost. Interest rates for additional investment are low and there is a discount for the high sulphur fuel.

The example did not recommend to burn high sulphur coals at any price. However, it clearly showed that in case only a high sulphur coal is available and low-sulphur coals carry a high premium (or supply is unreliable) it is certainly more cost effective and more environmentally friendly to burn the high sulphur coal in an expensive power plant equipped with a wet scrubber for flue gas de-sulphurisation than trying to burn a low-sulphur or standard sulphur fuel in a normal power plant.
11. QUANTIFICATION OF ENVIRONMENT RELEVANT ACTIVITIES OF INDUSTRIES (MINING AND MANUFACTURING)
by Gilles Tremblay
Genivar-Quebec, Canada
(April 21 - 23, 1997)

11.1 INTRODUCTION
The two days session was an introduction to use of statistics, and statistical methods, for environmental impacts assessment of mining and production of pulp and paper industries. Examples from Canada were utilised as case studies. In Canada both industries are of great economic importance and are subject to the same kind of monitoring processes. The important role played by partnership between government and industries in achieving successful environmental monitoring programmes in Canada was stressed.

11.2 MINING
There are two primary step in the mining process. These are extraction and beneficiation. Extraction is the removal of ore from deposits in the ground. Once the ore is removed, additional processing is required to isolate the valuable minerals from the remaining wastes. These supplementary processing steps are known as beneficiation. In some cases, the ore is not crushed, but the valuable metal is extracted by leaching. This implies the use of chemicals (sulphuric acid most of the time) to dissolve the metal. Based upon the location and type of mineral, the mining practices may differ, but they all lead to large amount of waste materials.

The mining operations produce large amount of waste minerals and tailings. Once these wastes and tailings get into contact with air and water they become major sources of three kinds of environmental impacts namely acid mining drainage, air pollution and land use.

The acid mining drainage is caused by the presence of sulphurs in waste materials. When the sulphur gets into contact with air and water it produces acid which lowers the PH and results in metals dissolving. The solution produced may in some instances be transported to the rivers, lakes and underground water. The acid mining drainage is by far the worst problem of mining.

Pollution caused by transportation of particles by the wind is less important. However, in some cases, the pollution may have severe consequence for particular cases. For example pollution caused by asbestos is dangerous for human health. In these situations, a cover can be made with special textiles or other kind of rocks or minerals in order to stop the air pollution. Finally, the changes in land use due to drilling, blasting, and change in topography are considered to be environmental issues because of the hazardous nature of the mined region.

11.3 STEPS IN ENVIRONMENTAL PROJECT
In development of an environmental monitoring programme it was noted that the first crucial step is to get all background information on the project impacts assessments report. The following steps were recommended for the report.

1. Project rationale.
   • Cost/market analysis;
   • Socio-economic benefits;
   • Environmental ecology and economics; and;
Chapter 11 Quatification of Environmental Relevant Activities (Mining and Manufacturing)

- Description.

2. Project name

3. Technical description of project
   - Location, layout, land requirement and time table for development;
   - Construction supply requirement;
   - Mining operation;
   - Process and product;
   - Waste management;
   - Water management;
   - Infrastructure requirement;
   - Transportation system requirement;
   - Employment work force; and;
   - Health and risky safety risk.

4. Scope of environmental assessment
   - Temporal and spatial boundaries;
   - Potential for cumulative environment effect (difficult to asses);
   - Committee of specialists who set out the assessment criteria; and;
   - Value ecosystem components namely human beings, forests and animals.

5. Project Setting
   - Regional context;
   - Biophysical environment;
   - Socio-economic environment;
   - Land ownership; and;
   - Land use present.

6. Conservation with affected parties
   - Who to approach;
   - Nature of information; and;
   - Conservation technique.

8. Prediction and interpretation of environmental impact direct and indirect
   - Direct forecast response;
   - Criteria for assessing significance- ANOVA could be used;
   - Determination of impact significance; and;
   - Cumulative environmental impact.

9. Mitigation and compensation
   - How to reduce impact; and;
   - Residual impacts.

10. Monitoring programme
    - Objectives;
    - Parameters;
    - Sampling;
    - Methods;
    - Location;
    - Description of sampling site; and;
    - Sampling and reporting frequency.

11. Net profits and costs of the project.
11.4 **STATISTICAL METHODS USED IN ANALYSIS OF ENVIRONMENTAL EFFECTS OF MINING AND MANUFACTURING**

**Analysis of Variance (ANOVA)**
Analysis of variance (ANOVA) is a statistical method that is used to determine whether there is a significant difference between the means of variables such as height of plants, herbicides, etc., for the different habitat’s or groups. The assumptions made are; the different groups or habitat’s should be independent, the variables should be normally distributed with equality of variance and additivity of effects.

**Principal Components analysis**
Principal components are uncorrelated linear function of the multi-dimensional variables under consideration. This statistical method is used to reduce large amounts of multi-dimensional data (such as yields of beans, peas, potatoes, sorghum for different land types) to a manageable two or three factorial variables, which are a linear combination of the original variables. The principal component technique is an exploratory technique utilised to determine (the patterns of) relationships among variables, groups of samples, or simply explore data. The key question that arises having identified the principal component is that any meaning can be attributed to the resulting linear relationship. If there is an elaborate meaning attached to the components then the statistical method can be utilised to rank the variables under study.

**Correspondences analysis.**
The correspondences analysis is utilised to analyse categorical data. Such data does not need to have any ranking. They are simply identifiers of the different habitats, species or any other categories. In correspondences analysis the first step is to construct a contingency table which is centred and reduced. The sum of each line and column is then weighted (once for the lines and once for the columns). Diagonalisation of the resulting matrix is done in order to determine the factorial’s axis as in a principal components analysis. The first diagonalised matrix gives plots of columns identifiers of lines in the multidimensional space by columns variables and the other diagonalised matrix to give plots of the identifiers of lines in the multidimensional space of the same contingency table, the factorial’s axis are the same, so both projects can be done on the same graph. The correspondences analysis technique is useful as an exploration technique to find out what is happening in the different habitats.

**Polynomial Regression**
Polynomial regression is a statistical method that it utilised to study curvilinear relationships. In particular this technique was developed in Canada to study the relationships between fish (L) and mercury concentration (HG). Until very recently interpretation was based on linear regression, covariance analysis (ANCOVA) and Student newmann keuls (SNK) multiple comparisons of means mercury levels. These procedures were not always satisfactory.

For comparison between years, polynomial regression model relates mercury level to length (L), square length (L²), binary (dummy) indicator variables (Bᵢ), and the products of each of these explanatory variables (Lx B₁, L²x B₂, etc.) for each sample year as shown in equation below.

\[ HG = Lx B₁ + L²x B₁ + Lx B₂ + L²x B₂ \ldots \]

Polynomial regression with indicator variables allows to perform rigorous statistical comparison of mercury to length relationships in different years, even when the shape of the relationships differ. It is simple to obtain accurate estimations of mercury levels at standardised
length, and multiple comparisons of these estimations are simple to perform. The method can also be applied to spatial analysis (comparison of sampling stations), or to the comparison of different biological forms of the same species.

11.5 OVERVIEW OF THE STUDY ON GOLD MINING

The case study is based on gold mining in Val D’Or, in Québec. The study forms a part of the Aquatic Effects Technology Evaluation program which was created by the co-operation between industries and government. It’s purpose is to review and evaluate environmental monitoring technologies for the assessment of mining related impacts on the environment. The study considered the comparison of surficial mapping of sediment techniques, water quality, sediment toxicity and invertebrate and fish communities.

The pilot study was implemented in three main phases. The first phase was an assessment of the adequacy of the site selected by the technical committee by undertaking a field reconnaissance survey and preparing a field study design. The second phase was the implementation of the study design and the third phase was the preparation of a final report assessing and comparing the methods and recommending modifications to the design that allow the technical committee to reliably compare methods in subsequent years.

One of the methods utilised in analysing the case of gold mining in Canada was the Principle Components Analysis. It demonstrated that station groupings based on full and partial extraction were similar. Several other methods were utilised and a fish survey was carried out to evaluate various methods for measuring mining related fish community impacts. The major conclusions were that metal may be readily measured at detectable level in all tissue types samples. There is probably some inherent redundancy in the analysis of tissue types in adult fish. It was indicated that they are some possible differences in fish tissues among sites, suggesting that such measurements may be of some value as measures of biological response, young fish are easier to collect and maintain in viable condition than adult fish. It was also noted that field costs can be substantially reduced if small invertebrates could be monitored rather than organs of large fish.

11.6 A CASE STUDY FOR PULP AND PAPER INDUSTRY

The goal of regulations on effluents of pulp and papers is to measure and follow the consequences of industrial effluents on environment in order to evaluate if the regulations are adequate for fish and habitat protection. To do that, the program involves a series of cycles which allows to gather the scientific information needed to evaluate and improve the program. Each report produced at the end of a cycle is used to elaborate the next cycle. The environmental effects monitoring (EEM) programme was developed to guide the monitoring process of Canadian pulp and paper mills.

The EEM is carrying out an invertebrate survey which is a partial fulfilment of reporting requirements. In most cases, the invertebrate survey should involve collection of the macroinvertebrate community. The survey can be of two types that is intensive or extensive. The objective of an intensive survey is to test specific effluents related to hypothesis set. In general four sampling areas within each major habitat class will be sampled. Generally if historical information on the invertebrate communities within a system has been described in enough detail to determine where zones effects and recovery are located, then an intensive study should be designed. The objective of an extensive survey on the other hand is to describe variations in the invertebrate community relative to the effluent discharge. Extensive surveys are also needed to describe the zones of effect and recovery of the invertebrate community. Effect zones are those sections (areas) of the system where specific measures of invertebrate community structure are significantly different from sections of the system which receive no
effluent discharges. Zones of recovery are those sections of the system where measures of invertebrate community structure are more similar to measure from unexposed areas. Generally, recovery zones are found at increasing distances from the effluent discharge. An extensive survey is designed when there are no biological data on the system and when changes in effluent quality are expected to result in changes in the location(s) of the effect and recovery zones of the receiving environment.

The EEM is also carrying out a fish survey. A large number of biotic and abiotic factors determine the suitability of habitat for fish. Data on water and sediment quality cannot be used to define environmental acceptability, or monitor ecosystem level changes over time. It is necessary to monitor the resident biological of aquatic systems to ensure that no adverse changes in the ecosystem. Historically, fish have been useful organisms for evaluating environmental impacts on aquatic systems. Some of the advantages of using fish include:

- Some species are long-lived and therefore are good indicators of long-term effects
- The health of the local fish populations is of central importance due to their recognised socio-economic and recreational value;
- There is an abundance of literature on the life history, distribution and environmental requirement of fish, as well as on the responses of fish to a variety of chemical and physical stressors; and;
- Different species of fish are relative easy to identify and collect.

11.7 COMPUTER EXERCISES

The participants were given exercises to find out the relevance of applicability and repercussions of using some of the statistical methods in carrying out environment impact assessments. The windows based software entitled for statistical analysis was utilised to analyse hypothetical data.
12. QUANTIFICATION OF ENVIRONMENT RELEVANT ACTIVITIES OF INDUSTRIES (TOURISM)
by Andrea Möller
German Institute for Tourism Research - Munich
(April 23, 1997)

12.1 INTRODUCTION
The course topic on tourism was introduced so that the participants have an understanding of
the impact of a service sector (such as tourism) on the environment. The course topic was
treated under five main headings and these were:

- The life cycle analysis of tourism products;
- Tourism development world-wide and the transport problem;
- The domain of tourism definitions;
- Approaches to measuring tourism on the environment; and;
- Building up an information system on “Tourism and Environment”.

12.2 LIFE CYCLE ANALYSIS OF TOURISM PRODUCTS
The life cycle analysis of an inclusive tour is a conceptual framework utilised to analyse the
impact of the tourism sector on the environment. In the life cycle analysis several materials
are utilised. There different stages of the life cycle have different implications on the envi-
ronment. The stages of an inclusive tour are as shown in Figure 12.1 below

Figure 12.1 Life Cycle Analysis of an inclusive Tour
For each stage of the life cycle there is an impact which could be environmental in nature, economic or social and these could be analysed by the various inputs into the various levels of the life cycle shown in Figure 12.1.

The greatest impact of tourism on environment is high air emissions as a result of air transportation. The scheme for calculation of primary energy consumption by different means of transport is given in the following Table 12.1. To get an impression of the magnitude of the problem the participants were requested to calculate the amount of energy that has been utilised in coming to the Munich Centre from their respective countries.

**Table 12.1 Scheme for Calculation of Primary Energy Consumption by Different Means of Transport.**

<table>
<thead>
<tr>
<th>Primary Energy Consumption per person and trip</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>By Car</td>
<td>No of Kilometres x 2.88 mega-joule/Km per person in the car</td>
</tr>
<tr>
<td>By Bus</td>
<td>No. of kilometres x 0.35 mega joule/km (85% use of capacity)</td>
</tr>
<tr>
<td>By Train</td>
<td>No. of kilometres x 0.17 mega-joule/km</td>
</tr>
<tr>
<td>By Ship</td>
<td>No. of kilometres x 1.49 mega-joule/km</td>
</tr>
<tr>
<td>By Aeroplane</td>
<td>No. of kilometres x 1.49 mega-joule/km + (No. Of take-off/landings x 343 MJ)</td>
</tr>
</tbody>
</table>

Source: Mezzasalma, R., Eco-Management for Tour Operators, Research Institute for leisure and Tourism.

**12.3 CLASSIFICATION OF INTERNATIONAL VISITORS**

The flow diagram Figure 12.2 shows the classification of international visitors according to the World Tourism Organisation.
Figure 12.2 Classification of International Travellers

Travellers

Not included in tourism statistics

Leisure, recreation and holidays

Included tourism statistics

Visiting friends and relatives

Visitors

Business and professional

Tourists

Health treatment

Main purpose of visit

Religion and pilgrimages

Others

Non residents (foreigners)

Crew members (non-residents)

Nationals residing abroad

Cruise passengers

Crews

Statistics for Environmental Policy, 1997
Chapter 12  Quantification of Environment Relevant Activities and Industries (Tourism)

Key to Figure 12.2
1. Visitors who spend at least one night in the country visited, but less than one year.
2. Visitors who arrive and leave the same day for leisure, recreation and holiday; visiting friends and relative; business and professional; health treatment; religious pilgrimages and other tourism purposes, including transit day visitors en route to or from their destination countries.
3. Persons who arrive in a country aboard ship even when disembarking for one or more day visits.
4. Foreign air or ship crews docked or inlay over and who use the accommodation establishments of the country visited.
5. Crews who are not residents of the country visited and who stay in the country for the day.
6. As defined by the United Nations in the “Recommendations on the International Migration statistics, 1980.”
7. Who do not leave the transit areas of the airport or the port, including transfer between airports or ports.
9. When they travel from their country of origin to the duty station and vice-versa (including household servants and dependants accompanying or joining them.

12.4 CARrying Capacity

The concept of carrying capacity was outlined as follows:

“ How many tourists can I put there before I threaten the long term viability of the system? ”

This concept of carrying capacity is founded on the experience of pastoral agriculture which is based on the principles that a pasture can support only a particular number of cattle in perpetuity. If this threshold is exceeded, the supporting system is damaged often to point where it can support no more grazing at all.

This concept only deals with one product (in this case cattle), the tourism product includes a variety of products and services. Tourism depends on many attributes of an environment - the aesthetics, wildlife, access to shoreline, ability to support active uses (e.g. Sports); each attribute has its own response to different levels of use. Different types of uses have different impacts. Different cultures have different levels of sensitivity towards change. Human activity’s impact can be gradual, affect different parts of the systems at different rates. Tourism environments are mostly multipurpose environments. Other uses have to be considered when determining the correct level of development.

Hence the concept of carrying capacity is not an ideal concept for evaluating impact of tourism on the environment. The simplistic concept of carrying capacity involving identification of a single threshold value is inadequate for tourism management. An approach should rather reflect the sensitivity of the different attributes of the environment to various types and levels of use. At each level of use certain trade-offs have to made.
The dimensions of carrying capacity for sustainable tourism are highlighted in Box 12.1 below:

**Box 12.1 Dimensions of Carrying Capacity for Sustainable Tourism**

| **Environmental carrying capacity:** | The degree to which an ecosystem, habitat or landscape can accommodate the various impacts of tourism and its associated infrastructure without damage being caused or without losing its “sense of place”. |
| **Cultural and social carrying capacity:** | The level beyond which tourism development and visitor numbers adversely affect local communities and their ways of life. |
| **Psychological carrying capacity:** | The level beyond which the essential qualities that people seek in the protected area (such as peace and quiet, few other people, few signs of human development) would be damaged by tourism developments. |

Source Federation of National Parks in Europe, 1993

Carrying capacity is a concept beyond ecological matters. A policy for sustainable tourism development avoids serious environmental problems such as congestion, pollution of air and water, noise or degradation, degradation of ecosystems, overload of infrastructure. It also avoids loss of culture identity of the host society or serious social problems (e.g. Crime). It avoids serious economic distortions, while still bringing economic benefit. A sustainable policy for tourism development maintains tourists satisfaction levels so that the desired tourist markets continue visiting the area.

**12.5 APPROACH BY WORLD TOURISM ORGANISATION**

The aim of the approach proposed by World Tourism Organisation are

- To develop an international system of indicators for sustainable tourism;
- Measure sensitivity of environment rather than carrying capacity;
- To develop warning systems for areas of concern in order to improve decision making with regard to sustainable tourism development; and;
- Reduce number of crucial indicators.

The characteristics of indicators developed are grouped into two dimensions the core indicators for general application and destination specific indicators applicable to particular ecosystems or types of tourism. This disaggregation enables the understanding of tourism and environment as a two way relationship including socio-economic indicators. The areas of concern covered in this approach are environmental sensitivity, stress on the environment, results of tourist use and human, biological consequences of tourism use.
### Table 12.2 Ecosystem Indicators.

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Sample Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal zones</td>
<td>Degradation (% of beach degraded, eroded) Use intensity (persons per metre of accessible beach) Shore/marine fauna (number of key species sightings) Water quality (faecal coliform and heavy metal counts)</td>
</tr>
<tr>
<td>Mountain regions</td>
<td>Erosion (% of surface areas eroded) Biodiversity (key species counts) Access to key sites (hours wait)</td>
</tr>
<tr>
<td>Cultural sites</td>
<td>Potential social stress (ratio average income of tourists/local) In seasonal sites (% of vendors open year round) antagonism (reported incidents between locals/tourists)</td>
</tr>
<tr>
<td>Small islands</td>
<td>Currency leakage (% loss from total tourism revenues) Ownership (% foreign/non-local ownership of tourism establishments) Water availability (costs, remaining supply) Use intensity measure (scale of entire island as well as for impacted sites)</td>
</tr>
</tbody>
</table>

### Table 12.3 Core Indicators of Sustainable Tourism

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SPECIFIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site protection</td>
<td>Category of site protection according to IUCN index</td>
</tr>
<tr>
<td>Stress</td>
<td>Tourism numbers visiting site (per annum/peak month)</td>
</tr>
<tr>
<td>Use intensity</td>
<td>Intensity of use peak period (persons/hectares)</td>
</tr>
<tr>
<td>Social impact</td>
<td>Ratio of tourists to locals (peak period)</td>
</tr>
<tr>
<td>Developing control</td>
<td>Existence of environmental review procedure or formal controls over development of site and use densities.</td>
</tr>
<tr>
<td>Waste management</td>
<td>Percentage of sewage from sites receiving treatment (additional indicators may include structural limits of other infrastructure capacity on site e.g. water supply, garbage.)</td>
</tr>
<tr>
<td>Planning process</td>
<td>Existence of organised regional planned for tourist destination region (including tourism component)</td>
</tr>
<tr>
<td>Critical ecosystems</td>
<td>Number of rare/endangered species</td>
</tr>
<tr>
<td>Consumer satisfaction</td>
<td>Level of satisfaction by locals (questionnaire based)</td>
</tr>
</tbody>
</table>

The IUCN Protected Area Categories are as listed below

I. Scientific reserve/strict nature reserve
II. National park
III. Natural monument
IV. Managed nature reserve or wildlife sanctuary
V. Protected landscape  
VI. Resource reserve  
VII. Natural biotic areas of anthropological reserve  
VIII. Multiple use management areas/managed resource  
IX. Biosphere reserve  
X. World Heritage Site

12.6 EUROPEAN COMMUNITY MODEL OF SUSTAINABLE TOURISM

This approach of sustainable tourism has been developed in conjunction with the IFTO/EU and the DWIF. The aims of the approach are: to provide a model for analysing the basic objects and requirements for the long term maintenance of a tourist destination; to develop a reduced number of indicators, comparatively easy collection of relevant data, significance, quantification, if possible; determining points/threshold at which critical values or situations are reached in order to know that action is required (identifying standards/limiting factors/carrying capacities).

The characteristics of this approach is that it is management oriented. Tourism is understood as an equilibrium between three major objectives/aims which are protection of population’s prosperity/socio cultural identity; preservation of the destination’s attractiveness for tourists and preservation of destination’s ecological functions. This approach has been applied to destinations such as Mallorca, Rhodas, Ibiza whereby stress on socio-economic indicators/welfare in these destinations measured. Figure 9.2 below show the pyramid of sustainable tourism.

Figure 12.3 Pyramid for Sustainable Tourism

For each of the major aims special targets/variables can be attributed. For example the major aim of securing population’s prosperity in the socio-cultural identity is represented by security of the population’s prosperity, security of the economic efficiency and preservation of the population’s socio-cultural identity. Table 12.4 below shows the targets, indicators and critical values or situations.
### Table 12.4 Target variable indicators and critical value/situation

<table>
<thead>
<tr>
<th>Target/variables</th>
<th>Indicator</th>
<th>Critical Value/Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observance of carrying</td>
<td>Airport</td>
<td>If maximum capacity of airport is exceeded</td>
</tr>
<tr>
<td>capacity</td>
<td>Tourists attractions</td>
<td>If communication ways and parking lots are continuously overcrowded</td>
</tr>
<tr>
<td></td>
<td>Potable water supply</td>
<td>If there is water shortage in peak season, long term danger of overselling, floods, forest fire and other subsequent ecological damages</td>
</tr>
<tr>
<td></td>
<td>Sewage disposal</td>
<td>If EU standards for sewage disposal are mostly neglected (standard per inhabitant not complied with)</td>
</tr>
<tr>
<td>Protection of species</td>
<td>If due to (direct or indirect) exploitation by tourists, species are in</td>
<td></td>
</tr>
<tr>
<td>and biotopes, protected</td>
<td>danger or becoming extinct and/or biotopes are imperilled or being</td>
<td></td>
</tr>
<tr>
<td>areas</td>
<td>destroyed.</td>
<td></td>
</tr>
<tr>
<td>Pollutio,n, emissions</td>
<td>If due to (direct or indirect) tourist utilisation. Water, soil air are</td>
<td></td>
</tr>
<tr>
<td></td>
<td>continuously being threatened by pollution and or noise.</td>
<td></td>
</tr>
<tr>
<td>Population</td>
<td>Preservation of intensity</td>
<td>If at local level the ration of beds of Tourists to locals is greater than 3:1</td>
</tr>
<tr>
<td>Second residence per</td>
<td>If number of second residences is extensive and if financial burdens on</td>
<td></td>
</tr>
<tr>
<td>household</td>
<td>the municipality are measureable.</td>
<td></td>
</tr>
<tr>
<td>Foreign infiltration’s</td>
<td>If local inhabitants feel disturbed by tourists</td>
<td></td>
</tr>
<tr>
<td></td>
<td>observance of quality of tourists supply and evaluation of ecological</td>
<td>Persistent and/or important criticism of destination’s condition with special reference to quality of accommodation, restaurants, service, leisure, infrastructure overcrowding (communications, network, beaches, sights) Ecological condition nature (landscape, waste) Aesthetic (settlement pattern, landscape, cultural assets)</td>
</tr>
<tr>
<td></td>
<td>Behaviour</td>
<td>Fewer people trading up to higher quality supply</td>
</tr>
</tbody>
</table>

### 12.7 APPROACH BY EUROSTAT

The aim of the approach that has been developed by EUROSTAT is to build up a European community system of integrated environmental and economical indicators for monitoring. Tourism is one of the priority economic sectors identified for assessing impact of the economy on the environment. The approach also aims to integrate environmental aspects by calculating physical indicators/indices related to the pressure of human and economic activities on the environment.

This approach is on the UN framework for interrelationship between tourism and environment. Social/economic activities describe human activities impact on the environment. Environmental impacts of tourism can be described as changes in the quality of the environment. Stock, inventories, background conditions are needed to describe the qualities of environment which include tourism demand. Responses to environment impact as actions/measures taken for environmental and nature protection.

Hunting and fishing are environment topics which lead to increased tourism activity in certain areas. The major environmental problem caused loss of biodiversity. Increasing tourists leads to increased use of various means of transport and the consequence is the green house effect, destruction of the ozone layer, air pollution. With regard to water used for human consumption, with increasing number of tourists leads to increased consumption of water and in small
islands this may lead to water scarcity. The construction of hotels and roads, ski lifts and other infrastructure leads to land use and environmental restructuring, this leads to loss of biological diversity and soil erosion. Increase in the number of persons in tourism areas implies an increase in the amounts of waste. The table 12.5 shows the variables or indicators and the impact of tourism on the environment.

Table 12.5 Variables related to the impact of Tourism on the Environment and vice versa.

<table>
<thead>
<tr>
<th>Variable related to the impact of tourism on the environment</th>
<th>Energy Use</th>
<th>Water use for human consumption</th>
<th>Land use and environment restructuring</th>
<th>Hunting</th>
<th>Fishing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total amount of energy used for passenger transport (visitors only) by mode of transport. Total amount of energy used for the transportation of goods for consumption by visitors (by mode of transport) Energy use for tourism purposes other than transport, e.g. energy used in tourist accommodation.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water supply to the tourism sector</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas changed for tourism purposes. Ratio of area occupied by tourism establishment total residential area</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Areas with vegetation changes caused by trampling, skiing or other tourism activities.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of animals killed by visitors Percentage of game killed by visitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Percentage of fish catches taken by visitors Introduction of artificial species for angling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variables related to the influence of the environment on Tourism demand</th>
<th>Land use and soil quality</th>
<th>Biological resources</th>
<th>Water quality</th>
<th>Climate and Air pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in land use Soil erosion risk Protected areas</td>
<td>Population numbers of wild species Forest damage</td>
<td>Water quality of lakes, rives, seas Bathing water quality</td>
<td>Mean monthly temperature average monthly precipitation Air pollution</td>
<td></td>
</tr>
</tbody>
</table>

12.8 TRILATERAL MONITORING AND ASSESSMENT PROGRAMME/TRILATERAL MONITORING EXPERT GROUP (TMAP/TMEG)

The TMAP and TMEG approach has been used to assess the state of the Wadden Sea a famous ecosystem in Northern Germany. The target was to monitor the development in space and time.

The characteristics of this approach is that it is applied to a specific ecosystem the Wadden sea of the Netherlands, Germany and Denmark. It only measures the impact of human activity on the ecosystem (one-way relationship between tourism and environment!) and is based on selection of issues of concern and corresponding hypothesis.

The approach is being utilised to test a particular hypothesis that recreational activities can affect the occurrence and abundance of species. This includes the population size, growth and reproduction of species. The main impact of recreational activities may be related to the presence of visitors inside the Wadden Sea and their activities. National fluctuations have to be taken into account.
In this approach the impacts of land based pollutant inputs, dumping, military use, fisheries, recreation, shipping/harbour, oil/gas extraction and sand gravel grading, coastal change on the ecosystem is studied. Only a few of the variables are studied in detail.

12.9 CONCLUSION
To enhance the understanding of the participants an exercise on building an information system on tourism was given. This exercise entailed studying hypothetical data from an island and name the main environmental issues, the indicators that would be required to monitor the environment and the questions that can be asked and methodology required to collect information.
13. STATISTICS ON WATER AND AIR
By Léon Tromp
Central Bureau of Statistics Netherlands
(April 24 - 25, 1997)

13.1 INTRODUCTION
The topic on water and air statistics was introduced to enable participants to manage information on the status and the trends in water supply and demand and water quality, as a basis for short and long term forecasts of shortages and countermeasures. The course topic was also aimed at presenting information on the quality of air with respect to most important pollution factors.

To achieve this aim the course was arranged under the following main headings

- Generalities of environment statistics;
- Air pollution;
- Water pollution; and;
- Environmental Policy Plan.

13.2 GENERALITIES ON ENVIRONMENT STATISTICS.
The organisation of environmental statistics is by and large done using the Pressure State Response framework. Environmental statistics cannot be viewed in isolation for the main interactions played between the social, economic and environment. In this regard therefore environmental statistics includes aspects of social and economic statistics which can be built upon. Figure 13.1 below shows the domain of environmental statistics.

Figure 13.1 Environment Statistics Interrelationships

The three fields of statistics are very interdependent; for instance in environmental accounting most of the data utilised and definitions are an expansion of the existing economic concepts. From the social statistics surveys, such as household surveys basic statistics can be provided, that can be utilised for estimation of some environmental parameters.

On the whole, environmental statistics exist, however, they are fragmented in nature, hence co-ordination becomes a crucial issue. The other impediments for collection of data are gen-
erally the lack of expertise, manpower and co-operation. However it should be noted that a first compendium is relatively easy to assemble but sustained efforts to produce regular additions to meaningful time-series data is a much harder task.

### 13.3 AIR POLLUTION

#### 13.3.1 Sources of air pollution

The main sources of air pollution are industry, power plants, transport and in-house pollution from the households. The main pollutants are subdivided into two pollutants the macro pollutant which are found in large quantities and are from many sources include, sulphur dioxide \((\text{SO}_2)\), suspended particulate matter \((\text{SPM})\), nitrogen oxides \((\text{No}_x)\), carbon monoxide \((\text{CO})\), Volatile organic compounds \((\text{VOC})\) such as ozone \(\text{O}_3\) and an example of a micro pollutant which occurs in small quantities is Lead \((\text{Pb})\).

Sulphur dioxide and nitrogen oxide are the main source of acid rain. Sulphur dioxide is also responsible for respiratory diseases. Suspended particulate matter are finely divided solid pollutants that may be dispersed through the air from combustion processes, industrial activities or natural sources. Increased mortality, morbidity and impaired pulmonary and permeability responses have been attributed to \(\text{SO}_2\) and \(\text{SPM}\). Nitrogen dioxide and ozone also affect respiratory system; acute exposure can cause inflammatory and permeability responses, lung function decrements and increases in airway reactivity. Ozone is known to irritate the eyes, nose and throat and to cause headaches. Carbon monoxide is dangerous to human health because it combines with the red blood cells and then reduces their oxygen carrying capacity. Volatile organic compounds evaporate readily and contribute to air pollution mainly through the production of photochemical oxidants. Lead is a pollutant which is dangerous to human health; in severe cases it may lead to retardation of mental health among children. It inhibits haemoglobin synthesis of red blood cell in the bone marrow, impairs liver and kidney function and causes neurological damage.

#### 13.3.2 Responses to air pollution

Responses to air pollution are of three types. These include reducing consumption of resources which is a difficult alternative in the cases where the options are limited. The second is a change in the production process by reducing some inputs and the third alternative are the end of pipe measures e.g. catalytic converters in vehicles. The measures which relate to the production process or the product are called end of pipe protection measures. End of pipe protection in other words implies adding on technical installations for environmental control of emissions. These operate independently from the production process or are on an identifiable part added on to production facilities. The end of pipe measures are more or less short term measures compared to the resource based measures which are longer term in nature. These policies may be achieved by enacting laws, fixing certain norms or taxes subsidies and other measures.

#### 13.3.3 Air pollution Statistics

Air pollution statistics are categorised into two main groups; these are air quality and emissions. Most of the air pollution statistics are localised and there have various methods of measurement. There is also no uniform way of aggregating the statistics. Some of the methods that have been utilised to aggregate statistics include mean, highest levels and distance to desired levels. In some cases one is confronted with different kinds of data for different time periods hence in these cases it is difficult to measure the trends. For air quality you need to cluster the samples. Air pollution statistics have a signal value.
For emissions data the major sources include point sources such as industry, area sources such as traffic (although sometimes it is referred to as line sources) micro sources such as households and diffuse sources such as agriculture. Emission data just like air quality data have signal values. Emission data is a neglected information source yet is politically relevant. The method of collection of data entails building up an emission inventory. In the Netherlands there are 700 industries which are monitored individually. In these cases inspectors from the statistical offices actually visit the factories. It is estimated that 80% of all emission is taken care of. For the small polluters indirect methods are used. It should however be noted that the indirect approaches are less reliable. The data required to make the indirect approach is the amount of people working in the households, small shops of 5 to 10 people and emission factors.

13.3.4 Exercise on construction of an emission inventory.
The participants were required to came up with an emission inventory for a hypothetical case study on air pollution in Pascalo, capital of sampling. The WHO rapid assessment method was used to calculate the emissions. In this exercise activities itemised by production process were outlined according to the ISIC codes. A short description of the activities enabled one to select the process and hence the relevant emission factors for the calculation of an emission inventory.

13.4 WATER POLLUTION

13.4.1 Water supply (See Chapter 14 for more details)
The amount of water on the earth is constant and cannot be increased or decreased. Of a global total of 1,360 million cubic kilometres of water, which cover about 70% of the earth’s surface, only three percent is fresh, and of that, less than one percent is available for human use in the form of surface waters such as rivers and lakes. Although there is ample fresh water on the earth to meet present and future demand, it is often not where it is needed. Uneven distribution of ground water, surface water and rainfall means that many arid and semi arid parts of the world are without reliable sources of fresh water.

13.4.2 Water uses
Different levels of water purity are required for different types of water use. There are five basic categories of water use: public water supply, mainly destined for human consumption; water used in agriculture; in industry; for recreation; and for fisheries and wildlife. Each category of use has its own quality criteria and method for assessing suitability. The highest standard of purity is required for drinking water, while, on the other hand, it is acceptable for water used for industrial cooling to be relatively highly polluted.

13.4.3 Sources of water pollution.
The main sources of water pollution are agricultural sources which include pesticides, manure, fertilisers and irrigation; industrial sources which include heavy metals and warming up of water and households which include faeces, bathing and washing water. A description of pollutants is given below. It is based on the lecture notes and a UNEP publication entitled “fresh water pollution”.

Pathogens
Pathogens such as viruses and bacteria and other biological organisms cause water borne diseases. Organic material from domestic sewage, municipal water and agro-industrial effluent are the most common water pollutants and are the main sources of pathogens. Because water borne diseases are difficult to detect in the laboratory, indicators which easily measure organ-
isms are used. The presence of organisms indicates that water is contaminated with faecal matter. The most commonly used indicators is of faecal coliforms, so faecal contamination is often expressed as the number of faecal coliforms per 100 ml of water. According to WHO, total coliforms in drinking water should not exceed 10 per 100 ml, and faecal coliform concentrations should be zero per 100 ml.

**Organic matter**
More organic matter is discharged into water courses than any other pollutant. This organic matter contains a wide range of carbon compounds, the primary source of which is domestic sewage, but industrial effluents, such as those from tanneries, paper mills and textile factories, are also significant sources. Organic matter is broken down by aerobic microbes. The oxygen required for this process is taken from the surrounding water, thus diminishing its total oxygen content. Large amounts of organic matter cause severe oxygen depletion in water, which is then unable to support both the decomposition of organic compounds and many forms of aquatic life. The amount of oxygen required for microbial decomposition can be measured as biochemical oxygen demand. Two other most common variables used to estimate amounts of organic matter present in water are chemical oxygen demand (COD) which is the oxygen required to oxidise the organic compounds using a powerful chemical oxidant; and the oxygen saturation expressed as a percentage of water’s oxygen carrying capacity.

**Nutrients**
Small doses of nutrients are essential to the metabolism and growth of aquatic organisms. But man made sources of nutrients - such as the organic matter in municipal waste and waste water and run off from fields fertilised with chemical manure can upset the natural balance of organism living in water. In many cases, nitrogen and phosphorus the two most important nutrients are far above levels monitored by Global environmental monitoring water background stations. The nutrient overloading in water bodies, primarily with nitrogen and phosphorous, causes eutrophication of lakes and reservoirs by promoting abnormal plant growth (seen as algae blooms) and then deplete oxygen as they decompose. More worrying are high nitrate level of drinking water, which have potentially serious consequences for human health.

**Heavy Metals**
Heavy metals include cadmium, chromium, copper, lead, nickel and zinc. Heavy metal pollution of water has a number of man-made causes including processing of ores and metals; the industrial use of metal compounds (chromium tanneries, for example); and, particularly, leaching from domestic and industrial water dumps, mine tailings, contaminated bottom sediment and lead pipes. This kind of leaching has potentially acute consequences. Acidified or saline water enhances metal mobility so drawing more lead from pipes, or other metals from mine tailings; it also transforms the metal into a more readily absorbed and stored in living tissues, thus amplifying the toxic effects of leaching. Safe levels of metal concentration are hard to establish and vary according to type and degree of exposure and state and toxicity of metal in question. Acute human intoxication from heavy metal pollution is not yet common.

**Organic micro pollutants**
Organic micro pollutants (chemical substances such as DDT, PCBs and industrial solvents) originate primarily in industries such as coal mining and petrol refining, and in textile, wood pulp and pesticide factories. They are released into the environment through urban and agricultural run-off, atmospheric fall-out, and urban and industrial wastewater. Organic compounds are also found in substances for domestic use, such as household solvents and aerosol containers. Because these compounds are commonly used, their rate of dispersal into the envi-
ronment is correspondingly high. More synthetic organic compounds are introduced every year, often without a full understanding of the risk they pose to the environment in general and human health in particular. They can have two effects on humans: immediate short term toxicity and reactions from long term exposure, both of which can result in chronic symptoms and death. There is now evidence that disinfecting public water supplies with chlorine (to eliminate pathogens) might actually lead to the formation of volatile halogenated derivatives, some of which are known carcinogens. It is impossible to generalise about the potential toxicity of organic micro-pollutants because there are so many of them, all with different derivatives and not all laboratories are equipped to detect low (but possibly still harmful) concentrations.

**Suspended Matter**
Suspended particulate matter (SPM) consists of material that float in suspension in water. They have three main sources; natural soil erosion, matter formed organically within a water body, and material produced as a by-product of human activity. SPM particle can make water unsuitable and unpleasant to drink and are also major carriers for many organic and inorganic pollutants, including most toxic metals, pathogens and nutrients. Suspended matter is one of the simples variables to measure.

**Salinity**
Increasing salinity is a significant and widespread from of freshwater pollution, particulate in arid, semi-arid and some coastal regions. Salinity is caused primarily by a combination of poor drainage and high evaporation rates that concentrate salts on irrigated land and occurs mainly in regions that rely on irrigation for crop production. Another cause of salinity’s is the over pumping of coastal aquifers, which leads to the intrusion of saline water. Local increases in salinity have also been caused by the use of salt to prevent icing on roads, as a side effect of mining and a result of disposal of the saline water that is produced during oil production. None of there issues compares in importance with the problem of salinity introduces as a result of irrigation.

13.4.4 Responses
Several steps have been taken to control the pollution of freshwater. Some of these are as listed below:

- Regulating sewage disposal;
- Constructing city sewerage schemes;
- Installing water treatment plants;
- Treating and recycling industrial effluents;
- Substitution harmful consumer products (such as phosphates in washing powder);
- Banning dangerous pesticides (DDT for example) and industrial chemicals.

According to UNEP these steps, although by no means comprehensive, have begun to reduce levels of pollutants in many industrialised countries. In the developing countries, far fewer regulations and controls exist, and pollution from domestic wastes is still the cause of widespread death and disease.

The rapidly developing countries of South American and Asia also pose a higher threat to water quality because of the different types of pollution that evolved slowly over a century in Europe are affecting those nations within a decade. Only 10 of the 60 countries of this category have laws in place to deal with their environmentally damaging problems.
Action need to be taken in three main areas: Water resource management, waste water treatment, and providing safe public water supplies.

13.5 ENVIRONMENT POLICY PLAN
To have an understanding of the end uses of data on environmental statistics the participants were divided into four groups to discuss the environmental plan. This entailed drawing up a 10 point plan outlining the essential elements of a policy.

13.6 REFERENCES
UNEP, Fresh Water Pollution, 1991
UNEP, Urban Air Pollution in Megacities of the World, 1992
WHO, Assessment of Sources of Air, Water, and Land Pollution, 1993
14. STUDY TOUR
CDG MUNICH CENTRE
(April 29 - May 2, 1997)

14.1 WELCOME REMARKS (BERNARD LANGEVIN)
Welcome remarks were made by the head of the unit on technical cooperation with non-member countries. He noted that training for the ACP countries has been the main priority of technical co-operation for the European Union (EU) for a period of more than 30 years. He observed that the trend now was to train statisticians within their region of origin. The courses being held at the Munich Centre, which entailed travel by the students to Germany, were a survival of the older strategy that had been utilised by the EU. The reasons for survival were itemised as the need to update the knowledge of statisticians and foster south to south network. The second priority areas for technical co-operation was observed to be specific projects which in most instances focused on strengthening of institution rather than concentrating on a specific issue which was a strategy carried out in the past. He also noted that the institution strengthening was being focused at regional levels. He ended his remarks by welcoming participants to the EUROSTAT.

14.2 INTRODUCTION TO EUROSTAT (DAVID BOND)
EUROSTAT’S mission statement is to provide the European Union with a high quality statistical information service. It is one of the 34 directorate generals of the European Union. The objectives of the EUROSTAT are:

- To supply the European institutions with data;
- To construct the European Statistical System;
- To offer as wide an audience as possible access to data; and;
- To co-operate with non-member countries for the development of statistical systems

The aims of supplying European Institutions with data is to ensure that the data which is relevant, scientifically produced, objective and independent is assessed and utilised in conceiving and achieving policies within the member states. The critical points that are considered in setting up a European Statistical System are to harmonise concepts and definitions, classifications and methodology. Statistical data is equated to a public service which becomes useful if dissemination of results is efficient. It was noted that the four main ways of disseminating information were publications, databases, electronic products and information services. In addition it was noted that EUROSTAT co-operates with other countries in the development of statistics. These were categorised into those who are trading partners, such USA and Canada, and those countries which need assistance for example, ACP countries, Latin America and Central and Eastern European countries.

14.2.1 Strategies
The various ways of achieving objectives were pointed out as legal procedures, committees, working groups and statistical programmes.

The decision making process is categorised into two, that is, the legal acts and votes. The legal acts are decisions binding upon those it is addresses, directives obliging member states to achieve objectives and regulations binding in all parts objectives and means. The votes one the other hand were simple, unanimous and based on qualified majority (62 out of 87 votes). Member states have weights for votes based on their population. These are as follows: France
10, Germany 10, Italy 10, Spain 8, Belgium 5, Greece 5, Netherlands 5, Portugal 5, Austria 4, Sweden 4, Denmark 3, Finland 3, Ireland 3 and Luxembourg 2.

Working groups are of paramount importance in building teamwork among the member states. It was noted that EUROSTAT has 10 sector committees, 80 specialised working groups and task forces. The members of these groups are National Statistical Institutes, EUROSTAT (chair) and observers from other countries and international organisations.

The Statistical Programme Committee is the overall decision making committee and has delegated powers from the council. The Committee is composed of National Statistical Institutes Directors General, with EUROSTAT as the chair. The role of the committee is to provide assistance in the co-ordination of the programmes and consultation on measures to achieve the programme methodology.

14.2.2 Organisation and Resources.
EUROSTAT employs 600 permanent staff and 200 temporary staff. These staff work very closely with other institutions such as Eurocost, CESD, TES, private firms and experts.

The amount of financial resources that have been availed to EUROSTAT in the previous years are as follows: 47 Million ECU in 1996, 54 million ECU in 1995 and 56 Million ECU in 1994. Twenty two (22%) of budget availed to EUROSTAT is returned to member states through European Statistical Service projects.

14.2.3 EUROSTAT Publications
The major themes of EUROSTAT’S publications are general statistics, economy and finance, population and social conditions, energy and industry, agriculture, forestry and fisheries, foreign trade and balance of payments, services, transport and tourism and research and development. The series of publications include yearbooks, annual statistics, short term statistics, accounts and surveys, studies and research, methods and statistics in focus.

14.2.4 Channels Of Dissemination
The channels of dissemination are representation offices, EUROSTAT’S data shops and press office, 50 commercial hosts and brokers, 45 sales offices, national and regional statistical institutes, 750 European documentation centres and depository libraries, 300 Euro-Info-Centres, 140 delegations of the EU and representation offices of the EU. The factors considered in dissemination include: selection of information, required data carrier, frequency of delivery, price, presentation, target group and dissemination channel. At the conclusion of the presentation participants were given the following addresses for further information:

Central Information Office
JMO B3/88
L-2920 Luxembourg
Tel (352) 4301-34841
Fax (352) 4301-32649

Internet access through Europa site http://europa.eu.int/Eurostat.html.

14.3 EUROSTAT AND THE ACP COUNTRIES (ROGER EDMUNDS)
The main objective of EUROSTAT related the ACP countries is to enter into technical co-operation with non-member states. This technical co-operation includes partners across the world (EFTA, USA/Canada and others) and other countries which request for co-operation
As it relates to the ACP countries, there are 70 signatories of the Lomé Convention. This convention is the legal basis for the Community Co-operation System. Under the Lomé Convention, grants from the European Development Fund (EDF) accounts for 52% of the funds for development programmes (the National Indicative Programme - NIP and the Regional Indicative Programme - RIP) in the ACP. Other sources of funds for ACP countries are from the following programmes: EIB credit; Structural Adjustment; STABEX; SYSMIN; Emergency aid; Venture capital, and Interest-rate subsidies. Figure 14.1 shows the stages of an EDF project.

**Figure 14.1 The Stages of an EDF project**

14.3.1 **EUROSTAT and Development Aid:**

Development aid to ACP (and other developing countries) falls under Division C-3 which falls under Directorate C. EUROSTAT C-3 intervenes in projects at the following points in the project cycle:

- Identification;
- Supervision of feasibility studies;
- Preparation and compilation of the financing proposal;
- Supervision of implementation;
- Evaluation; and;
- Co-ordination of technical assistance with EU and EFTA.

The other parts of the Commission responsible for statistical co-operation are DG I (external relations), and DG VIII (development). These intervene in projects at the financing stage. DG VIII is responsible for projects in the ACP countries.
14.3.2 EUROSTAT: Priorities for Statistical Co-operation:
The following were the main programmes of technical cooperation.

Training Projects: COMSTAT: Community support programme for statistical training for the benefit of ACP countries. PALOP: Portuguese speaking African countries benefit from this project which is statistical training for middle managers. EASTC: (Eastern Africa Statistical Training Centre in Tanzania) provides intermediate level training for English-speaking Africa. SADC: Training projects for the “Southern African Development Community”.

External Trade: EUROTRACE: The maintenance and development of the software for managing external trade at the regional level.

Food Security: DIAPER: (Ongoing Diagnosis of Food Policy and Rural Development). The objective of this project is to improve statistical information in the food sector, paving the way to national self-sufficiency and food security.

National Accounts: ERE-TES: The development of a software for the preparation of input/output tables by products and branches.


Social Statistics: 123 Survey: This was developed by DIAL (Development of Instruments for the Long Term Adjustment) for the informal sector of the economy. It can however be adapted to other social sectors (like poverty, education and health).

Migration: An analysis of the causes of migration flows between the European Union and the countries of the south.

14.4 INDICATORS OF SUSTAINABLE DEVELOPMENT (EVA GUINOMET)
An overview of the approach that was undertaken by EUROSTAT in developing indicators for sustainable development was given to the participants. It was noted that the United Nations Commission of Sustainable Development developed the framework for sustainable development indicators which had been utilised by the EUROSTAT. Therefore, the mandate of EUROSTAT was to compile existing data and present the facts without analysis. It was observed that out the recommended list EUROSTAT had produced 46 of the recommended 132 indicators. Four categories of indicators had been developed and these were the economic, social, environmental and institutional. These four categories of indicators are differentiated: by driving force indicators, which represent human activities, processes and patterns having an impact on the environment; state indicators, providing a snap-shot of an existing situation; response indicators, which outline measures; and institutional indicators which highlighted the extent to which institutions take account of sustainable development issues. The purpose of developing indicators on sustainable development were outlined as creation of an information base rather than a definitive list of sustainable development indicators. The break down for the economic, social and environmental indicators that have been collected is as follows:

Economic Indicators
1. Per capita GDP
2. Investment share in GDP
3. Share of manufacturing value added in GDP
4. Annual consumption of energy per capita
5. Consumption of renewable energy
6. Lifetime of proven energy reserves
7. Environmental protection expenditure as a percentage of GDP
8. Foreign direct investment
9. Total ODA given or received as a percentage of GDP

**Social Indicators**
10. Population growth rate
11. Net migration rate
12. Total fertility rate
13. Infant mortality rate
14. Life expectancy at birth
15. Total national health expenditure as a proportion of GDP
16. Unemployment rate
17. Women per 100 men in the labour force
18. Ratio of average female wage to male wage
19. Population density
20. Percent of population in urban areas
21. Rate of growth of urban areas
22. Rate of growth of urban population
23. Floor area per person
24. Per capita consumption of fossil fuel by motor vehicle transport

**Environmental indicators**
25. Emissions of sulphur oxides
26. Emission of nitrogen oxides
27. Expenditure of air pollution abatement
28. Consumption of water per capita
29. Waste water treatment
30. Annual withdrawals of ground and surface water
31. Arable land per capita
32. Land use changes
33. Energy use in agriculture
34. Use of fertilisers in agriculture
35. Use of agricultural pesticides
36. Generation of industrial and municipal solid waste
37. Expenditure on waste management
38. Rate of waste recycling and reuse
39. Forest area change
40. Wood harvesting intensity
41. Managed forest area ratio
42. Threatened species as a percentage of total native species

**14.5 PROTECTED AREA AS A PERCENTAGE OF TOTAL AREA. EFFECTS OF TRANSPORT ON THE ECOSYSTEM (GRAHAM LOCK - EUROSTAT)**

The aim of introducing the topic on “Effects of Transport on the Ecosystem” was to provide the participants with an overview on the methods and efforts undertaken by EUROSTAT in aggregating and presenting statistics on environment and its effect on the ecosystem. It was pointed out that the major environmental issues in the area of Transport were energy use and its implications for emissions and land use. It was, however, noted that in the Union, data on
impacts on land uses was less available. Transport in comparison to industry was noted to have an increasing trend and it contributed almost half of emissions with respect to volatile organic compounds, carbon monoxide and nitrogen oxide in comparison to other sectors of industry electric generation and space heating.

### 14.5.1 Policy Areas

The overview of the major policy fields of the Union were highlighted as:

- Climate change.
- Ozone depletion
- Loss of biodiversity
- Resource depletion
- Waste
- Air pollution
- Dispersion of toxics
- Water pollution and water resources
- Marine environment and coastal zone.
- Urban problems of noise and odours.

In developing data systems and answering policy questions it was noted that the Pressure-State-Response approach was used in the Union. The advantages of using the Pressure-State-Response were observed to be:

- Not everything needs to be covered;
- The framework helps to build a picture of the situation;
- Enables one to assess very easily whether a certain policy is absolutely necessary; and;
- Focuses on a particular question.

### 14.5.2 Air Emissions

Example of questions on air emission were given as follows:

**Attribution of responsibility:**
- Who produces?
- Where are the emissions produced?
- How are they dispersed and where are they deposited?

**What is responsibility based on:**
- Fuel sales
- Fuel consumption
- Flag or nationality of vehicle or vessel
- Ownership of transport and the transport activity itself

**Attribution of country:**
- National
- Domestic (both origin and destination within the country)
- Transit (neither origin nor destination in country)

**Option of attribution:**
- 100% to country of origin
• 50:50 between countries of origin and destination (push and pull)
• According to the distance travelled through each country on the route.

Having introduced the questions, it was noted the data available does not necessarily answer the questions which are required, however, available data was utilised to give a picture on transport trends an effects on the environment.

The following trends in the transport sector were noted:

**Infrastructure:** Length of motor ways in the European union has more than doubled in the last twenty years. However, railway lines have decreased by 4% from 1970 to 1980 and a further 4% from 1980 to 1990. Although the trend on railway has decreased, it still contributes about 27% of expenditure, which is assumed to be maintenance of the railway lines.

**Vehicle fleets:** The numbers of virtually all types of road motor vehicles and passenger cars are, however, increasing at a far higher rate than vehicles used for public transport. The factors which affect emissions are aggregate of turnover of vehicle fleets, engine type and size. Based on data from a few countries, it is generally noted that diesel cars are increasing in some countries, apart from Germany, where the trend seems to have levelled off.

**Energy Consumption** The major fuel used by road motor vehicles is petrol, although usage of diesel has been increasing at a rate higher due to the pricing policies.

**Carbon dioxide emissions:** Increasing man-made emissions of the so-called greenhouse gases (carbon dioxide, methane, nitrous oxide, chloroflorocarbons) that contribute to the threat of global warming. The major part of these emissions, both in terms of quantity and potential greenhouse effect, results from combustion of fossil fuels. Emissions of carbon dioxide from transport are continuing to rise since no technology exists to remove carbon dioxide from exhaust gases, and it will therefore be necessary to reduce consumption of fossil fuels by developing more fuel efficient cars or by modifying driving habits.

**Noxious emissions:** Control engines vehicles are responsible for the greater part of emissions of volatile organic compounds and oxides of sulphur, and both engine types contribute approximate equal emissions of nitrogen. Passenger vehicles are the major source of volatile organic compounds, due to their large numbers on the roads.

**Lead:** In recent years the motor car has been a major contributor to atmospheric lead pollution, especially in urban areas. Lead in petrol now contains on average only 1/3 of the lead it contained 20 years ago. The major reduction in lead emissions has been achieved by reducing the lead content of leaded petrol before introduction of unleaded petrol.

**Volatile organic compounds:** The major organic volatile compound emitted by road motor vehicle is benzene, which is present in petrol. Estimates indicate that road traffic emissions of volatile organic compounds are starting to fall in Germany, France, Netherlands and the United Kingdom since the introduction of catalytic converters. As the vehicle stock in all the member states is replaced with catalytic converters, this trend will continue throughout the European Union.

**Carbon monoxide:** The most dangerous traffic emissions for human health is carbon monoxide, due to its ability to combine with haemoglobin and thereby interfere with the transport oxygen through the body. It also contributes to the greenhouse effect. Since introduction of
catalytic converters and improvements in engine efficiency, emissions have started to decrease in some member states.

**Particulate Matter**: There are a variety of sources including coal combustion and industrial activity, but the major sources of the smaller particles (less than 10 micrometers in diameter), which have been linked with cardiovascular and pulmonary diseases, is diesel exhaust.

### 14.5.3 Responses

The responses to environmental issues were presented in form of the major taxes that have been taken by the European Union in the area of transport. Some of these included taxes on energy consumption, road transport taxes and eco-taxes, which were defined as taxes which are introduced with particular environmental policy objectives.

It was noted that ecological taxes may have an influence on consumer behaviour, although, in the absence of real alternatives to petroleum products there is little product switching, except between fuels. An example of this was noted to be the tax differential between leaded and unleaded petrol which had increased the consumption of unleaded petrol although the fall in lead emissions has been for the most part caused by regulatory standards which have reduced the lead content of leaded petrol.

### 14.6 GEOGRAPHICAL INFORMATION SYSTEMS (KOSTAS GLANNAKOURIS)

Geographical information system was defined as a computer based set of tools for capturing collecting, editing, integrating, analysing and displaying data in association with their geophysical location. It was noted that the primary data collection was done through field measurements and satellites and secondary data collection using vector digitising and raster scanning.

It was noted that economic, social and natural actions and phenomena all have a spatial component. By coupling statistical information with geographical territories we enhance the effectiveness with which they are presented or analysed.

Some of the questions which GIS could answer were noted as:
- What is found at a specific location?
- Does a regional distribution of earthquakes show any pattern or predictability?
- Does the distribution of cases of a disease form a pattern in space? Is it associated with environmental pollution? Can we estimate the extent of mineral deposits over a particular region?

#### 14.6.1 GISCO Project

The work of the GISCO project of EUROSTAT was outlined. The origin of GISCO was noted to have arisen from the EUROSTAT’S task force on spatial statistics. It was later established in 1992. The user community of GISCO includes EUROSTAT Sectoral Units, other commissions Directorate General and commission external users. The objectives of GISCO were given as follows; Information assessment, policy definition support, implementation of decisions, monitoring and follow up and public information.

The GISCO activities are:
- Geographic information policy;
- GISCO reference data base management;
- Map production and servicing;
• Dissemination and external relations;
• Desktop mapping tools; and;
• GIS analytical applications.

The work plan for the GISCO project is to:

• Refine spatial detail and consolidate date base contents for selected themes;
• Integrate statistical nomenclatures;
• Link with EUROSTAT statistical data bases;
• Link with policy instruments; and;
• Integrate to multimodal concept.

14.6.2 Technical Environment
The hardware used by GISCO consists of: Sun-Sparc 10 workstations, UNIX, NCD X - Terminals Disk space 10 GB. Calcomp electrostatic plotter, AO format Calcomp digitiser, AO format, TEKTRONIX A4 format. The software utilised are Arc/Info V7.0.4 GI system, ARC/View Atlas/GIS, MapInfo, and ARC/view for PC.

14.6.3 Spatial Analysis
Two spatial analysis examples were given. These are
i. To design the least cost paths connecting a selected Transport European Network (TEN) lines with other links of the same TEN; and;
ii. Delimitation of urban agglomerations with the help of remote sensing of the four cities of Bordeaux, Limbourg Sud, Main Taunus Kreis and Swanley.

The reference data that was utilised in the first example was soil type, land cover, digital elevation model and the Trans European Network of roads. The final result was a map showing the minimum cost paths. It was noted that GIS calculated the minimum cost paths by utilising only two reference points at a time rather than using multiple points.

The data utilised for the second example was satellite images, 37 photos from the air at a scale of 1:2000 and 11 maps of National Geographical Institute of France 1:25000. The steps that were involved in the pilot exercise were highlighted as follows:

• Correction of satellite images
• Automated classification for delimiting urban and agricultural areas
• Analysis -synthesis coding and interpretation of the results
• Application of two methods for the identification of urban agglomerations
• Differences of the urban morphological zones.

The major results of the remote sensing pilot exercise was that overall precision of automating land use recognition and classification was 86.7%. It was also observed that there was no difference in using raster analysis and vector analysis.

14.7 Environment Statistics at Eurostat (Theo Van Cruchten)
Organisation of environment statistics in EUROSTAT is based on the Pressure-State-Response model. EUROSTAT’S concentrates on the driving force/pressures of environment, which means attempting to make an inventory of human activities that influence the environment well as making inventories of pollutants that are discharged. The framework shown in Figure 14.2 is used for the collection of inventories.

**Figure 14.2 Framework for Environmental Statistics**

![Framework for Environmental Statistics](image)

**Figure 14.3 Organisation of the Environmental Statistics**

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<tr>
<th>Driving Force Statistics</th>
<th>Environment Statistics</th>
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<td>Agriculture</td>
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<td>Transport and Tourism</td>
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<td>Noise</td>
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<td>Material flows</td>
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| State Statistics         | Economic Satellite data |

14.8 THE DEVELOPMENT OF EUROSTAT'S WORK PROGRAMME ON WATER STATISTICS.

The overall objective of water statistics was noted as to collect and publish data in a broad sense on the use of water for human activities (abstraction, supply, disposal). It is anticipated that over time the results will illustrate the following: changes due to the EU policy on water, effects of the legal tools to reduce water pollution and the effects of the general policy on waste as included in the 5th Environment Action Program. When the full programme is developed it is envisaged that a balance sheet for water in the European Union and each of its member states will be prepared. The balance sheet is aimed at showing the water needs as well as the water use and in particular the discrepancies both in water quantities and water quality and the availability and need.

14.8.1 Water Statistics

The main areas of focus and items for data collection were highlighted as follows:

**Resources:** Precipitation, evaporation, inflow and outflow of rivers and lakes.

**Water abstraction:** Ground water, surface water, spring water and other water for human consumption and how much is used.

**Water use and water consumption:** Public supply, self supply, type of application and cooling.

**Waste water collection:** Population served by waste water collection and treatment facilities.

**Waste water treatment facilities:** Number, capacity, influent and effluent road of treatment plans by type.

**Sewage sludge production:** Production and disposal of sewage sludge.

**Waste water production:** Quantities of water and their pollution load by type and activity by pollutant.

**Flow of water in economy/society:** Flow balance: where water is used, polluted and discharged into sewer system and its treatment.

With regard to the areas mentioned above it was noted that data in the member countries was not necessarily available and the following observations were made.

With regard to water resources, estimates in the member countries are available, however, the precision of the estimates is difficult to judge and the imbalances therefore warrant standardisation of estimation methods. Large differences in measuring frequencies and the work load of the member states differs according to the number of rivers entering or leaving the country.

The data on water abstraction and consumption however needs to be collected from industry and water supply companies. Household estimates for self supply need to be made. In addition, data used for irrigation and for animals is difficult to estimate and it is recommended to add questions in the farm structure surveys of each of the member states. Furthermore, all water that is abstracted and not immediately returned to its source should be considered to be consumed, however, opinions may differ in the member states.

Waste water originating from households of biodegradable material is dealt with by the bacterial flora in the water. However, due to population growth and concentration of population in the cities, the pollution has become more concentrated and the natural capacity of self purification is now insufficient to treat all wastes. Next to the population emissions an important load in the water comes from industry and the variety of pollutants is large, ranging from compounds comparable to those in household waste water, over highly concentrated organically polluted water waters from the food processing industry. Industry produces a wide vari-
ety of pollutants ranging from metal surface treatments, pesticides and derivatives of oil. The effects of some of these pollutants is so high that they destroy self purification capacity.

Data on surface water quality has been reported since 1977 and it concentrates more or less on bacteriological pollution. Only two heavy metals, cadmium and mercury, are included on the list. A presentation of data showing degradation of water quality from the source of the river to the mouth would require that enough sample points are available along the streams.

14.8.2 Policy measures
Some of the policy areas in the area of water were highlighted as follows:-

- Measures relating to detergents;
- Quantity of water required for abstraction for drinking water;
- Bathing water quality;
- Pollution caused by dangerous substances;
- Quality of water intended for human consumption; and;

14.9 FEDERAL STATISTICAL OFFICE OF BERLIN (J. KAISER)
The Director of the Federal Statistics Office in Berlin welcomed the participants to the statistics office of Germany. He noted that that main statistical office was in Wiesbaden and the Berlin office was only one of the three offices of the Federal Statistics Office. He also pointed out that centralised expertise existed in the area of agriculture, forestry and fisheries, construction and dwellings, family budget, foreign trade and environmental protection and trading and special studies.

14.9.1 Work of the Federal Statistical Office:
The main task of the Federal Statistical Office is to prepare statistics on:

- Population;
- Employment;
- Housing and building activities;
- Education, culture and justice;
- Public health and social security systems;
- Prices, wages and salaries;
- Foreign trade;
- Food and agriculture;
- Commerce and transportation;
- Production and industries;
- Environment; and ;
- Enterprises accounts and family budget.

The major sources of information are censuses, sample surveys and administrative records.

The demand for statistics produced by the Federal Statistics Office is from various users and these include international organisations, Federal Government, State Government and Local authorities, enterprises, associations and trade unions, universities, research institutes, opinion and market researchers. The general public as well such as political parties, media, other organisations and private citizens are all part of the users of statistics collected at federal level.
14.9.2 Principles of Statistics
The three principles that guide the statistical office are objectivity, neutrality and legality. Objectivity is required of all statistical offices. The statistical office is financed by and is dependent on the government. Other sources of income include revenues from special projects required by the government and other organisations. However, the statistical office is its own entity and not part of another ministry. This means that it has its own budget and laws on statistics. This allows for the neutrality of the statistics. The framework of the statistical system is given by 4 categories of laws:

- Basic law for the Federal Republic of Germany (human rights, etc.).
- Law on statistics for federal purposes (statistical law).
- Specific legal provisions for individual statistics - i.e. all statistics produced by the office have a legal basis.
- Relevant provisions of the EC. This means that the EC can recommend that some statistics be produced and the statistical office must comply.

No statistical data can be collected without a legal foundation. The legal foundation prescribes the:

- topics to be recorded;
- types of surveys to be conducted;
- reporting period;
- periodicity;
- groups of respondents;
- obligation to provide information and
- protection of data.

The advantages of this system is that the legal situation is clear and it ensures optimum protection of respondents. The disadvantage is that it makes the quick adaptation to a situation impossible because of the necessary legislative procedure.

14.9.3 Division of Labour: Federal Statistical Office and “Länder” Statistical Offices:
It was indicated that there was one main statistical office (Federal) and 16 statistical offices (one for each Länder) in Germany.

The relationship between these is that the Federal Office:

(i) deals with the method and material preparations, and
(ii) plans for the data collection and processing.

The Länder Offices:

(i) deal with the actual data collection,
(ii) select the respondents to be included in the surveys,
(ii) conduct the surveys,
(iv) process the surveys, and
(v) compile the results for the Länder.

The advantages of this decentralisation are:

- it allows for the distribution of the work among several different offices, and
- service to the public is facilitated.
The disadvantages of this decentralisation are:

- due to the different capacities of the Länders, the supply of statistics to the Federal Office is inconsistent, and
- the publication of statistics is only possible when all Länders are ready.

14.10 GERMAN ENVIRONMENT STATISTICS (JOSEPH STEINFELDER)

Environment Statistics is an indispensable base for environmental policy. The great demand for environment information emphasised the need for a constant and systematic collection of environmental data. The aim of collecting environment statistics is to reflect material cycles and impact of man on the environment spending. The legal basis for environmental statistics is the German Environment Statistics law which was first established in 1974, and amended in 1980 and 1984. In 1994 a new environment statistics law was adapted and entered into force on 1 January 1997. It was observed that the latest changes were responsible for the increased demand for environment data.

German Environment Statistics consists of four areas, namely waste management, wastewater management, air pollution and environment economy. The Federal Statistical Office is in a phase of methodological, organisational and technical preparation of new surveys, with most of them being conducted for the first time in 1997 and later years.

The main statistical tasks which the Federal Statistics Office are a result of the increasing demand of environment statistics. These include identification and establishment of new groups of respondents, conducting preliminary or test surveys, inventing new classifications for instance for air emissions or substances damaging the ozone layer.

14.10.1 Waste Management Statistics.

The three principles based on the Waste Disposal Act of Germany were identified as avoidance of waste, recovery of waste and disposal of waste. The three surveys in the area of waste management statistics are; waste collection, waste treatment and recovery and waste disposal. The characteristics of these surveys were outlined as follows;

- Type, quantity, origin and destination of treated waste (sorted, crushed, recycled waste) and discarded waste (e.g. dumped waste);
- Use of energy and recycled material obtained by waste-treating processes; and;
- Technical data on waste treatment and waste disposal facilities (like capacity, equipment e.g. incineration plants).

Special surveys will be designed and these will include those producers that contribute most to the total waste e.g. construction and demolition waste and those of special interest like used oils, plastic waste, glass waste, paper and paperboard waste, packing material. The survey will include questions on collection, treatment and disposal of these types of waste and the owners of the respective facilities.

The other special types of surveys include hazardous wastes, which is yearly and the, secondary statistical survey on waste which utilises administrative records of transport’s of waste.

14.10.2 Water and waste-water management statistics

The surveys for water and waste-water management statistics were highlighted as follows; survey on water and waste-water management, surveys on water and waste-water
management in industry, agriculture, public thermal plants, survey on accidents with water-
harmful substances, survey on facilities/plants handling water harmful substances and survey
on the facilities/plants handling water-harmful substances.

The respondents for such surveys include owners of public and private water and waste-water
facilities. In the case of agriculture the survey is proposed to cover farms which use water for
irrigation and introduce discharge waste-water into lakes, rivers or canals. Water statistics
comprise of a survey on accidents with water harmful substances investigates such as
accidents through storing, handling and transporting these substances.

14.10.3 Air pollution statistics
Two surveys for air pollution statistics are the survey on air pollution (by industrial facilities)
and the survey on substances damaging the ozone layer which is based on administrative
records and conducted every four years. The source of information was environment
authorities or licensing and monitoring authorities of the facilities.

The characteristics covered in these surveys are: The type and quantity of emitted substances,
the type and capacity of facilities and the type of substances handled.

14.10.4 Environment Economy/Environment industry statistics.
Three surveys for environment economy and industry statistics are; the survey on investment
of industry for environmental protection, survey on the current expenditure of industry on the
protection of the environment and survey on goods and services for the protection of the
environment.

The characteristics of the survey on environmental investment industries include waste
management, waste-water management, air pollution control, noise control, nature
conservation and soil conservation.

The survey on current expenditures for protection of environment include production related
measures that help to reduce, avoid or remove harmful emissions on the environment. These
measures are in the areas of waste management, waste-water management, air pollution
control, noise control, nature conservation and soil conservation.

The survey on goods and services for the protection of the environment is an annual
representative sample which provides information on size, structure and the development of
the environment industry market. The environment industry is defined as the industries
producing goods and services to avoid or eliminate harmful influences of production or
consumption. An example of such an industry is installation for water treatment plants. The
data collected is usually referred to as end of pipe environmental protection technology.
15. EFFECTS OF AGRICULTURAL ACTIVITIES ON THE ECOSYSTEM

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15.1 INTRODUCTION
The aim of introducing the course topic on effects of agricultural activities on the ecosystem was to sensitise the participants on the qualitative and quantitative effects on the ecosystem and to discuss the measurement of these effects. To achieve this target the course was treated under the following main headings

- The policy context and objective for developing agri-environmental indicators;
- The conceptual framework for developing agri-environmental indicators;
- Indicators to address agri-environmental indicators;
- Plenary discussion on national experiences; and;
- Developing work on building a set of agri-environmental indicators.

15.2 THE POLICY CONTEXT AND OBJECTIVES FOR DEVELOPING AGRI-ENVIRONMENTAL INDICATORS
What is agriculture doing to the environment? And what impact do different policy measures have? These questions underlie work on developing agri-environmental indicators (AEIs). The demand for information on agri-environmental linkages largely reflects the high priority given by governments to environmental improvement. The supply of quantitative information of this sort, however, is currently inadequate. But without governments and others cannot identify the environmental risks and benefits associated with agriculture, which makes it difficult to improve the monitoring, assessment and targeting of agricultural and environmental programmes. Agri-environmental indicators are intended to:

- Provide information to government policy makers and the public on the current state of the environment in agriculture, and changes to it;
- Help policy-makers understand links between causes and effects and the impact of agricultural policies on the environment, and guide their responses to changes in environmental conditions;
- Contribute to monitoring and evaluating policy effectiveness in promoting sustainable agriculture.

15.3 THE CONCEPTUAL FRAMEWORK FOR DEVELOPING AGRI-ENVIRONMENTAL INDICATORS
A major challenge is to provide a solid conceptual and methodological basis to support the empirical analysis of agri-environmental linkages, especially in terms of quantifying the impact of agricultural policies and policy changes on the environment in agriculture. In order to better understand agri-environmental linkages, and to identify and develop policy relevant indicators, particular consideration has been given to:

- recognising specific characteristics of the linkages between agriculture and the environment;
- situating agriculture in the broader context of sustainable development, especially in terms of the relationships between the economic, social and environmental dimensions;
ensuring the framework to structure agri-environmental analysis is largely consistent with that commonly being used in other related work in national administrations and elsewhere.

The specific characteristics of agriculture in relation to the environment that are of particular importance are as follow:

First, agricultural activities produce a diverse range of harmful and beneficial impacts on environmental quality. Farming can lead to a deterioration in soil, water and air quality and the loss of habitats and biodiversity. But agricultural activity can contribute to environmental benefits such as acting as a sink for greenhouse gases, conserving and also enhancing biodiversity and landscape, and preventing flooding and landslides.

Second, the relationship between agricultural activities and the environment is frequently complex, site specific and non-linear. Agricultural activities can have impacts on the environment which are determined by different agro-ecological systems and physical attributes of the land, the prevailing economic conditions and production technology, and farmers' management practices in relation to natural conditions.

Third, the agricultural sectors in most OECD countries, and many other non-OECD countries, are characterised by policies delivering high levels of support and government intervention. Farmers' behaviour can be significantly affected by these policies, in that they influence the level of agricultural production, its location, and the farming practices and management systems employed. Also changes in environmental quality can trigger market and societal reactions which may in turn influence agricultural and environmental policy decisions.

The situation of agriculture needs to be considered in the broader context of sustainable development.

Human activities, such as agriculture and economic developments, and modifications to them in the form of plans, programmes, and policies are linked to the, capacity of natural systems, including agro-ecosystems, to absorb the effects of human activities on the environment, and determine, environmental impacts, both harmful and beneficial, and the long term sustainability of the ecosystem.

The Driving Force-State-Response Framework (DSR) is utilised to improve the understanding and help in organising what needs to be measured and develop relevant indicator. The framework is most useful in developing the linkages.

Driving forces are those elements which cause changes in the state of the environment. These include:

Natural environmental processes and factors, including the agro-ecological system, the physical attributes of the land, meteorological conditions, and random events such as earthquakes;

Biophysical inputs and outputs at the farm level, covering the use of chemical inputs, energy and water resources; farm management practices; and decisions taken in terms of the level and mix of agricultural commodities produced;

Economic and societal driving forces, encompassing reactions to economic and policy signals received from markets and governments; variations in the level and composition of farm
financial resources; changes in technology; cultural attitudes and public pressure; social structures; and population growth.

The concept of “driving forces” recognises that agricultural activities can both produce beneficial impacts to enhance environmental quality, for example by increasing the water storage capacity of certain agricultural systems which may ameliorate problems of soil erosion, landslides and flooding, and also have harmful impacts on the environment, such as the excessive use of fertilisers and pesticides and inappropriate management practices. Driving forces also accommodate a broader coverage of the influences affecting the environment in agriculture and sustainable agriculture, including farmer behaviour, government policies, economic, social, and cultural factors.

The state or condition of the environment in agriculture, refers to changes in environmental conditions that may arise from various driving forces. The impact of agriculture on the environment can occur both on-farm and off-farm, for example the effects on biodiversity and climate change, and operate at various temporal and spatial scales from the field through to the global scale. While the state of the environment in agriculture encompasses a wide range of different elements, it can be broadly categorised into the following sub-categories of the:

- **State of the natural resources**, used in agricultural production — soil, water and air — covering their physical, chemical and biological condition;
- **Composition, structure and functioning of the ecosystem**, affected by agricultural activities, including biodiversity and natural habitats, for many countries the inclusion of the man-made environment, such as agricultural landscapes, is also an integral part of this sub-category;
- **State of human health and environmentally related welfare**, including for example the risk to human health from pesticide spraying and the public nuisance caused by odours from intensive livestock production. The range of issues in this sub-category may vary greatly from country to country depending on where the boundaries of agri-environmental issues are drawn, and the importance society attaches to these issues.

An important consideration when examining the “state” component in the DSR framework is to identify the share of agriculture in the environmental media or issue concerned, and to assess its importance for policy purposes. Typically, agriculture is only one amongst other activities in the economy which has an impact on the state of the environment. For example, river and groundwater water quality may be the combined result of agricultural and industrial activities and the disposal of urban waste. A further aspect in this context is that while agriculture can affect the state of the environment, changes in environmental conditions can also impact on agricultural production activities, such as through acid air emissions or ozone depletion.

**Responses** refer to the reaction by groups in society and policy makers to the actual and perceived changes in the state of the environment in agriculture, the sustainability of agriculture and to market signals. The responses include:

- **Farmer behaviour**, by changes in input use, farm management practices, such as integrated pest management, and co-operative approaches between farmers and farmers and other stockholders;
- **Consumer reactions**, through altering food consumption patterns, including preferences for “organically” produced foods;
- **Responses by the agro-food chain**, with changes in technology to produce less toxic pesticides and the voluntary adoption of better safety and quality standards by the food industry;
Government actions, through changes in policy measures, including regulatory approaches, the use of economic instruments such as subsidies and taxes, training and information programmes, research and development, and agricultural policies.

15.3.1 Linkages between driving-force, state and response
Analysis of the linkages between driving forces, state and response is a key element in shedding light on the relationship between the causes and effects of agriculture’s impact on the environment to better guide policy makers in their responses to changes in environmental conditions in agriculture. At this stage of the OECD work and in analysis elsewhere, however, these linkages are not yet fully developed. Significant further work needs to be undertaken on the linkages between indicators in the DSR framework, before causal relationships and feedback can be better understood and easily expressed for use by policy-makers and other stakeholders.

Analysing agri-environmental linkages in the DSR framework highlights the need to develop knowledge not only of the physical, chemical and biological factors that relate variations in agricultural practices, input use and production to changes in environmental quality, but also to improve knowledge of the economic, socio-cultural and policy factors that determine and influence the effects of agricultural activities on the environment.

The driving forces are not always sufficient to explain changes in the state of the environment, because the environment in agriculture has the capacity to absorb some stress. Moreover, a particular change in the state of the environment may not easily be quantified and interpreted as either beneficial or harmful in all cases, especially where judgements on environmental quality are affected by evolving societal and cultural attitudes. This emphasises the importance of understanding the linkages between policies, agricultural production and environmental quality, to help to guide responses by policy makers to changes in environmental conditions in agriculture.

The DSR framework outlined here is essentially a working tool with the possibility of its components being modified as understanding of agri-environmental linkages improves and as agricultural and environmental policy goals evolve. This process is being complemented by other policy related analysis undertaken by OECD, which could help towards the development of a policy relevant set of AEIs.

Structuring work on indicators in the context of the DSR framework should ensure that indicators are not developed in isolation but can provide insights for policy makers as to the economic, social and environmental linkages and components of sustainable agriculture. In this respect it is worth noting that the interpretation of any one indicator may need to be complemented with other indicators, and be seen within the overall context of the set or appropriate sub-set of indicators.

15.3.2 Selection Criteria for Indicators
There are potentially a large number of indicators that could be developed to help quantify the various components and linkages in the DSR framework. To assist in the choice of an operational set of indicators within this framework each indicator is examined against four general criteria:

Policy relevance;
Analytical soundness;
Measurability; and;
Level of aggregation.

Policy relevance relates to those agri-environmental issues identified in the DSR framework as being of importance to policy makers.
The criterion of analytical soundness concerns, in particular, the extent to which the indicator can establish links between agriculture activities and environmental conditions, and thus refers more specifically to the attributes which provide the basis to measure the indicator. It should also be possible for the indicator to explain a link between agriculture and an environmental issue which is easy to interpret and applicable to a wide set of farming systems. The indicator should also be able to show trends and ranges of values over time, which might be complemented by nationally defined targets and thresholds where these exist.
The criterion of measurability, relates to the appropriate data available to measure the indicator. The indicator should be developed from established national or sub-national data, preferably using a long time series where this is available given the lengthy time period for many environmental effects to become apparent. While a considerable database exists in many countries from which to calculate indicators, problems of data definitions, quality, the regularity of data collection and methods of indicator measurement remain obstacles to progressing the work on certain indicators.
The criterion of the level of aggregation seeks to determine at which level (i.e. farm, sectoral, regional, national), the indicator can be meaningfully applied for policy purposes and not to conceal more than it reveals. This criterion highlights the issue of encapsulating the spatial and temporal diversity of the environment and the geographical scale of different environmental issues ranging from the farm through to the global scale. Moreover, the extent to which different agro-ecological zones have varying physical resource characteristics and property rights associated with those resources can change the impact of environmental outcomes that may arise from farming in those zones.

15.4  INDICATORS TO ADDRESS AGRI-ENVIRONMENTAL ISSUES

Indicators are being developed for the measurement of thirteen agri-environmental issues identified by OECD countries, which can be grouped under three headings relating to primary agriculture (indicators might be developed at a later stage on upstream/downstream activities related to agriculture):

1. The use by primary agriculture of:

   **Nutrients** – mainly chemical fertilisers and livestock manure;
   **Pesticides** – herbicides, insecticides, fungicides and other pesticides;
   **Water** – particularly water for irrigation;
   **Land** – this covers both changing farmland use and agricultural land conservation.

2. The impact of primary agriculture on:

   **Soil quality** – the impact on soil quality, in particular to reveal the risk of erosion;
   **Water quality** – the impact on surface and groundwater quality;
   **Greenhouse gases** – both the release and accumulation of such gases;
   **Biodiversity** – of domesticated species used by agriculture, as well as on wild species;
   **Wildlife habitats** – changes and fragmentation of habitat in agricultural areas;
   **Landscape** – changes in agricultural landscapes;

3. The environmental impacts from primary agriculture related to:
   **Farm management practices** – on nutrients, pests, soil, irrigation and the farm as a whole;
Farm financial resources – the varying and different sources of financial resources for farms;
Socio-cultural aspects – the impact of the socio-cultural structure of rural communities.

15.4.1 Agricultural Nutrient Use
To capture how well nutrients are used in the agro-ecosystem the OECD is developing a nutrient balance approach, which can provide an indicator of the extent to which agricultural production leads to a net surplus (or deficit) of nutrients into (or from) the soil, water or air. However, a deficit or surplus of the nutrient balance, at least over the short term, does not unambiguously indicate a beneficial or harmful environmental impact. Two main approaches are being considered to measure nutrient balances, limited at this stage of the work to nitrogen and phosphorous balances, including the:

- Soil surface balance, which measures the difference between the input or application of nutrients entering the soil and the output or withdrawal of nutrients from the soil. Using nitrogen as an example, the inputs include chiefly the application of chemical fertilisers and livestock manure, but the use of other inputs can also be taken into account including, sewage sludge, the atmospheric deposition of nutrients in the soil (which mainly includes ammonia), the nitrogen content of crop residues remaining in fields (e.g. potatoes), and the biological fixation of nitrogen by leguminous crops. The output consists of the withdrawal of nitrogen from harvested and fodder crops.
- Farm gate balance, which measures the difference between the nutrient content of farm inputs and the nutrient content of the outputs from the farm. Again using nitrogen as an example, the inputs consist of purchased materials such as chemical fertilisers, manure, fodder and livestock, but natural phenomenon, such as the atmospheric deposition of nitrogen in the soil and biological fixation by leguminous crops, can also be included. Outputs include the nitrogen content of milk, meat, manure, fodder and cereals, sold of-farm.

Preliminary OECD work on national nitrogen balance calculations, using the soil surface method for the period 1985 to 1995, suggests a number of key trends in terms of the nitrogen surplus/deficit expressed as kilograms of nitrogen per hectare of total agricultural land:

- Overall the trend in nitrogen balance surpluses over the last decade is downwards or constant, especially for those OECD member countries with a nitrogen surplus in excess of 100 kg/ha;
- Generally those countries with high livestock densities and intensive production systems have the highest nitrogen surpluses. Regional data, however, suggests that in areas of some countries where the national nitrogen surplus is below 100 kg/ha, they may be experiencing both the effects of nitrate pollution and soil nutrient depletion from crop production;
- Further analysis is required to explain the causes of the changing levels and trends in nitrogen surpluses/deficits between countries, and the potential environmental impacts.

15.4.2 Agricultural pesticide use
The approach being considered by OECD to measure the agricultural pesticide use issue involves classifying pesticide use data into different environmental risk categories. This approach combines information on pesticide use with that on pesticide chemistry which influences environmental risk, that is mobility, persistence, and toxicity. Until OECD evolves a suitable pesticide risk classification system, initially work would begin on collecting pesticide use data, expressed in terms of the quantity of active ingredients per crop and/or per hectare, taking into account the proportion of agricultural land on which pesticides are applied, and the distinction between pesticide use on arable crops and pastures.
From a **preliminary examination of trends in pesticide use data in OECD countries**, between 1985 to 1995, several key points emerge:

- Overall the trend in pesticide use over the last decade has remained constant or declined in most OECD countries, although pesticide use increased in a few countries;
- Variability of weather conditions may alter pesticide use, warmer conditions generally require higher uses of pesticides than colder conditions to maintain agricultural productivity;
- Cereals, industrial crops, fruit and vegetables account for the major share of agricultural pesticide use in most countries, while pasture and rangeland account for the major part of agricultural land use, pesticides on forage account for below 5% of total pesticide usage;
- There is considerable variation in the quantities of pesticides used per hectare both between various crops and between different countries;
- Changes in cropping systems, rotations and tillage systems can affect pesticide use, for example, agricultural land changing from arable and permanent crop use to pasture where little if any pesticides are used;
- Technological developments, can lead to smaller quantity of active ingredients required per hectare, although the toxicity of the new products may still be high;
- The effects of organic agricultural production systems and the use of biotechnology in plant engineering in some countries on overall trends in pesticide use is at present uncertain; and;
- Further analysis is required to explain the causes of the changing levels and trends in pesticide use between different crops and countries and the potential environmental and health impacts.

The interpretation of pesticide use data will be improved by linking it to an environmental and health risk ranking system and also other indicators, in particular those covering soil and water quality and farm pest management. For example, there is some evidence that moving from more “traditional” intensive farm practices to organic farming systems may achieve a considerable reduction in pesticide use while maintaining the economic viability of the system. On the other hand, maintaining winter green cover to limit nutrient losses from agricultural land, for example, can require the additional use of pesticides.

### 15.4.3 Agricultural water use

Measurement of agricultural water use is being considered by developing water balances, both for the use of surface and groundwater resources by agriculture, together with exploring possible linkages with indicators related to farm management, especially irrigation management.

Indicators for measuring a water balance include consideration of various water use efficiency equations, monitoring stream and river flows (surface water) and also groundwater levels. Monitoring of water flows and levels might be in terms of measuring the relationship over time between surface water flows and groundwater levels in relation to rainfall within a catchment area. To monitor “excess” water, possible indicators could include measuring groundwater levels and the incidence of flooding. Other additional indicators being examined include calculation of water costs per tonne of crop/livestock output, and estimating the quantity of water recharged into groundwater reservoirs through certain agricultural practices.

It will be necessary to develop the water balance approach in terms of the sustainable use of water by agriculture, and also explore the linkages with indicators related to irrigation management. As regards the latter, it is necessary to identify different irrigation techniques and to classify them according to their water use efficiency in relation to a given unit of agricultural
output. Work is also needed to examine the spatial aspects of agricultural water use and also consider the related issue of water resource pricing.

15.4.4 Agricultural land use and conservation
The indicators under consideration to monitor changes in agricultural land use include:

- Land retired from production and maintained for conservation purposes;
- Total agricultural land area in relation to the total land area;
- Agricultural land per capita;
- Agricultural land shifted to non-agricultural uses, including abandoned farmland;
- Shifts in land use from wetlands to farmland.

Indicators under consideration to address agricultural land conservation, cover the role of agriculture in ameliorating soil erosion, landslides and flooding, measured by the volume of:

- Water stored by agricultural soils and ridges and banks (flood prevention);
- Water penetrating into groundwater reservoirs relative to the outflow of water from agricultural lands into surface flows (sustainable agricultural water use); and;
- Soil eroded from sloping land that is abandoned (prevention of soil erosion and landslides).

In further developing the indicators of agricultural land use and conservation it will be necessary to define more precisely the linkage between a particular change in land use and land conservation and environmental quality, and thus the establishment of the relevant indicators. It should be noted that understanding these linkages is also of concern to a number of other agri-environmental issues discussed in this paper. However, this issue, and related indicators, can provide policy relevant information on the ability of agriculture to provide environmental benefits not captured by other indicators discussed here. It will also be important to identify more clearly the links between land use and conservation and other agri-environmental issues.

15.4.5 Agricultural soil quality
Measurement of agriculture’s impact on soil quality is being considered through the development of a soil risk methodology which combines indicators on the vulnerability of soil to various degradation processes; extent of soil degradation; and soil management practices.

The emphasis with this methodology is on measuring “risk” rather than the “state” of soil quality in view of the difficulty and cost of measuring the latter and also of separating out natural impacts from water and wind erosion from the influence of farm practices on soil quality. At present the risk method is most suited to soil erosion and salinity degradation processes, rather than to aspects of soil quality such as waterlogging and toxic contamination. Estimated risk of soil degradation can be expressed in absolute terms (tonnes per hectare), classes of severity (low to excessive) or as a trend (% change), taking into account specific ecosystems. This provides an integration of information on the natural susceptibility of soil to change with land management practices. Although the soil risk approach does not reveal the extent of environmental damage, it can suggest the degree of soil fragility in some regions.

While the focus is on biophysical processes of soil degradation risk, the economic consequences of degradation are also relevant. Thus, the economic effects of soil degradation could be measured through, for example, the loss of production foregone, using data for trends in yields, and the cost of the rehabilitation of soil degradation.
Further analysis is required to examine the potential of integrating indicators that address the issue of soil quality with other indicators, particularly farm management. However, some farm management practices are already incorporated into the soil risk methodology outlined above, including the soil cover factor (a function of crops grown and the tillage practices being used). Moreover, the inclusion of some indicators that address the agricultural land use and conservation issue, such as the contribution of agriculture to the environment through its water holding capacity, might be considered in the soil risk methodology.

15.4.6 Agriculture and water quality

The method under consideration to establish agriculture’s impact on water quality involves the integration of the "state" and "risk" approaches to measure surface water (rivers and lakes) and groundwater quality in agriculture:

- The “state” approach, measures observed data on the concentrations in weight/litre of water of nitrogen, phosphorous, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, toxic pesticide residues, bacteria, viruses, ammonium, salinity and suspended matter resulting from agricultural activities.
- The “risk” approach, measures the ratio of potential contaminant concentration to the tolerable or allowable concentration, based on a partial budgeting method for nutrients and pesticides.

More work will be required to improve the basic data and methodologies for both the “state” and “risk” approaches to measure agriculture’s impact on water quality. The links between this and other issues is being explored, especially nutrient and pesticide use, land use and conservation, soil quality, and farm management. The need to develop methods of expressing the regional diversity concerning this issue is also necessary, including comparison against national water quality standards, and work might also examine the impact of agriculture on marine water quality drawing on other efforts in this area.

15.4.7 Agricultural greenhouse gases

To measure the release and accumulation of agricultural greenhouse gases the OECD is developing a net balance of the release and accumulation of carbon dioxide, methane and nitrous oxide by agriculture expressed in CO₂ equivalents. The net balance method of measurement can provide a better reflection of agriculture’s contribution to climate change than just measuring gross emissions, by taking into account the role of agricultural green house gases (GHG) sinks. The need to ensure consistency with other international methodologies to calculate GHG in this area is important.

The net balance GHG measurement will require refinement in terms of including the use of fossil fuel on farm, and clarification of the distinction between farm-forestry and forestry. It will also be necessary to provide information that can reveal the range of uncertainty in estimates of agriculture as a sink and source for GHG, which some studies show can be substantial. Consideration also needs to be given to examining links with the farm management indicator to measure the options to reduce GHG emissions and/or develop sinks in agriculture.

15.4.8 Agriculture and biodiversity

The development of indicators to address biodiversity in agriculture is complex because of differing levels at which it operates in agriculture. Since it is possible to preserve biodiversity ex situ and in situ the indicators that could address biodiversity in agriculture will need to reflect both approaches, including the measurement of the biodiversity of “domesticated” species in agriculture; and the impact of agriculture on the biodiversity of “wild” species.
It will be necessary to define more clearly the link between agriculture and biodiversity, in particular drawing a sharper distinction between biodiversity of “domesticated” species and the biodiversity of “wild” species. Work will also need to focus on the significance of site-specificity, as the scale of many biodiversity issues is at the sub-national level. Methods also need to be evolved that can interpret the environmental impact of agriculture on biodiversity, such as whether a farm structure with smaller field plots and a denser and more comprehensive network of border elements such as hedges and boundary strips provides more favourable conditions to enhance biodiversity. Work will also explore links between this issue and those covering agriculture in relation to wildlife habitats and landscape.

15.4.9 Agriculture and wildlife habitats

Indicators to measure agriculture and wildlife habitat are not yet established but the following are under consideration: changes in the area of selected “large-scale” habitats in agriculture such as wetlands and pasture; fragmentation of habitats both in the agro-ecosystem and “natural” habitats; length of "contact zone" between agricultural and non-agricultural lands.

None of these indicators provide a direct causal link between agricultural activities and impacts on habitats, although if used in conjunction with other indicators, such as those that address nutrient and pesticide use and farm management, they may contribute information to establish these linkages. The indicators outlined here provide little information on the relationship between changes in the quality of habitats and agriculture, although the measurement of changes in “key indicator” wildlife species and habitat fragmentation could be of value in this context.

In developing indicators to address the link between agriculture and wildlife habitats work is required to define more precisely the scope of wildlife habitats in agriculture and establish the linkages between natural habitats and agriculture, especially in relation to key indicator species and landscape. National legislation and international agreements may be of help in establishing these definitions and linkages. More work has to be undertaken to understand the direction of agriculture’s impact on biodiversity. The difficulty of encapsulating the spatial diversity of wildlife habitats into national wildlife habitat indicators also needs to be addressed.

15.4.10 Farm management

A number of indicators to assess the environmental impacts of farm management practices are under consideration, including the measurement of:

- **Nutrient management** - the share of land which is analysed regularly for soil phosphorus; the share of farms using a nutrient management plan; the area of land which require less than normally recommended nutrient inputs and also receiving excessive (i.e. Above recommended levels) of nutrient inputs; the timing of slurry application and months of available slurry storage on farm; and the use of low ammonia emission slurry application machinery;

- **Pest management** - the share of land on which integrated pest management practices are adopted; the use of pest forecasting systems; the area of cropping land on which pesticides are not applied; and the efficiency of pesticide spraying equipment in applying pesticides;

- **Soil management** - the share of land on which soil conservation practices are adopted including the use of winter cover crops, and appropriate tillage practices;

- **Irrigation management** - the efficiency of water use on irrigated land in terms of the quantity of water used to produce a unit of agricultural output; and the pricing of water to agriculture; and;
• **Whole farm management** - the rate of adoption of farm plans or property management plans—which, when fully developed, may contain information relating to economic, farm production and biophysical or environmental factors—either approved by governments or voluntarily.

Further analysis of farm management practices will be required in terms of defining measurable indicators that can separate out environmentally appropriate from inappropriate practices. Additional work could also explore the relationship with other agri-environmental issues and related indicators. As some countries have already defined certain practices in national legislation, for example “organic farming,” while FAO has developed internationally accepted definitions for certain farm management practices, such as integrated pest management, this information could provide an input to develop indicators that address the farm management issue.

### 15.4.11 Farm financial resources

The indicators under consideration to address the issue of farm financial resources and the environment include measurement of: net farm and off-farm income; policy transfers; average rate of return on capital employed; and the average debt/equity ratio, on a per farm basis and adjusted for inflation in real terms.

More work has to be completed on defining the direction of environmental impact, associated with changes in the level of farm financial resources. Further investigation is also required of the links between farm financial resources, farm management practices employed, and the effect on the environment, taking into account other factors, such as longer term climatic changes and population growth, which may indirectly influence farmer behaviour and environmental outcomes.

### 15.4.12 Socio-cultural issues in relation to agriculture

Although the importance of socio-cultural issues in the analysis of agriculture and the environment, including sustainable agriculture, is generally accepted, no precise definition of the policy issues nor relevant indicators have yet been established. However, some indicators are under consideration, including the measurement of:

- Land use changes, especially the transfer of agricultural land to use for urban development;
- Changes in population growth and composition, in particular rural-urban changes;
- Education and training of farmers, in relation to the adoption of environmental plans and sustainable farming practices; and;
- Farmer health and safety, related to the use of agricultural pesticides and machinery.

The key aspect to further work to address the socio-cultural issue in relation to agriculture and the environment, relates to establishing a clear definition of the relevant policy issues and developing indicators that can quantify these issues. Work underway both on other agri-environmental issues, for example land use and farm management, and in other OECD activities, such as on rural development and structural adjustment in agriculture, could be drawn on to help develop the definition of issues and identification of indicators. However, further conceptual work is also required to examine the linkages between the socio-cultural, economic and environmental components in the DSR framework, and also consider the spatial aspects of these links in developing appropriate indicators.
15.5 CONCLUSION

The participants were given the opportunity to have a question and answer session with particular reference to the work they would need to perform in their offices which is related to agriculture.

To conclude the course topic the future of OECD agri-environmental indicator work was also highlighted as follows:-

- **Improve the conceptual and analytical understanding of the links between agriculture and the environment** in specific areas to help identify which policy relevant indicators might be developed and how they should be measured, in particular for example biodiversity, habitats, landscape, farm financial resources and socio-cultural aspects of agri-environmental linkages. In these areas the links between agriculture and environmental impacts need further refinement and relevant indicators identified.

- **Identify policy relevant indicators and methods of measurement** for those agri-environmental issue areas, where the conceptual basis is advanced but for which indicators and methods of measurement are not yet established, such as pesticide use, soil and water quality.

- **Collect, systematically, basic agri-environmental data and begin the calculation of indicators** where methods of measurement are established. In this regard, work is already underway on calculating indicators and collecting basic data related to, for example, nutrient use and greenhouse gases.

- **Examine how the driving force-state-response (DSR) framework** and related indicators can be used as analytical tools to better understand agri-environmental relationships in policy analysis and to evaluate the impact of policies on the environment in agriculture.
16. INFORMATION SYSTEM ON FORESTRY

By Howard Wright
Oxford Institute of Forestry
(7th - 9th May 1997)

16.1 INTRODUCTION.
The aim of introducing information system on forestry was to provide background knowledge required to for accurate, up-to-date information on forestry. To achieve this target the following sub-topics were treated:

- Definition of a forest;
- Roles of a forests;
- Criteria for selection of indicators;
- Forest resource accounting;
- Current issues in forestry management; and;
- Forest inventories.

16.2 WHAT IS A FOREST?
The term forest encompasses an enormous range of habitats, ranging from elfin cloud forests a few metres tall to 50 metre-high stands of redwoods or eucalyptus and from single species coniferous plantations to topical moist forests of extraordinary complexity.

The major problem in mapping forests is in deciding at what point tree cover becomes dense enough to be called a forest rather than, say, an open woodland. There is no straightforward answer. FAO classifies a forest as any area more than 10 per cent canopy cover. But this very wide definition includes many areas which few would regard as forests. A more satisfactory definition is one covering closed canopy forest (any area with over 40 per cent crown cover). This works well with broadleaf or mixed coniferous and broadleaf forests but less well with purely coniferous forests, where canopy cover is often less than 40 per cent.

16.2.1 Status of the World Forest Resources
Ninety percent of the world’s forests are unprotected. Surprisingly, tropical moist forests and mangroves appear to be the two best protected forest types - but this protection is in theory rather than practice. It is therefore important that we improve the quality of existing protected areas, as well as increase the territory they cover. Table 15.1 shows the percentage of protected forest by area and type.

<table>
<thead>
<tr>
<th>Forest type</th>
<th>Global area (sq km)</th>
<th>Percentage protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical moist</td>
<td>11.2 million</td>
<td>8 percent</td>
</tr>
<tr>
<td>Tropical dry</td>
<td>0.8 million</td>
<td>5 percent</td>
</tr>
<tr>
<td>Temperate broadleaf/mixed</td>
<td>7.2 million</td>
<td>6 percent</td>
</tr>
<tr>
<td>Temperate needle leaf</td>
<td>13.9 million</td>
<td>5 percent</td>
</tr>
<tr>
<td>Mangrove</td>
<td>0.2 million</td>
<td>9 percent</td>
</tr>
</tbody>
</table>

Source: The WWF world Forest map 1996.
16.3 **ROLE OF FORESTS**
The forests have economic, environmental and social uses. The economic uses of forests include timber production, pharmaceutical products, provision of energy, fodder and food. The environmental roles of forests include conserving the soil, controlling floods and flow of water, rehabilitation of degraded land and genetic conservation. The social roles of forests include employment creation, provision of areas that can generate income e.g. tourism and forests contributions to human and animal health.

16.4 **CHARACTERISTICS OF TROPICAL FORESTS**
There is increasing human population pressure on the forestry. It is estimated that 450 sq. km are lost every day. This has been due to low government commitment to conservation of forestry resources, slow pace of industrial development and frequent exploitation of natural forests usually aimed for export. The physical causes of tropical deforestation are shifting agriculture, secondary agriculture, fuel production, logging and overgrazing, fires, urban and industrial expansion and war damage. There has also been loss of genetic variation due to over-exploitation, climatic change, pollution, introduction of exotics and artificial breeding. Many plantations species have been started. These are usually exotic, fast growing species which have short commercial cycles. There has been a growing phenomena of nationalism with regard to forests hence the advocacy for growing indigenous species.

16.5 **CONSERVATION AND SUSTAINABLE MANAGEMENT OF FORESTS**
There is need to conserve biodiversity for ethical and ecological reasons. Many species live together and maintain an ecological balance. The objective of conservation to maintain ecological processes and life support systems to preserve genetic diversity and promote sustainable use of forest resources.

Sustainable management of forest is defined as

> “The stewardship and use of forests in a way, at a rate, that maintains their biodiversity, productivity regeneration capacity, vitality; and their potential to fulfil now, and in the future, relevant ecological, economic and social functions at local, national, and global levels; that does not cause damage to other ecosystems” (Interministerial Conference on European Forest Helsinki 1993)

16.6 **CRITERIA FOR SELECTION OF INDICATORS**
The process of identifying indicators entails identifying critical components to operationalise sustainability. Some of the factors that can be considered in selection of forestry indicators are as highlighted below:

- Primary tools of evaluation;
- Site specific (or generic);
- Ranked according to importance;
- Possibility of cross linkage; and;
- Possibilities of information sharing.

16.7 **FOREST RESOURCE ACCOUNTING APPROACH**
Forest resource accounting focuses on three key areas of information. These include the demand for forest goods and services, the supply, the use and management of forest assets. The supply aspect includes information of the extent, composition, ownership and capability of

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5 There is need to have several types of trees as mono type forests may be destroyed by a diseases single disease.
forest assets. The demand aspects includes information on market demands, international obligations, investment opportunities and threats to forests. The use aspect includes information on flows of forest goods and services, management practices and industry capabilities. (For more information see Chapter 19)

16.8 CURRENT ISSUE IN FORESTRY MANAGEMENT
The participants were divided into four groups and given an article from UNASYLVA to read and to summarise the main salient features. The four papers that were:

- “Policy and Legal Aspects of Sustainable Forest Management” by R. M. de Montalember and F. Schmithüsen
- “Common Property Regimes in the Forest: Just a Relic from the Past?” By M. McKean and E. Ostrom
- “The Conservation of Genetic Resources in Managed Tropical Forests” R. H. Kemp.
- “Present and Potential Roles of Forest in the Global Climate Change Debate” by S. Brown.

16.8.1 “Policy and Legal aspects of Sustainable Forest Management” by R. M. de Montalember and F. Schmithüsen
This paper identifies the policy shift from traditional yield concept to sustainable forest management. The policy shift to sustainable forest management is a result of increasing complex challenges of reconciling the demands of various users. This shift consists of a significant change from production techniques designed to ensure sustained commodity flow over time to a broadened focus that encompasses socio-economic impact, the participation of rural people, environmental benefits and ecological stability while maintaining the potential to respond to evolving demands. The sustainable forest management policy framework now embraces more systematically the economic, social and ecological roles of forests development. For the policy framework to be achieved the aspects which are particularly important are the

- Land use policies and planning aspects;
- Macro-economic policies and structural adjustment measures;
- Policy interactions between forestry and related sectors;
- The conservation and wise utilisation of forests;
- Forest dwellers and neighbouring communities;
- Fiscal policies for forestry activities; and;
- Price polices for all marketed forest goods and services.

The implementation of polices and laws and their impact as an effective incentive and regulatory framework ultimately depends on the attitudes and capacities at national and local levels. This is why any progress in policy regulations requires a critical examination of the institutional arrangement and skills of people involved in developing, disseminating, supporting and implementing more widely sustainable forest management practices. Forest management can only be undertaken and pursued through interdisciplinary approaches with effectively coordinated rural development policies and regulations. No sustainable forest management is feasible unless it benefits from sound and sustainable context of consistent developments and converging strategies occurring in related sectors.
16.8.2 “Common Property Regimes in the Forest: Just a Relic from the Past?” By M. McKean and E. Ostrom

The objective of this paper is to examine current and future potential of common property rights (CPRs) in the conservation and sustainable use of forest resources. The basic argument is that CPRs were once used globally for management of forest resources for long term benefits. With the natural decay of CPR communities opted for other system under the influence of new technologies in the economic development process. CPRs were legislated out of existence. In this case CPRs were left out in the formal property rights codification process and where such rights existed land reform transferred such rights to individuals.

Common pool resources refers to an arrangement of property rights in which a group of resource users share rights and duties towards a resource. CPR refers to an arrangement of property rights in which a group of resource users share rights and duties towards a resource.

Common property has been oddly used to refer to a resources system of non-property or rather to open access resources for which rights and duties are undefined. In CPR, there is property rather than non-property, their are rights rather than absence of rights. These rights are not common to all but are common to a specific group of users. Hence, common property is not access open to all but access limited to a specific group of users who hold their rights in common.

The advantages of CPR is that it is a way of privatising the rights to a resource without dividing it into pieces, a system desirable when the resource system is productivity managed as an intact whole rather than fragmented and uncoordinated smaller pieces.

CPR is a favoured policy because it promotes keeping resources intact as whole rather than division into smaller pieces, it provides the possibility to share risk, collective management is less costly.

The policy recommendations for CPR are:

- User groups need the right to organise their activities, or at least a guarantee of no interference;
- The boundaries of the resource must be clear;
- The criteria for membership in the group of eligible users of the resource must be clear;
- Users must have the right to modify their use rules over time;
- Use rules need to be clear and enforceable;
- Inexpensive and rapid methods of resolving minor conflicts need to be devised;
- Institutions for managing very large systems need to be layered, with considerable authority devolved to small components.

Therefore the CPR can be applicable and it should not be considered as relics of the past since this approach could be effectively applied to reduce deforestation rates in some parts of the world.


This paper highlights the importance of genetic diversity of tropical forestry. The biological diversity of tropical forests constitutes a unique national and international asset. As human populations continue to increase, setting aside large areas purely to preserve biodiversity becomes more and more difficult. At the same time, however, the conservation of genetic re-
sources is fundamental to the sustainable management of the forest ecosystem in which they occur. The conservation of a wide diversity of species and variation in natural forests is dependent on maintaining essential functional components of the ecosystem. These often involve a range of complex interactions. The key elements that need to be considered in order to achieve sustainable management are selective logging, improved forestry inventories, national data centres, and national strategies.

Selective logging in mixed forests can be managed to allow for maximum genetic diversity of both pioneer and climax species. In this regard logging should leave large seed bearing trees which can help to ensure regeneration and maintenance of genetic equality.

The paper emphasises the need for a forest inventory in conservation of diversity. Traditional forest inventories need to be improved to include information on the composition and condition of forests. Inadequate information on species composition of the forest is one of the main problems confronting natural forest management.

National data centres are critical in achieving conservation of genetic diversity. This is because a variety of information sources is required to contribute to the construction of a tropical forest inventory. Information that is required ranges from forest composition, species composition and the science of flowering and fruiting.

Existing laws and regulations may need to be revised and a coherent system of incentives for sustainable forest management to be met. Management of forests particularly genetic diversity, must be undertaken at local levels. However, in the context of national plans, there is ample scope for international conventions on biological diversity, currently being negotiated.

16.8.4 “Present and Potential Roles of Forest in The Global Climate Change Debate” by S. Brown.

The article describes how forests contribute to climate change through their influence on the global carbon cycle. The Carbon cycle consists of the following processes:

- Storage of carbon in vegetation and soil;
- Exchange of carbon with the atmosphere through photosynthesis (plants take up carbon dioxide and store it in their leaves, stems, roots, fruits) and respiration;
- Release of atmospheric carbon when disturbed by either human or natural causes such as wild fires, logging, over harvesting and degradation, clearing and burning for conversion to non forest uses e.g. agriculture and pastures;
- Absorption and becoming sinks during re-growth after disturbance.

There is a distinction between the forests in temperate (18%), boreal zone (30%) and tropical zone (52%). Tropical forests are undergoing high rates of loss, but with sound management they can be regenerated and hence can accumulate carbon.

Carbon storage in vegetation and soil can be achieved by:

- Increasing the area and or density of forest;
- Establish plantations on non forested lands;
- Promote vegetation and protection; and;
- Increase carbon stored in durable wood products (expand demand for wood products at a faster rate than decay of wood).
Although forest contribute to climate change through their influence on carbon cycles, the research has shown that their current contribution to global warming is minimal. However, this could change as forests are annually and increasingly being cleared and degraded. In addition as forest, mature, die and decay they cease to absorb carbon.

16.9 FOREST INVENTORIES
Inventories are crucial for the sound management of forests. They are various sampling methods utilised for constructing forest inventories. These include systematic, stratified and multi-stage sampling.

In a typical forest plantation the size of tree and age follow a normal distribution. On the other hand the age and size of tree in a natural forest follow a negative exponential. Figure 16.4 shows the distribution of trees by size and frequency. In this figure the shaded area shows the trees that can be harvested in order to have sustainable management. This technique enables one to achieve low impact logging. In practice, there are computer software that can enable one to select the right age of tree for logging. Data sources for the computer data bases include, remote sensing, surveys and administrative records.

Figure 16.1 Potential Harvest

16.9.1 The case of Australia forests inventories
The participants were shown a video presentation from Australia’s national forestry inventory. Australia has a multi-resource inventory which includes environment, economic and social attributes of a forest. Some of the key issues portrayed in the video presentation were:

- Inventories are looking more at aggregating information collected from various sources;
- Non timber products are becoming more important as the policy shifts to community management of forests is attained; and;
- A participatory approach to making inventories is being promoted.

16.10 OUTLOOK
The participants were encouraged to carry out more reading on the topic. There were hence shown some of the important web pages on the internet which included:
• FAO Forest Home Page (Http://www.fao.org/waicent/faoinfo/forestry/forestry.htm);
• International Unit of Forestry Research Organisation (Http://iufro.boku.ac.at/);
• Oxford Forestry Institute (Http://ifs.plants.ox.ac.uk/ofi/tfrg/ofi.htm);
• World Forest Frontiers Initiatives (Http://www.wri.org/wri/ffi);
• World Conservation Monitoring Centre (Http://www.wcmc.org.uk/); and;
• World Wildlife Fund (www.wwf-UK.org/home.shtml)

16.11 REFERENCES
Chapter 17 Human Settlements and Environment

17. HUMAN SETTLEMENTS AND ENVIRONMENT
by Makandey Rai
UNCHS
(May 12 - 16, 1997)

17.1 INTRODUCTION
Human settlements interrelationship with environment was introduced to enable the participants to gain an understanding of demographic pressure on environment patterns and to analyse the effects of the household sector on environment.

To achieve the aims the aims of the course the topic was arranged as follows:

- Human settlements concept;
- Agenda 21;
- Methodology;
- Human settlements statistics;
- Data collection instrument at the national and city level and UNCHS habitat’s experience in the collection of human settlements statistics and are there any suggestion on how to improve it?;
- Publications, databases, world-wide web as an alternative media of data dissemination.

17.2 HUMAN SETTLEMENTS CONCEPT
In order to have adequate human settlements the natural environment is encroached upon to create the man made environment. The key question are what limits should we have in encroaching natural resources.

Human settlements is not synonymous with housing but rather it is the physical articulation of the social, economic, political activities of the people. Human settlements includes housing, shelter, services and infrastructure. The main objective for human settlements is to improve quality of life. The definition of human settlement is as given below:

“The fabric of human settlements consists of physical elements and services to which these elements provide the material support. The physical components comprise shelter, i.e. the superstructures of different shape, size, type and materials erected by mankind for security, privacy, and protection from the elements and for his singularity within a community; infrastructure, i.e. the complex networks designed to deliver or remove from the shelter people, goods, energy of information. Services cover those required by a community for the fulfilment of its functions as a social body, such as education, health, culture, welfare, recreation and nutrition.”

17.3 AGENDA 21.
The major issues raised with regard to human settlements in the Agenda 21 is the problems of overconsumption which leads to wastage of natural resources. The need to provide the basic needs of shelter, food, water and clothing is also highlighted.
There are five approaches recommended for achieving improved quality of life in development of human settlements and these are:

- Enabling approach;
- Capacity building;
- Partnership;
- Monitoring approach; and;
- Dissemination of information.

The Agenda 21 recommends the following:

- To make urban life more sustainable, governments should see that the homeless, poor and unemployed get access to land, credit and low-cost building materials. People also need security of tenure and legal protection against unfair eviction. Informal settlements and urban slums should be upgraded to ease the deficit in urban shelter. All urban areas need such services as clean water, sanitation and waste collection, and higher income neighbourhoods should pay the full cost of providing such services.
- Construction programmes should emphasise use of local materials, energy-efficient designs, material that do not harm health and the environment, and labour intensive technologies that employ more people.
- National action programmes are needed to promote energy saving and renewable energy technologies, such as solar, hydro, wind and biomass. Transportation strategies should reduce the need for motor vehicles by favouring high occupancy public transport, and providing safe bicycle and foot paths. Municipalities need to be developed in way that reduce the need for long distance commuting.
- Countries need to reduce urban poverty by supporting the informal economic sector, which operates many small businesses. Governments need to develop urban renewal projects in partnership with non-governmental organisations.
- To reduce migration to big cities governments should improve rural living conditions and encourage the development of medium-sized cities that create employment and housing. Sound management is needed to prevent urban sprawl onto agricultural land and environmentally fragile regions.
- It is also important to see that settlements are built in locations using designs and materials that reduce the risk of damage from such natural disasters such as storms, flooding, earthquakes and landslides.
- Developing countries need financial and technical assistance to help train experts in field such as urban planning, waste reduction, water quality, sanitation, energy efficiency and clean, efficient transportation.

### 17.4 METHODOLOGY FOR COLLECTION OF HUMAN SETTLEMENTS DATA

The FDES as described in chapter 20 is utilised for organising human settlements data. Table 17.1 shows the indicators recommended for human settlements statistics development that have been arranged by utilising the FDES. The recommendations for data acquisition are:

- Assess the existing data and data needs;
- Study the forms in which the data exists;
- Collect the data; and;
- Develop a method to store as a data base.
The main concerns that need to be addressed in the development of human settlements statistics are:

- Population growth and natural growth;
- Urbanisation;
- Inadequate shelter and basic amenities especially in marginal settlements;
- Overcrowding and urban decay;
- Environmental degradation;
- Lack of services and related infrastructure in rural as well as urban areas especially water supply and sanitation;
- Improvement of cultural heritage by the 2000; and;
- Health effects and living conditions.

17.4.1 Problems of Concepts
The definitions of urban and rural differ from country to country hence comparability of countries is difficult. With regard to the trends it is anticipated that one half of the population will be living in urban areas. Secondly another limitation with regard, to the concept of urbanisation is that the city boundaries change with time.
### Table 17.1 Framework for the Development of Environment Statistics: Human Settlements

<table>
<thead>
<tr>
<th>Social and economic activities and natural events</th>
<th>Environmental impacts of activities and events (B)</th>
<th>Responses to environmental impacts (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Settlements growth and change</td>
<td>1. Conditions of shelter, infrastructure and services</td>
<td>1. Human settlements policies and programmes</td>
</tr>
<tr>
<td>1.1 Population growth and change</td>
<td>1.1 Housing</td>
<td>2. Pollution monitoring and control</td>
</tr>
<tr>
<td>1.2 Construction of shelter and infrastructure</td>
<td>1.2 Access to infrastructure and services</td>
<td>2.1 Environmental standards</td>
</tr>
<tr>
<td>1.3 Utilities (energy and infrastructure)</td>
<td>1.3 Human settlements sprawl and dispersion</td>
<td>2.2 Monitoring</td>
</tr>
<tr>
<td>1.4 Transport</td>
<td></td>
<td>2.3 Treatment, disposal and reuse of discharges</td>
</tr>
<tr>
<td>1.5 Land use in human settlements</td>
<td></td>
<td>2.4 Expenditure for pollution control</td>
</tr>
<tr>
<td>2. Other activities</td>
<td>2. Conditions of life-supporting resources</td>
<td></td>
</tr>
<tr>
<td>2.1 Emission and waste discharge</td>
<td>2.1 Ambient concentrations of pollutants and wastes</td>
<td></td>
</tr>
<tr>
<td>2.2 Hazardous activities at workplace [not developed]</td>
<td>2.2 Biological and ecological impacts [not developed]</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3 Micro climates [not developed]</td>
<td></td>
</tr>
<tr>
<td>3. Natural events</td>
<td>3. Health and welfare conditions in human settlements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1 Exposure and health effects</td>
<td></td>
</tr>
</tbody>
</table>
The housing unit is defined in terms of conventional housing and marginal housing. The problem is that the definition of marginal housing is not agreed. In addition, they are not adequately covered in the statistics available. Marginal housing units are sometimes referred to as slums or squatter settlements. In the housing census marginal housing units are further subdivided into i) improvised housing ii) housing units in permanent buildings and iii) other premises not intended for human habitation.

Homeless population is a concept very much talked about in the political dimensions however the methodologies to establish the homeless population are not yet well developed. Therefore, routine figures on homeless population by country are difficult to find. What is always quoted i.e. (1 out of every 5 persons is without adequate shelter) is only an estimate. A related concept to homeless population is the street children.

17.4.2 Questionnaires utilised by UNCHS

The UNCHS has so far developed two questionnaires namely the human settlements statistics questionnaire and the city data programme questionnaire that has been developed for cities with a population of over 100,000.

The participants were divided into four groups so that they can discuss these questionnaires. The following were some of the observations made:

- Rural environment aspects are being neglected yet most of the developing countries have large rural population;
- Information in rural area is a big problem as additional data requirements are on fishing, deforestation and afforestation, agricultural land, soil erosion and recreation facilitates such as national parks; and;
- It is difficult to collect crime data.

17.5 DATA COLLECTION

The Kenya pilot programme (KPP) was given as an example of how human settlements information can be collected. The KPP programme concentrated on getting information from 8 cities in Kenya. The steps that were taken are as stated below:

- Sensitisation of local authorities;
- Team sent to fact finding missions to find out what data are available, to sensitisise and generate capacity to collect data;
- Team to all cities to explain the difficulties of how to get records, followed by training in computer skills; and;
- Review of programme meeting.

17.6 DATA DISSEMINATION

Data dissemination has been done using various available options ranging from pocket booklets to statistical compendia in the print media and electronic media utilising diskettes for data bases and the internet.

The human settlements statistical database version 4 (1997) is one of the dissemination tools utilised by human settlements. The flowing data is included in this data base

*Demography:* Population, sex age structure, urbanisation, fertility/life expectancy, household and migration.
Economy: National accounts, labour, income distribution, poverty, household expenditure, public expenditure.

Land/natural resources: Land use, deforestation.

Housing: Housing stock, occupancy, tenure of households, housing construction, Housing facilities, building material.

Infrastructure and services Safe water, sanitation services, health, education, transport and communication and energy.

The list of human settlements indicators that are given in this data base are as listed below:

1. Total population in 000s
2. Urbanisation level
3. Total population growth rate
4. Urban population growth rate
5. Gross national product per capita
6. Income share of highest 20% to lowest 20%
7. Population below poverty line: urban %
8. Population below poverty line rural (%)
9. Government expenditure on housing an community amenities (% of total)
10. Land area per capita (ha/person)
11. Annual deforestation (sq. km)
12. conventional dwelling per 1,000 inhabitant (/1000)
13. Average number of persons per room (person/room)
14. Owner occupancy ratio (%)
15. Housing unit with piped water (%)
16. Housing unit with toilet (%)
17. Population with access to safe water urban (%)
18. Population with access to safe water: rural (%)
19. Population with access to sanitation services: urban ()
20. Population with access to sanitation service: rural (%)

To conclude the topic the participants were exposed to the web pages (Http://www.UNCHS.org/habrrd/info.htm) of UNCHS which highlighted activities being carried out and raw data which can be downloaded.

17.7 REFERENCES
18. ENVIRONMENT AND ECONOMIC ACCOUNTING

By Richard Allen
London
(May 20 - 23, 1997)

18.1 INTRODUCTION

Environment and economic accounting was a course topic introduced to enable Participants to be familiar with the principles of national accounts and the current role of environment in the SNA. The other aims of the course were: to enable participants to understand the concept of GDP and its limitation, to know the forms of presentation of national accounts and to be informed on satellite accounts.

18.2 THE SYSTEM OF NATIONAL ACCOUNTS

The system of National Accounts (SNA) consists of a coherent, consistent and integrated set of macroeconomics accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. It provides a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision taking and policy making. The accounts themselves present in a condensed way a great mass of detailed information, organised according to economic principles and perceptions, about the working of an economy. They provide a comprehensive and detailed record of the complex economic activities taking place within an economy and of the interactions between the different economic agents, and groups of agents, that takes place on markets or elsewhere. In practice the accounts are compiled for a succession of time period, thus provide a continuous flow of information that is indispensable for the monitoring, analysis and evaluation of the performance of an economy over time. The SNA provides information not only about economic activities, but also about the levels of an economy’s productive assets and the wealth of its inhabitants at particular points of time. Finally, the SNA includes an external account that displays the links between an economy and the rest of the world.

International interest in the comparability of national economic statistics dates from 1928 when the International Conference Relating to Economic Statistics and the League of Nations was held. The great depression of the 1930’s was an impetus to the study of national income. In 1939 the League of Nations published national income estimates for 26 countries, half of these were official estimated but still half were based on academic or other private studies.

The second world war led to further official interest in national accounts- particularly in the optimal allocation of resources to further the war effort. After the war the UN continued the work of the League of Nations and first “SNA” was published in 1953. Two slightly modified versions were published in 1960 and 1964. In 1968 the Statistical Commission published a revised version, the one which most of us are familiar, which has been used for 25 years. The most current version is the 1993 version (SNA 1993) which is not a UN publication but one jointly issued by the commission of European Communities, IMF, OECD, UN and the World Bank.

The uses of national accounts include, monitoring, analysing and evaluating the performance of the economy. National accounts enable informed rational policy-making and decision-taking. They also serve as a co-ordinating statistical framework. National accounts are not a completely satisfactory means of assessing welfare although GDP is often used as one. Valuations are based on market or quasi-market prices without any adjustment for utility (or welfare judgement) or on the effect on those not a party to the transaction.
In principal there is only limited change in the 1993 SNA from that of 1968. The aim is to preserve maximum continuity, however, with regard to the presentation and detail there are many changes and the conversion to the new SNA is not a trivial process.

18.2.1 Concepts and definitions
The phenomena of an economy are production, income, consumption, accumulation and wealth. Production of goods and services generates income and it is distributed (and redistributed) and used to finance final consumption, accumulation of capital, goods and wealth. The SNA provides an accounting framework based on internationally agreed concepts, definitions, classifications of rules. The SNA is not the only way of presenting national accounts.

Production is understood to be a physical process, carried out under the responsibility, control and management of an institutional unit, in which labour and assets are used to transfer inputs of goods and services into outputs of other goods and services. All goods and services produced as outputs must be such that they can be sold on markets or at least be capable of being provided by one unit to another, with or without charge. The system includes within the production boundary all production actually destined for the market whether for sale or for barter. It also includes all goods and services provided free to individual household or collectively to the community by government units or non profit institutional serving households (NPISH).

Consumption boundary: Consumption is equivalent to production. Services produced for own consumption are however not part of the consumption boundary. An example of such services are commonly known as “do it yourself services”. However, the expenditures used for “do it yourself” purposes are included in the household final expenditures.

Assets as defined by the system are entities that must be owned by some unit, or units, and from which economic benefits must be derived by their owner(s) by holdings or using them over a period of time. Financial assets and fixed assets, such as machinery, equipment and structures which have themselves been produced as outputs in the past, are clearly covered by this definition. However, the ownership criterion is important for determining which natural occurring i.e. non produced - assets are included in the system. Naturally occurring assets such as land, mineral deposits, fuel reserves, uncultivated forests or other vegetation and wild animals are included in the balance sheets provided that institutional units are exercising effective ownership rights over them - that is there are actual in position to be able to benefit from them. Assets need not be privately owned and could be owned by government units exercising ownership rights on behalf of entire communities. Thus, many environmental assets are included within the system. Assets that are not included are those such as the atmosphere or open sea, over which no ownership rights can be exercised, or mineral or fuel deposits that have not been discovered or that are unworkable - i.e. incapable of bringing any benefits to their owners, given the technology and relative prices existing at the time.

Changes in the values of naturally occurring assets owned by institutional units between one balance sheet and the next are recorded in the accumulation accounts of the system. For example, the depletion of a natural asset as a result of its use in production is recorded in the other changes in volume of assets account, together with losses of fixed assets due to their destruction by natural disaster (floods, earthquakes, etc.). Conversely, when deposits or reserves of minerals fuels are discovered or previously unworkable deposits become workable, their appearance is recorded in this account and they enter the balance sheets in this way.
Transactions can take place only between 2 resident institutions or between resident institutions and the rest of the world. Each transaction needs transactors, a buyer and seller, giver and receiver. A transaction is the transfer and must be in units of the economy.

Institutional units and institutional sectors: These are units capable of owning goods and assets, incurring liabilities and engaging in economic activities and transactions with others in their own right. The two main kinds that are distinguished in the SNA are households and legal entities. The institutional units are aggregated into five sectors and these include:

- Non financial corporations;
- Financial corporations;
- Government;
- Non-profit making institutions serving household; and;
- Households.

Non financial corporations include all resident non-financial corporations, irrespective of residence of their shareholders, all resident non-financial-quasi corporations, including branches or agencies of foreign-owned non-financial enterprises (provided they have significant production are on a long-term basis) and all resident Non profit institution that are market producers of goods non-financial series (e.g. hospitals, schools). The sub-sectors include

- Public non-financial corporations;
- National private non-financial corporations; and;
- Foreign controlled non-financial corporations.

Financial corporations include resident corporations or quasi-corporations (and NPIs, if any) principally engaged in financial intermediation or in auxiliary financial intermediation or in auxiliary financial activities which are closely related to financial intermediation. The sub-sectors include

- The central bank;
- Other depository corporations;
- Other (financial intermediaries), except insurance corporation and pension funds (e.g. Investment corporations, financial leasing, hire-purchase companies etc.);
- Financial auxiliaries (e.g. broker etc.); and;
- Insurance corporations and pension funds.

Each of the above mentioned sectors is further sub-divided into public financial corporations, national private financial corporations and foreign controlled financial corporations.
**Government** is subdivided into the following sub-sectors:

Central Government;
State Government;
Local Government; and;
Social security funds.

Alternatively the social security funds may be associated with the level of government which operates them. Government enterprises which produce goods and services should be included in non-financial corporations as quasi-corporations if they have separate accounts and “act independently”.

**Households** are defined as a small groups of persons who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain goods and services collectively, mainly housing and food. Persons living permanently or may be expected to live indefinitely or for a very long time, in an institution e.g. prison, hospital etc. are treated as belonging to that “institutional household”.

Unincorporated enterprises may produce for the market or for own final use. Those activities included within the boundaries of the systems are all those for the production of goods, whether for the market or for own final use; the production of services for the market but only the production of the services of owner occupied dwellings and domestics services produced by employing paid staff.

Households may be sub-classified in various ways to satisfy particular needs and analyses. The system suggested in the SNA is based on the nature of the largest source of income of the household. This system is as highlighted below:-

- Employers-mixed incomes accruing to owners of unincorporated enterprise with paid employees;
- Own-account workers-mixed incomes accruing to the owners incorporated enterprises without paid employees;
- Employees; and;
- Recipients of property and transfer of incomes-preferably further divided property incomes; pension; other transfer incomes.

**Non profit institutions serving household:** Non profit institutions (NPIs) are legal entities created for the purpose of producing goods and services. They are not a source of income or profit to those who establish, control or finance them. The NPIs may serve corporate and quasi-corporate enterprises, known as market NPIs, and unless financed and controlled by government are included in the appropriate corporate sector. All NPIs financed and controlled by government are included in the government sector. All other NPIs, that is those that are not market producers or government controlled are non profit institutions serving household.

**Rest of World:** To complete the institutional sectors used in the SNA there is the Rest of world which may or may not be subdivided to meet analytical needs. It comprises all non-resident units that enter into transactions with resident units. It may include certain institutional units physically located within the geographic boundary of the country such as foreign embassies, military bases or international organisations.
Enterprises, Establishment and Industries: Enterprises are the institutional unit of the production sector they may be a corporations, a quasi-corporations, unincorporated enterprises or a non profit institutions.

- Enterprises may have several secondary activities and to group them as “industries”: results in very heterogeneous groupings.
- Establishments are the result of partitioning enterprises on the basis of kind of activity. It may also be advantageous to partition by geographic locality.
- Industries are groupings of establishments according to the ISIC.

18.3 THE ACCOUNTS OF THE SNA
The accounts of the SNA are many and detailed as they may be prepared for sectors, sub-sectors, industries and products. the general sequence as follows:

- Production account;
- Generation of income account;
- Allocation of primary income account;
- Secondary distribution of income account;
- Redistribution of income in kind account;
- Use of disposable income account;
- Capital account;
- Financial account;
- Other changes in assets accounts, re-evaluation and other changes; and;
- Balance sheets.

Rest of the world accounts

- Goods and services;
- Primary income and current transfers;
- Capital transfers;
- Assets and liabilities;
- Other changes in volume of assets;
- Revaluation; and
- Balance sheets.

18.3.1 Production account
The production account is the first in the sequence of the accounts and is compiled for institutional units, sectors, establishments, industries and the total economy. It is production which generates the income for the economy which is carried forward into the other accounts. The accounts are also of importance as they themselves show “who” produces “what”.

<table>
<thead>
<tr>
<th>Production account (Total economy)</th>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Intermediate consumption</td>
<td>1883</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gross domestic product</strong></td>
<td>1854</td>
<td><strong>Total uses</strong></td>
</tr>
<tr>
<td><strong>Consumption of fixed capital</strong></td>
<td>222</td>
<td><strong>Total Resources</strong></td>
</tr>
<tr>
<td><strong>Net domestic product</strong></td>
<td>1,632</td>
<td></td>
</tr>
<tr>
<td><strong>Total uses</strong></td>
<td>3,737</td>
<td></td>
</tr>
<tr>
<td><strong>Total Resources</strong></td>
<td>3737</td>
<td></td>
</tr>
</tbody>
</table>

In the above production account
**Gross domestic product = Total resources - Intermediate Consumption**

**Net domestic product = Gross domestic product - consumption of fixed capital.**

Output is measure in this presentation in basic prices, that is producer prices less taxes on production plus subsidises on production.

### 18.3.2 Income account

The generation of income account is compiled to the economy as a whole, for institutional units and sectors, for establishments and industries in their capacity as producers. It is an elaboration of the production account. It shows the sectors, sub-sectors or industries in which different types of primary incomes originate. An example of an income account for a non-financial corporation for which value added was 717 is highlighted below.

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compensation of employees</td>
<td>Value added 717</td>
</tr>
<tr>
<td>Wages and salaries</td>
<td>421</td>
</tr>
<tr>
<td>Employers social contribution</td>
<td>124</td>
</tr>
<tr>
<td>Taxes on production</td>
<td>86</td>
</tr>
<tr>
<td>Subsidies on production</td>
<td>-35</td>
</tr>
<tr>
<td>Operating surplus</td>
<td>122</td>
</tr>
<tr>
<td>Total uses</td>
<td>717</td>
</tr>
</tbody>
</table>

In the above generation of income account,

**Operating surplus = Total resources - Compensation of employees - taxes on production - subsidies on production.**

### 18.3.3 Allocation of primary income account

The allocation of primary income account focuses on resident institutional units or sectors as recipients of primary incomes rather than as producers whose activities generate incomes. Below is a presentation of two allocation of primary income accounts one for households and the other for the total economy.

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property income</td>
<td>Operating surplus 60</td>
</tr>
<tr>
<td>Interest</td>
<td>Mixed income 432</td>
</tr>
<tr>
<td>Rent</td>
<td>Compensation of employees 150</td>
</tr>
<tr>
<td></td>
<td>Interest 49</td>
</tr>
<tr>
<td></td>
<td>Distributed income of corporations 57</td>
</tr>
<tr>
<td>Balance of primary incomes</td>
<td>Dividends 13</td>
</tr>
<tr>
<td>Total uses</td>
<td>Withdrawals 44</td>
</tr>
<tr>
<td></td>
<td>Re-invested foreign inv. Earnings 3</td>
</tr>
<tr>
<td></td>
<td>Property income to insurance policy 20</td>
</tr>
<tr>
<td></td>
<td>Holders 21</td>
</tr>
<tr>
<td></td>
<td>Rent 27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total resources</td>
<td>1408</td>
</tr>
</tbody>
</table>
### Allocation of primary income account (total economy)

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property income</td>
<td>Operating surplus</td>
</tr>
<tr>
<td>Interest</td>
<td>Mixed income</td>
</tr>
<tr>
<td>Distributed income of corporations</td>
<td>Compensation of employees</td>
</tr>
<tr>
<td></td>
<td>Taxes on production and imports</td>
</tr>
<tr>
<td></td>
<td>Subsidies on products and production</td>
</tr>
<tr>
<td></td>
<td>Property income</td>
</tr>
<tr>
<td></td>
<td>Interest</td>
</tr>
<tr>
<td></td>
<td>Distributed income from corporations</td>
</tr>
<tr>
<td></td>
<td>Dividends</td>
</tr>
<tr>
<td></td>
<td>Withdrawals</td>
</tr>
<tr>
<td></td>
<td>Re-invested earnings on dir for investment</td>
</tr>
<tr>
<td></td>
<td>Attribution to insurance policyholders</td>
</tr>
<tr>
<td></td>
<td>Rent</td>
</tr>
</tbody>
</table>

National Income 1661

Total uses 2052  Total resources 2052

18.3.4 Secondary Distribution of Income

The secondary distribution of income account shows how primary incomes of an institutional unit or sector is transformed into disposable income by the receipt and payment of current transfers excluding social transfers in kind.

They are three types of current transfers. These are:
- Current taxes on income and wealth;
- Social contribution and benefits; and;
- Other current transfers.

Redistribution of income is a major purpose of government. An example of secondary distribution of income for households is given below.

### Secondary distribution of income account (households)

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current taxes</td>
<td>Balance of primary incomes</td>
</tr>
<tr>
<td>Taxes on income</td>
<td>Social Benefits, except transfers</td>
</tr>
<tr>
<td>Other current taxes</td>
<td></td>
</tr>
<tr>
<td>Social contributions</td>
<td>Social security benefits in cash</td>
</tr>
<tr>
<td>Actual</td>
<td>Private funded social benefits</td>
</tr>
<tr>
<td>Employers</td>
<td>Unfunded employee social benefits</td>
</tr>
<tr>
<td>Compulsory</td>
<td>Social assistance benefits, cash</td>
</tr>
<tr>
<td>Voluntary</td>
<td></td>
</tr>
<tr>
<td>Employees</td>
<td></td>
</tr>
<tr>
<td>Compulsory</td>
<td></td>
</tr>
<tr>
<td>Voluntary</td>
<td></td>
</tr>
<tr>
<td>Voluntary</td>
<td></td>
</tr>
<tr>
<td>Self and non employed persons</td>
<td></td>
</tr>
<tr>
<td>Compulsory</td>
<td></td>
</tr>
<tr>
<td>Voluntary</td>
<td></td>
</tr>
<tr>
<td>Imputed</td>
<td></td>
</tr>
<tr>
<td>Other Current transfers</td>
<td></td>
</tr>
<tr>
<td>Non-life insurance premiums</td>
<td>Other current transfers</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
</tr>
<tr>
<td>Disposable income</td>
<td></td>
</tr>
</tbody>
</table>

Total uses 1735  Total resources 1735

18.3.5 Redistribution of Income Account

The redistribution of income in kind account takes the process one stage further by adjusting disposable income by the receipt and payment of social transfers in kind for the benefit of individual households. These may be of the social benefit or assistance nature but also include education and health services. The balancing item is then referred to as the adjusted disposable income.
18.3.6 The use of Income Account
The use of income account shows how household, government unit and non profit institutions serving households allocate their incomes between final consumption and saving. The account generated is entitled use of disposable income account. Below is an example for households.

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final consumption expenditure</td>
<td>1015</td>
</tr>
<tr>
<td>Savings</td>
<td>160</td>
</tr>
<tr>
<td>Total uses</td>
<td>1175</td>
</tr>
<tr>
<td>Disposable income</td>
<td>1164</td>
</tr>
<tr>
<td>Change in net equity of household in pension funds</td>
<td>11</td>
</tr>
<tr>
<td>Total Resources</td>
<td>1175</td>
</tr>
</tbody>
</table>

The same measure of savings is obtained using adjusted disposable income as the actual final consumption which then includes the consumption of transfers in kind.

18.3.7 Accumulation accounts and balance sheets
The accumulation and balance sheets form a group of accounts concerned with: the value of assets and liabilities owned by institutional units or sectors at particular points in time. The changes in their value over time are also included. Balance sheets measure the values of stocks of assets and liabilities and thus net worth.

18.3.8 Capital account
The purpose of the capital account is to record the values of non-financial assets that are required, or disposed off, by resident institutional units and change in net worth due to saving and capital transfers. The right side of the capital account records the resources available for the accumulation of assets; net saving and capital transfers. The left side of the capital account records the value of non-financial assets acquired, or disposed off, in transaction of various kinds. Five categories of changes in assets in the capital account are listed below:-

- Gross fixed capital formation;
- Consumption of fixed capital;
- Changes in inventories;
- Acquisitions less disposal of valuables; and;
- Acquisitions less disposals of non-produced non-financial assets.

<table>
<thead>
<tr>
<th>Capital Account (non-financial corporations)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Changes in assets</td>
</tr>
<tr>
<td>Gross fixed capital formation</td>
</tr>
<tr>
<td>Tangible fixed assets, net</td>
</tr>
<tr>
<td>Intangible fixed assets (net)</td>
</tr>
<tr>
<td>Non-produced non-financial assets</td>
</tr>
<tr>
<td>Consumption of fixed capital</td>
</tr>
<tr>
<td>Changes in inventories</td>
</tr>
<tr>
<td>Net acquisition of valuables</td>
</tr>
<tr>
<td>Changes in liabilities and net worth</td>
</tr>
<tr>
<td>Saving</td>
</tr>
<tr>
<td>Capital transfers, receivable</td>
</tr>
<tr>
<td>Capital transfers, payable</td>
</tr>
<tr>
<td>Changes in net worth due to saving and capital transfers</td>
</tr>
<tr>
<td>Net lending (+)/net borrowing (-)</td>
</tr>
</tbody>
</table>

18.3.9 The financial account
The financial account records transactions that involve financial assets and liabilities between institutional units and between institutional units and the rest of the world. The left side of the account records the net acquisition of financial assets; the right side of the account records the net incurrence of liabilities. In the SNA financial assets and liabilities are classified as:
• Monetary gold and special drawing rights (SDR);
• Current and deposits;
• Securities other than shares;
• Loans;
• Shares and other equity;
• Insurance technical reserves; and;
• Other accounts receivable/payable.

Financial account (financial corporations)

<table>
<thead>
<tr>
<th>Changes in assets</th>
<th>Changes in liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net acquisition of financial assets</td>
<td>Net incurrence of liabilities</td>
</tr>
<tr>
<td>237</td>
<td>232</td>
</tr>
<tr>
<td>Monetary gold and SDRs</td>
<td>Currency and deposits</td>
</tr>
<tr>
<td>-1</td>
<td>130</td>
</tr>
<tr>
<td>Currency and deposits</td>
<td>Securities other than shares</td>
</tr>
<tr>
<td>15</td>
<td>53</td>
</tr>
<tr>
<td>Securities other than shares</td>
<td>Loans</td>
</tr>
<tr>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>Loans</td>
<td>Shares and other equity</td>
</tr>
<tr>
<td>167</td>
<td>13</td>
</tr>
<tr>
<td>Shares and other equity</td>
<td>Insurance technical reserves</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>Insurance technical reserves</td>
<td>Other accounts payable</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other accounts receivable</td>
<td>Net lending (+)/net borrowing (-)</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

The financial account is the final account in the sequence of accounts that record transactions between institutional units. However before completing the balance sheets there are changes in the volume and value of assets and liabilities which are not the result of transactions.

18.3.10 Other changes in assets accounts
The “changes in the volume of assets account” records changes in issues such as discoveries or depletion of subsoil resources, destruction by war or other political events or destruction by natural catastrophes. The re-evaluation account records changes in the value of assets and liabilities due the level and structure of prices which are reflected in holding gains and losses.

18.4 PRESENTATION OF ACCOUNTS

18.4.1 Balance sheets
A balance sheet is a statement, drawn up at a particular point of time, of the value of assets owned and liabilities. A balance sheet may be drawn up for institutional units and sectors and for the total economy.

Balance sheet at the beginning of the period + changes in assets and liabilities = balance sheet at the end of the period. The balancing item - the difference between assets owned and liabilities - is the net worth.

18.4.2 Matrix presentation
The general system of the SNA is based on double entry bookkeeping (T-accounts) because it consists of transactions between institutional units. The results in the use (payments) by one institutional unit is on the left side of an account and an increase in resources (receipts) of another institutional unit is on the right side of the account. This is a well known and well understood method of presentation, but it is not the only one possible. An alternative is a matrix presentation. The matrix is a grid of cells in which the rows contain additions to resources and the columns contain uses. Each transaction (or aggregate of similar transactions) thus appears only once on the matrix in the cell at the junction of the column relating the institutional unit “making the payment”.
The matrix presentation has many advantages. The whole system can be presented on one table, although it require a very large sheet of paper; it is by definition fully articulated and must be internally consistent; and it can be manipulated by computer by using matrix algebra. On the other hand it has disadvantages in that many people have great difficulty in reading matrixes; the printed version, as opposed to the computer version, of a complete detailed matrix version is difficult to handle; it is not possible to produce a fully articulated set of accounts, i.e. it cannot be used for an incomplete set of accounts.

The main uses of the matrix presentation are in the input/output tables and the Social accounting matrix

### 18.4.3 Input-output tables
The supply and use tables are input/output tables but their analytical uses are limited because they are not symmetric or “square”, they cannot be manipulated by matrix algebra. The input/output element is producers and products and unless there is a one-to-one relationship between the two, which is unlikely, the matrix will be rectangular. By reallocating secondary products to homogeneous “single product” and on the basis of specific technical assumptions about production structure it is possible to drive a symmetric product by product matrix within the input/output table. Table 18.1 gives an example of input output table using hypothetical data.

### 18.4.4 Social Accounting Matrix (SAM)
The social accounting matrix is a matrix presentation of the complete system of national accounts. To a great extent it is an expansion of the input/output table, in particular an extension of the disaggregation of the household sector, but also includes details of the capital accounts of the “flow of funds”, that is transactions in financial assets. Table 18.2 gives an example of the presentation of a social accounting matrix using hypothetical data.

The SAM and input/output tables, including the supply and use tables serve two types of purposes and these are statistical and analytical. They provide a framework for checking the consistency of statistics on flow of goods and services obtained from different statistical sources. The system as a whole, and in particular the matrix tables, provides a framework for ensuring consistency through common concepts, definitions and classifications. As an analytical tool the input/output tables and the SAM can be used as a macroeconomics model or more likely incorporated into macroeconomics models.

### 18.4.5 Satellite Accounts
The SNA provides a framework with an integrated accounting structure and is exhaustive and consistent within the boundaries of economic activities it covers. There is a great deal of flexibility over detail and emphasis but only within the limits of the system. The SNA is not the only possible system for national accounts. Satellite accounts are a means of expanding or modifying the system for areas of interest in a way which retains links with the central system but without burdening the whole system with the changes needed for that the particular purposes.
Typically satellite systems allow for

- Additional information of a functional or cross-sector nature;
- Complementary or alternative concepts, classification or accounting frameworks;
- Extended coverage of costs and benefits of human activities;
- Further analysis of data by means of relevant indicators and aggregates; and;
- Linkage of physical data sources and analysis to the monetary accounting system.

Satellite accounts and analysis is particularly attractive for those concerned with environment problems because the environment, and more particularly the effect of economic activities (and some social activities), is not fully contained or separately identified with the SNA.

The environment is not a sector of the economy but is “related” to all sectors. Thus the study of the sector is of a cross-sector nature. The analysis may need to linked with physical data. The coverage of costs of human activities need to be extended to include, for example, the costs of pollution.
Figure 18.1 Input Output Table presentation

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making Food</td>
<td>1</td>
<td>40</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>Making things</td>
<td>2</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>Supplying Transport Servs</td>
<td>3</td>
<td>25</td>
<td>10</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td>Supplying Non-Fin. Servs</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>33</td>
</tr>
<tr>
<td>Supplying Fin. Servs</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Production of Govt</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Rest of World Imports</td>
<td>7</td>
<td>20</td>
<td>10</td>
<td>25</td>
<td>9</td>
<td>8</td>
<td>33</td>
<td>105</td>
</tr>
<tr>
<td>Intermediate Consumption by source</td>
<td>8</td>
<td>105</td>
<td>40</td>
<td>42</td>
<td>18</td>
<td>17</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>Compensation of employees</td>
<td>9</td>
<td>285</td>
<td>100</td>
<td>55</td>
<td>19</td>
<td>21</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Consumption of Fixed Capital</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Indirect taxes</td>
<td>11</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Operating Surplus</td>
<td>12</td>
<td>100</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>13</td>
<td>500</td>
<td>185</td>
<td>130</td>
<td>52</td>
<td>50</td>
<td>127</td>
<td>689</td>
</tr>
</tbody>
</table>
Figure 18.2 Social Accounting Matrix presentation

<table>
<thead>
<tr>
<th>R</th>
<th>Factors</th>
<th>Institutions (current)</th>
<th>Redistribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F1  F2  F3  F4  F5  F6  I1  I2  I3  I4  I5  I6  I7  I8  R1  R2  R3  R4  R5  R6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Prof. Admin. and Tech.</td>
<td>F1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Clerical workers</td>
<td>F2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Unskilled workers</td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operating surplus</td>
<td>F4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Depreciation (CFC)</td>
<td>F5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indirect taxes</td>
<td>F6</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Poor households</td>
<td>I1</td>
<td>386 58 4</td>
</tr>
<tr>
<td></td>
<td>Average households</td>
<td>I2</td>
<td>120 13 3</td>
</tr>
<tr>
<td></td>
<td>Pension households</td>
<td>I3</td>
<td>48 20 2</td>
</tr>
<tr>
<td></td>
<td>Rich households</td>
<td>I4</td>
<td>78 52 18 9</td>
</tr>
<tr>
<td></td>
<td>Rest of the world</td>
<td>I5</td>
<td>25 9 1</td>
</tr>
<tr>
<td></td>
<td>Non-financial enterprises</td>
<td>I6</td>
<td>89 9 1</td>
</tr>
<tr>
<td></td>
<td>Financial enterprises</td>
<td>I7</td>
<td>9 28 20 11</td>
</tr>
<tr>
<td></td>
<td>Government</td>
<td>I8</td>
<td>13 47 14</td>
</tr>
<tr>
<td>E</td>
<td>Interest</td>
<td>R1</td>
<td>6 3 1 17 1</td>
</tr>
<tr>
<td></td>
<td>Dividends</td>
<td>R2</td>
<td>4 35 6</td>
</tr>
<tr>
<td></td>
<td>Insurance premiums</td>
<td>R3</td>
<td>4 3 1 11 1</td>
</tr>
<tr>
<td></td>
<td>Insurance claims</td>
<td>R4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taxes on income</td>
<td>R5</td>
<td>11 10 6 18 2</td>
</tr>
<tr>
<td></td>
<td>Other transfers</td>
<td>R6</td>
<td>10 10 5 15 22 1 90</td>
</tr>
<tr>
<td>I</td>
<td>Making food</td>
<td>P1</td>
<td>233 18 10 15 174</td>
</tr>
<tr>
<td></td>
<td>Making things</td>
<td>P2</td>
<td>65 25 7 6 47</td>
</tr>
<tr>
<td></td>
<td>Supplying transport svs</td>
<td>P3</td>
<td>46 25 10 4</td>
</tr>
<tr>
<td></td>
<td>Supplying non-financial svs</td>
<td>P4</td>
<td>20 8 3 2</td>
</tr>
<tr>
<td></td>
<td>Supplying financial svs</td>
<td>P5</td>
<td>10 10 7 3</td>
</tr>
<tr>
<td></td>
<td>Government</td>
<td>P6</td>
<td>1 4 1 122</td>
</tr>
<tr>
<td>P</td>
<td>Non-financial enterprises</td>
<td>Ic</td>
<td>22 32</td>
</tr>
<tr>
<td></td>
<td>Supplying financial govern-</td>
<td>Id</td>
<td>1 13</td>
</tr>
<tr>
<td></td>
<td>ment</td>
<td>Ie</td>
<td>1</td>
</tr>
<tr>
<td>T</td>
<td>Financial assets</td>
<td>A1</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Total</td>
<td>48 120 386 169 29 18 482 165 76 40 380 116 60 225 28 45 20 17 47 21</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 19 Natural Resource Accounting

19. NATURAL RESOURCE ACCOUNTING
by Prashant Vaze
Office for National Statistics - London
(May 26 - 30, 1997)

19.1 INTRODUCTION
Natural resource accounts is an accounting system that deals with stocks and stock changes of natural assets in physical terms. Natural resource accounts is an attempt to organise the wide range of environmental information into aggregate information to enable policy makers to make informed decision making. It is one of the three main approaches to environmental accounting. The second approach to environmental accounting is the monetary satellite accounting which identifies expenditures on environmental protection and deals with the treatment of environmental costs to natural and other assets caused by production activities in the calculation of net product. Monetary satellite accounting is generally more limited in coverage of environmental concerns than physical resource accounting. The third approach is a welfare-oriented one. It deals with the environmental effects borne by individuals and by producers other than the producers causing these effects. In terms of practical implementation natural resource accounting is the most advanced. Experience with monetary satellite accounting is much more recent, and many controversies still surround this approach, particularly with regard to valuation. The least consensus exists with regard to the welfare approach to environmental accounting.

Therefore the course topic on natural resource accounting was introduced to enable the participants to have an understanding of the targets and methods used in NRA. Examples on the construction of natural resource accounts for forests, water and subsoil assets were also given through exercises utilising the EXCEL windows based spreadsheet.

19.2 CONCEPTS AND DEFINITIONS
In an attempt to organise information related to natural resources it was noted that the SNA has various concepts and definitions which can be utilised and built upon. These are as identified below:

Asset boundary: Assets are those naturally occurring or man-made products over which ownership rights have been established and are effectively enforced. It was noted that ownership can be communal and that assets must be capable of providing an economic benefit to the owner under current technology and economic circumstances.

Production boundary: This is the creation of goods or services from inputs. It includes production by firms and, government but excludes domestic or personal services for consumption within the household.

Balance sheet gives data relating to the values of a system at a moment in time.

Stock appears in the balance sheet. It is a value, or physical quantity of a resource at a moment in time.

Depletion is the reduction in value of a sub-soil asset as a result of physical removal and use of the resource.

Degradation of land, water or other natural resources is recorded in the ‘other volume changes of assets’ account. Degradation is the deterioration resulting from economic activity
for instance erosion and other damage to land from deforestation or improper agricultural practices and the harmful effects on fish stocks of acid rain or excess nutrients from agricultural run-off.

**Produced assets** are non-financial assets that have come into existence as outputs from production processes. Produced assets consist of fixed assets, inventories and valuables.

**Non-produced assets**: Tangible non-produced assets are those that occur in nature and over which ownership rights have been established. Environmental assets over which ownership rights have not, or cannot, be established, such as the high seas or air, are excluded because they do not qualify as economic assets.

**Environmental service** - Free service provided by nature (e.g. potable water)

In order to have an understanding of the differences between the GDP and the natural resource accounts the participants did an exercise to assess whether the GDP would rise or fall for various issues e.g. the accumulation of wood in a natural forest does not appear in the national accounts hence has no effect on the GDP. (old SNA)

### 19.3 BASIC STRUCTURE OF NRA

The SEEA is a method that builds on the concepts and definitions used by SNA in building up national accounts and is the United Nations favoured way of setting out natural resource accounts. Table 19.1 shows the basic structure of the SEEA.

**Explanation of terms in table 19.1**

The shaded areas are the usual flow and stock items in the SNA. The non shaded areas are alternative concepts used in environmental accounts.

<table>
<thead>
<tr>
<th>P</th>
<th>Production covering output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ci</td>
<td>Intermediate consumption</td>
</tr>
<tr>
<td>CFC</td>
<td>Consumption of fixed capital</td>
</tr>
<tr>
<td>NDP</td>
<td>Net domestic product</td>
</tr>
<tr>
<td>X</td>
<td>Exports</td>
</tr>
<tr>
<td>M</td>
<td>Imports</td>
</tr>
<tr>
<td>C</td>
<td>Final Consumption</td>
</tr>
<tr>
<td>Ig</td>
<td>Net Capital formation</td>
</tr>
<tr>
<td>-CFC</td>
<td>Net capital formation</td>
</tr>
<tr>
<td>X-M</td>
<td>Exports - Imports</td>
</tr>
<tr>
<td>Kop.ec</td>
<td>Opening stock of produced assets</td>
</tr>
<tr>
<td>Konp.ec</td>
<td>Opening stock of non produced natural assets</td>
</tr>
<tr>
<td>Use.op.ec</td>
<td>Use of non produced natural assets in that are economic assets in the SNA sense.</td>
</tr>
<tr>
<td>Inp.ec</td>
<td>Change in stock of non produced assets</td>
</tr>
<tr>
<td>Inp.env</td>
<td>Reduction of natural assets other than economic assets</td>
</tr>
<tr>
<td>Usep</td>
<td>Use of non produced natural assets</td>
</tr>
<tr>
<td>Useop.env</td>
<td>Degradation of other natural assets that are not economic assets.</td>
</tr>
<tr>
<td>Ap.ec</td>
<td>Net capital accumulation of produced economic assets</td>
</tr>
<tr>
<td>Anp.ec</td>
<td>Net capital accumulation of Non produced natural and economic assets</td>
</tr>
<tr>
<td>Anp.env</td>
<td>Net capital accumulation of other natural assets</td>
</tr>
<tr>
<td>Revp.ec</td>
<td>Holding gains on produced assets</td>
</tr>
<tr>
<td>Revp.env</td>
<td>Holding gains/losses of non produced natural assets</td>
</tr>
<tr>
<td>Volp.ec</td>
<td>Other changes in volume of produced assets</td>
</tr>
<tr>
<td>Volp;ec</td>
<td>Other changes in volume of non produced assets</td>
</tr>
</tbody>
</table>
Klp.ec  Closing stocks of produced assets  
Klnp.ec  Closing stocks of non produced natural assets

### Table 19.1 Basic structure of SEEA

<table>
<thead>
<tr>
<th>Economic activities</th>
<th>Environmental activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production</td>
<td>Rest of the world</td>
</tr>
<tr>
<td>Final consumption</td>
<td>Produced assets</td>
</tr>
<tr>
<td>Non produced assets</td>
<td>Other non produced assets</td>
</tr>
</tbody>
</table>

i. Opening stock of assets

ii. Supply

iii. Economic uses

iv. Consumption of fixed capital

v. Net domestic product

vi. Use of non-produced natural assets

vii. Other accumulation of non-produced natural assets

viii. Environmentally adjusted aggregated in monetary environmental accounting

ix. Holding gains/losses

x. Other changes in volume of assets

xi. Closing stock of assets

The environmental adjusted GDP is therefore as stated in equation below:-

\[
EDP = C + (Ap.ec + Anp.ec) - Anp.env + (X-M)
\]

### 19.4 VALUATION METHODS

Resources and environmental services have no market value, hence the SEEA proposes different methods for monetising environmental flows. The different methods for evaluation are as stated below:-

**Valuing depletion** is done by using market values e.g. the price of sub-soil oil is valued at the price at which oil reserves are bought and sold at, however, there are a few environmental transactions of this nature. The second method utilised for evaluating depletion is the net rent which is the difference between market price and all input costs. The user cost is a final valuation method and it is that part of the rent which if reinvested that would generate a permanent income stream.

**Valuing degradation** is done using three methods. The first is the restoration costs methods which values based on the costs incurred in repairing the damage caused. The second method
is called damage costs and valuation is based on preventing the damage occurring. The last method is the willingness to pay which is the only means of valuing intrinsic values for example tourist attractions or beautiful scenarios.

Environmental goods are not bought or sold hence there is no market for them. In principle two methods are further utilised in coming up with costs these include the costs caused which depends on the polluter pay principle and the costs borne approach which depends on the victim pays principle. The cost caused approach is sometimes referred to as the maintenance method of valuation.

The maintenance method costs is based on costs; incurred while modifying processes or mitigating costs to avoid long term quantitative and qualitative change. The options usually available in this method are imply closing down industries or using end of pipe measure or modifying the processes.

The cost borne approach estimates are based on actual costs paid by victims to defend against pollution. In this method costs are imputed that victims would pay/accept to reduce or increase environmental problems are imputed. The problems of utilising the cost borne approach is to link costs to the accounting periods and to determine which polluter is responsible. How to link back to the industry is also a problem. There are three ways in which the costs borne approach to valuation is done. The first is based on costs incurred by existence of the problem, the second on is based on the costs of various options and the last one is based on the use value. In general the existence costs estimates tend to be lower than either option and use values. This is because they are based on hypothetical markets. However, the existence cost estimates are more commonly used than the other two methods.

There are three approaches used in the contingent method. The first is based on a hypothetical market. In this approach a questionnaire is used to ask the people their willing to pay for the non marketable natural resources. For better results the approach does not use open ended questions but uses a dichotomous choice. In addition the questions set are based on the idea of a constrained budget. The actual values are then estimated using a logit regression model which uses dichotomous variables as independent variables. In the “willingness to pay” questionnaires it is also important to ensure that less information is given about the product so that valuation of costs is not biased by information given.

The second approach used is the contingent valuation which is based on real expenditure incurred such as travel costs incurred to visit an attractive scenic area. In order to have a good estimate the element of time spent to get to the destination and population density of areas of origin are also considered. The second real expenditure method is the hedonic pricing which uses a surrogate market or market for leisure. The actual costs for leisure activities in relation to natural resources is determined. However, this method is suitable for only a few goods. Finally actual expenditure of costs incurred because of an environmental problem may be utilised. Such costs may include losses of income and export and sales prices of timber. The contingent valuation methods are good for valuing issues such as tourism, forest resources, biodiversity.

**19.5 FOREST ACCOUNTS**

Forests are grouped under the renewable resources accounts. The principles therefore are based on harvesting, growth and afforestation rather than depletion. In order to understand the operation of forest accounts participants were given an exercise to construct timber accounts. The data utilised was about Indonesia and was loosely drawn from ‘Wasting assets: natural
resources in the national income accounts’ by Robert Repetto and others of the World Resources Institute.

In constructing timber accounts only productive forests are considered. In carrying out the exercise, the estimates utilised were based on a recent assessment by the land resources development centre and the Ministry of Transmigration which utilised aerial photographs dating mostly from the early 1980s, which roughly agreed with FAO totals. In coming up with the timber volumes since there was no data available in Indonesia to translate productive area into volumes of timber produced, Malaysia which is a country with similar forests was utilised. The assumption made was that Indonesia was expected to produce at 75% of the Malaysian forests because of lower forest densities. To determine annual rate of increment in volume a weighted average was used for two types of species. Table 19.2 below shows the account that was constructed from the exercise.

Table 19.2 Forest Account for Indonesia

<table>
<thead>
<tr>
<th>Opening stock at the beginning of the period</th>
<th>Volume in M³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>19,719</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change in volume</th>
<th>Volume in M³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth</td>
<td>74</td>
</tr>
<tr>
<td>Reforestation</td>
<td>25</td>
</tr>
<tr>
<td>Harvesting</td>
<td>55</td>
</tr>
<tr>
<td>Catastrophic loss</td>
<td>170</td>
</tr>
<tr>
<td>Changes in use to and from economic use</td>
<td></td>
</tr>
</tbody>
</table>

| Closing Volume   | 19,543       |

19.6 OIL ACCOUNTS

In constructing oil accounts an exercise based on actual data from the United Kingdom was used. The classification of oil in England is defined in terms of economic and physical existence. The McKelvey box is used to classify crude oil and natural gas reserves and resources. The classification made is based on the following criteria:-

- Proven - resource that is 90% chance or more of being economically and technically available for production;
- Probable - between 50% and 90% chance of being technically and economically available for production;
- Possible - a significant but < 50% chance of being technically and economically available; and;
- Undiscovered - reserves whose existence is estimated from statistical and geological information.

Three methods are used to value the oil depletion and these are market price, net rent and user cost. Formula i. and ii. below

\[ \text{i. net rent} = \text{sales} - \text{operating costs} - r \times \text{real stock of fixed capital} \]

\[ r = \text{expected rate of return on capital} \]

\[ \text{ii. true income} = \text{net rent} \times \frac{\text{net rent}}{(1 + r)^n + 1} \]

\[ n = \text{life expectancy of the reserve} \]

To have a better understanding on how subsoil assets can be handled the participants were given an exercise to calculate the life expectancy of the oil reserves using the definition of oil
reserves used in the United Kingdom. Table 19.3 shows the results of the exercise that was carried out. The following is a description of the various columns in the table.
Column 1: Year

Column 2: Proven reserves which includes all the oil that has been extracted as well.

Column 3: Probable reserves which have between 50% and 90% chance of being technically and economically available for production.

Column 4: Possible reserves which have a 50% or less chance of being technically and economically available.

Column 5: Maximum which is a summation of all three types of oil reserves probable, possible and proven.

Column 6: Cumulative production which is the cumulating amount of oil extracted.

Column 7: Undiscovered oil reserves lower limit.

Column 8: Undiscovered oil reserves upper limit.

Column 9: Average of lower and upper limits of undiscovered oil reserves.

Column 10: Depletion of oil reserves or in other words extraction.

Column 11: This was calculated by subtracting cumulative production from maximum to attain the remain proven reserves.

Column 12: This one was calculated by subtractive cumulative production from maximum production column 10 and adding the average of lower and upper estimated undiscovered reserve in column 9.

Column 13: Division of column 11 by depletion to attain life expectancy of proven resources.

Column 14: Division of column 12 by depletion to attain life expectancy total remaining oil reserves.

Table 19.4: Shows how the present value of estimated proven and total remaining reserves was done. The columns are as described below:

Column 1: End of year

Column 2: Revenue generated

Column 3: Operating costs

Column 4: Capital development

Column 5: Net capital formation

Column 6: Operating surplus = Revenue (Column 2) - Operating costs (Column 3)

Column 7: Rent = Operating surplus (column 6) - 10% of Development (Column 4) whereby 10 percent is the rate of return expected on capital that has been invested.

Column 8: Production

Column 9: Nominal rent per tonne which is rent (Column 7) divided by Production (column 8)

Column 10: GDP deflator which is used to change oil costs to 1990 prices.

Column 11: Real rent = Nominal rent (column 8) divided by GDP deflator (column 10) multiplied by 1000 tonnes.

Column 12: Total rent = Real rent (column 11) multiplied by production (column 8.)

Column 13: Life expectancy for proven resources.

Column 14: Life expectancy for total remaining reserves.

Column 15: Present value based on life expectancy for proven resources.

Column 16: Present value based on life expectancy for total remaining reserves.
### Table 19.3 Estimation of Life expectancy

<table>
<thead>
<tr>
<th>End of Year</th>
<th>Total Initial Oil Reserves</th>
<th>Undiscovered Oil Range of Estimated Reserves</th>
<th>Reserve Depletion</th>
<th>Proven</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Reserves Proven</td>
<td>Proven Probable Possible Maximum Cumulative Production</td>
<td>Lower</td>
</tr>
<tr>
<td>1976</td>
<td>1380</td>
<td>920</td>
<td>900</td>
<td>3200</td>
</tr>
<tr>
<td>1977</td>
<td>1405</td>
<td>625</td>
<td>590</td>
<td>2620</td>
</tr>
<tr>
<td>1978</td>
<td>1397</td>
<td>509</td>
<td>605</td>
<td>2511</td>
</tr>
<tr>
<td>1979</td>
<td>1200</td>
<td>625</td>
<td>575</td>
<td>2400</td>
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<tr>
<td>1980</td>
<td>1125</td>
<td>575</td>
<td>600</td>
<td>2300</td>
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<td>1981</td>
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<td>500</td>
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<td>2650</td>
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<td>1985</td>
<td>1580</td>
<td>480</td>
<td>650</td>
<td>2710</td>
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<td>3000</td>
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<td>1987</td>
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<td>1760</td>
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<td>660</td>
<td>620</td>
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</tr>
<tr>
<td>1991</td>
<td>2020</td>
<td>675</td>
<td>730</td>
<td>3425</td>
</tr>
<tr>
<td>1992</td>
<td>2170</td>
<td>755</td>
<td>710</td>
<td>3635</td>
</tr>
<tr>
<td>1993</td>
<td>2265</td>
<td>800</td>
<td>690</td>
<td>3760</td>
</tr>
<tr>
<td>1994</td>
<td>2360</td>
<td>920</td>
<td>580</td>
<td>3860</td>
</tr>
</tbody>
</table>

Total estimated reserves includes an estimate of all unextracted oil.
Table 19.4 Calculation of Present Value of Proven and Remaining Oil Reserves

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue</th>
<th>Operating Costs</th>
<th>Development Net Stock</th>
<th>Operating Surplus Sales-Operating Rent</th>
<th>Production Nominal rent</th>
<th>GDP Deflator Real rent</th>
<th>Total rent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>81</td>
<td>1507</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1977</td>
<td>2226</td>
<td>1559</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978</td>
<td>2805</td>
<td>1690</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1979</td>
<td>5694</td>
<td>1846</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1980</td>
<td>8851</td>
<td>2163</td>
<td>15237</td>
<td>8232</td>
<td>6708</td>
<td>80.467</td>
<td>83.37</td>
</tr>
<tr>
<td>1981</td>
<td>12340</td>
<td>2479</td>
<td>16958</td>
<td>11411</td>
<td>9715</td>
<td>89.454</td>
<td>108.61</td>
</tr>
<tr>
<td>1982</td>
<td>14441</td>
<td>2304</td>
<td>18178</td>
<td>13296</td>
<td>11478</td>
<td>103.211</td>
<td>111.21</td>
</tr>
<tr>
<td>1983</td>
<td>17023</td>
<td>1772</td>
<td>19275</td>
<td>15708</td>
<td>13781</td>
<td>114.960</td>
<td>119.87</td>
</tr>
<tr>
<td>1984</td>
<td>20587</td>
<td>1804</td>
<td>20680</td>
<td>19050</td>
<td>16982</td>
<td>126.065</td>
<td>134.71</td>
</tr>
<tr>
<td>1985</td>
<td>19895</td>
<td>1860</td>
<td>21755</td>
<td>17977</td>
<td>15802</td>
<td>127.611</td>
<td>123.83</td>
</tr>
<tr>
<td>1986</td>
<td>9295</td>
<td>1731</td>
<td>22351</td>
<td>7564</td>
<td>5329</td>
<td>127.068</td>
<td>41.94</td>
</tr>
<tr>
<td>1987</td>
<td>9954</td>
<td>1660</td>
<td>22747</td>
<td>8294</td>
<td>6019</td>
<td>123.351</td>
<td>48.80</td>
</tr>
<tr>
<td>1988</td>
<td>7239</td>
<td>1668</td>
<td>24127</td>
<td>5571</td>
<td>3158</td>
<td>114.459</td>
<td>27.59</td>
</tr>
<tr>
<td>1989</td>
<td>7310</td>
<td>1877</td>
<td>25659</td>
<td>5433</td>
<td>2867</td>
<td>91.710</td>
<td>31.26</td>
</tr>
<tr>
<td>1990</td>
<td>8647</td>
<td>2311</td>
<td>26159</td>
<td>6336</td>
<td>3720</td>
<td>91.604</td>
<td>40.61</td>
</tr>
<tr>
<td>1991</td>
<td>7962</td>
<td>2646</td>
<td>26746</td>
<td>5362</td>
<td>2641</td>
<td>91.261</td>
<td>28.94</td>
</tr>
<tr>
<td>1992</td>
<td>7727</td>
<td>2601</td>
<td>28120</td>
<td>5126</td>
<td>2314</td>
<td>94.251</td>
<td>24.55</td>
</tr>
<tr>
<td>1993</td>
<td>8632</td>
<td>2885</td>
<td>29781</td>
<td>5747</td>
<td>2769</td>
<td>100.085</td>
<td>27.67</td>
</tr>
<tr>
<td>1994</td>
<td>9492</td>
<td>3032</td>
<td>2483</td>
<td>31354</td>
<td>6460</td>
<td>126.706</td>
<td>26.24</td>
</tr>
</tbody>
</table>

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19.7 WATER ACCOUNTS

In order to come up with water stocks one crucial consideration is that water is a renewable resource. Therefore, the main issues to consider when coming up with a water stock account are volume, accessibility, time, uses and storage. Analysis of water stock entails studying the water cycle. Analysing the spatial component requires study of water regions which does not necessarily tie in with administrative boundaries. This therefore makes it difficult to compare water data with other data that is usually compiled based on administrative boundaries. The scarcity of water is a seasonal issue hence constructing accounts on an annual basis to fit within ordinary accounts is not as useful as quarterly data which can be used to take account of the times when water is scarce. The economic uses of water vary. While some industries return all water back to source others consume some of it. Other considerations which are crucial for water accounts like any other are the flows and stock of water.

The type of water source is also of critical importance and these include lakes, reservoirs, springs, rivers, ground water, canals and glaciers. Issues related to quality of water have not yet been brought into the accounts because of various complications such as BOD has a short lived impact while heavy metals in water have a long impact hence making an aggregate yearly quality assessment is difficult..

It was noted that construction of water accounts was not necessary an easy task and no standard yet existed. The following table of accounts shows the exercise that was carried out based on actual data from one region in the UK including some hypothetical figures to give an understanding of what water accounts should look like.

Table 19.5 Water Accounts

<table>
<thead>
<tr>
<th>Inland Resources, mega litres</th>
<th>Lakes/Rivers</th>
<th>Reservoirs</th>
<th>Canals</th>
<th>Groundwater</th>
<th>Coastal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening Stock - 1/1/94</td>
<td>767,000</td>
<td>385,683</td>
<td>141,588</td>
<td>1,104,700 N/A</td>
<td>0</td>
<td>2,398,971</td>
</tr>
<tr>
<td>Net natural change</td>
<td>840,960</td>
<td>350,400</td>
<td>35,040</td>
<td>0</td>
<td>2,803,200</td>
<td>4,029,600</td>
</tr>
<tr>
<td>Abstractions</td>
<td>963,965</td>
<td>276,670</td>
<td>151,110</td>
<td>0</td>
<td>2,168,830</td>
<td>3,560,575</td>
</tr>
<tr>
<td>Returns (process waters)</td>
<td>634,593</td>
<td>136,189</td>
<td>82,435</td>
<td>2,154,413</td>
<td>3,007,629</td>
<td></td>
</tr>
<tr>
<td>Exports of water</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Imports of water</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Flows into other water bodies</td>
<td>630,720</td>
<td>262,800</td>
<td>26,280</td>
<td>0</td>
<td>0</td>
<td>1,119,806</td>
</tr>
<tr>
<td>Closing Stock - 31/12/94</td>
<td>647,868</td>
<td>332,802</td>
<td>150,348</td>
<td>1,036,025</td>
<td>2,167,043</td>
<td></td>
</tr>
</tbody>
</table>

19.8 LINKS BETWEEN ENVIRONMENTAL ACCOUNTS AND THE NATIONAL ACCOUNTS

19.8.1 The NAMEA approach

The NAMEA approach concentrates on the main environmental themes. Hence the main methods of aggregation are based on thematic aggregation. In this regard in one single theme e.g. all natural resources or pollutants are aggregated based on scientific principles e.g. air pollution is aggregated based on the global warming potential. Unlike the SEEA approach the NAMEA approach does not use valuations. Rather linkages are drawn to the various sectors that are defined in the SNA and matrix methods of analysis utilised. The basis for non valuation is that long time effects have never been valued very well. It is assumed that politicians are aware of environmental issues hence there is no need to carry out valuation. Most valuation methods assume constant technology and market prices which is does not happen espe-
cially over the longer periods. (See Chapter 4 for further information on the NAMEA approach).

19.8.2 United Kingdom Environmental Accounting. (UKENA)

The United Kingdom has developed a system of extending national account to incorporate national resource accounts. The long term aim of UKENA is to produce a systematic and comprehensive account of the pressures placed by the economy on the environment. The accounts use standard national accounts classifications to reveal environmental impacts by different industries. This aggregation enables environmental data to be seen and analysed alongside economic data from the national accounts to assist in the modelling of interaction between environment and the economy.

19.9 CONCLUSION

To conclude the session it was observed that the field of NRA is evolving and the main work in progress is being carried out by various groups namely UNSD (SEEA), London group (annual meeting of OECD) and Nairobi group (UNEP). A paper entitled “Natural Resource Accounts Pilot Project” was presented by Dhitsupo Gaobotse. It served as a case study for construction of natural resource accounts for a developing country.

19.10 REFERENCES


UN, Integrated Environmental and Economic Accounting, Handbook of National Accounting Series F. No. 61, 1993

UN, System of National Accounts, 1993
Chapter 20
Environmental Indicators

By Reena Shah
UNSD
(June 2 - 6, 1997)

20. ENVIRONMENTAL INDICATORS

20.1 INTRODUCTION
The main aim of introducing environmental indicators was to sensitise the participants on the environmental and related socio-economic indicators proposed by the United Nations and those that have been proposed for sustainable development. In order to meet the above aims the topic was arranged under the following sub-topics:

- Organisation of Environmental Statistics;
- Framework for the Development of Environmental Statistics;
- Pressure-State-Response Framework;
- Framework for Indicators of Sustainable Development;
- Discussion of Selected Indicators; and;
- Development of an environmental statistics/indicator programme.

20.2 ORGANISATION OF ENVIRONMENT STATISTICS.
The presentation on organisation of environment statistics was based on the experience of the UN in organising environment statistics. During the period 1978 to 1982 the UN secretariat launched the first phase of a programme for the development of environment statistics. This phase consisted of surveys of data needs and statistical practices of countries and international organisations. One of the results of the survey was the approaches that have been utilised to organise environment statistics and these are highlighted as follows:-

- Media approach which organises environmental issues from the perspective of the major environmental components of air, water, land/soil and the man made environment;
- The Stress-Response approach which focuses on impacts of human intervention within the environment (stress) and the environment’s subsequent transformation (environmental response). This approach was first developed by statistics Canada;
- The resource accounting approach which aims at tracing the flow of natural resources from their extraction (harvest) from the environment through successive stages of processing and final use, to their return to the environment as waste or to the economic sector for recycling; and;
- The ecological approach which includes a variety of models, monitoring techniques and ecological indices. In this approach national boundaries are not used as units of analysis but rather the ecosystems. This method is mainly based on estimation and hypothetical data.

20.3 FRAMEWORK FOR THE DEVELOPMENT OF ENVIRONMENT STATISTICS (FDES)
The findings of the first phase of implementation revealed that the most commonly used approaches were the media and the Stress-Response approaches. Based on the findings, the UN developed the framework for development of Environmental statistics (FDES) which is a combination of both approaches and related methodologies. Table 20.1 shows the basic structure of the FDES.
Table 20.1 Framework for the Development of Environment Statistics (FDES)

<table>
<thead>
<tr>
<th>Components of the environment</th>
<th>Information Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social and economic activities, natural events</td>
<td>Environmental impacts of activities/events</td>
</tr>
<tr>
<td>1. Flora</td>
<td></td>
</tr>
<tr>
<td>2. Fauna</td>
<td></td>
</tr>
<tr>
<td>3. Atmosphere</td>
<td></td>
</tr>
<tr>
<td>4. Water</td>
<td></td>
</tr>
<tr>
<td>a) Freshwater</td>
<td></td>
</tr>
<tr>
<td>b) Marine water</td>
<td></td>
</tr>
<tr>
<td>5. Land/soil</td>
<td></td>
</tr>
<tr>
<td>a) Surface</td>
<td></td>
</tr>
<tr>
<td>b) Sub-surface</td>
<td></td>
</tr>
<tr>
<td>6. Human settlements</td>
<td></td>
</tr>
</tbody>
</table>

The information categories shown in Table 20.1 are further described below as follows:

**Social and economic activities and natural events**
The human activities and natural events included under this category are those that may have a direct impact on the different components of the environment. Human activities consist mostly of the production and consumption of goods and services but could also include activities in pursuit of non-economic goals. They produce environmental impacts through the direct use or misuse of natural resources or through the generation of waste and emissions in production and consumption processes. Natural events and disasters are also included in this information category because human activities frequently contribute to natural disasters and because natural events may have impacts on all environment components.

**Environmental impacts of activities/events.**
The statistical topics under this information category represent impacts of socio-economic activities and natural events. Responses to environmental impacts also affect the environment and ultimately, human welfare. Environmental impacts, which may include the depletion or discovery of natural resources, changes in ambient concentrations of pollutants and deteriorating or improving living conditions in human settlements, can thus be either harmful or beneficial.

**Responses to environmental impacts**
Individuals, social groups, non governmental organisations and public authorities respond to environmental impacts in different ways. Their responses are intended to prevent, control, counter, reverse or avoid negative impacts and to generate, promote or reinforce positive ones. Policies, programmes and projects designed to this end include monitoring and control of pollutants, the development and application of environmental sound technologies, changes in production and consumption patterns, management of sustainable use of natural resources, the prevention and mitigation of natural disasters and the development of human settlements.

**Inventories, Stocks, and background conditions**
Statistical topics in this category are intended to provide “benchmark” data and to illustrate links with other subject areas for possible further statistical analysis of these relationships. They include the stocks of natural resources and of capital assets of human settlements and refer to environmental inventories, as well as to economic, demographic, meteorological or geographical background conditions.
Table 20.2 presents the statistical topics within the framework for environmental statistics on the natural environment. The details for statistical topics on the man-made environment are as shown in Chapter 16.

20.4 FRAMEWORK FOR INDICATORS OF SUSTAINABLE DEVELOPMENT (FISD)

The framework is a modification of the FDES in that the agenda 21 clusters are taken into account however the information categories are the same as those described in section 20.2 above. In other words FISD combines the concerns of potential users as reflected in Agenda 21 with the framework for environmental data production, the FDES, endorsed by the statistical commission in 1985. The FISD can be seen as a framework which is the intersection of all other frameworks as described in chapter two of this report.
Table 20.2  Framework for the development of environment statistics: statistics of the natural env

<table>
<thead>
<tr>
<th>Social and economic activities and natural events</th>
<th>Environmental impacts of activities and events</th>
<th>Responses to environmental impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A)</td>
<td>(B)</td>
<td>(C)</td>
</tr>
<tr>
<td>1. Use of natural Resources and related activities</td>
<td>1. Resource depletion and increase</td>
<td>1. Resource management and rehabilitation</td>
</tr>
<tr>
<td>1.1 Agriculture</td>
<td>1.1 Biological resources</td>
<td>1. Protection and conservation of nature</td>
</tr>
<tr>
<td>1.2 Forestry</td>
<td>1.2 Cyclical and non-renewable resources</td>
<td>1.2 Management and conservation of natural resources</td>
</tr>
<tr>
<td>1.3 Hunting and trapping</td>
<td>2. Environmental quality</td>
<td>1.3 Rehabilitation of degraded environments</td>
</tr>
<tr>
<td>1.4 Fisheries</td>
<td>2.1 Atmospheric pollution</td>
<td>2. Pollution monitoring and control</td>
</tr>
<tr>
<td>1.5 Minerals, mining and quarrying</td>
<td>2.2 Water quality</td>
<td>2.1 Pollution research and surveillance</td>
</tr>
<tr>
<td>1.6 Energy production and consumption</td>
<td>2.3 Soil and land quality</td>
<td>2.2 Standards, control and enforcement</td>
</tr>
<tr>
<td>1.7 Water use for human activities</td>
<td>2.4 Quality of biota and ecosystems</td>
<td>2.3 Environmental clean-up and rehabilitation</td>
</tr>
<tr>
<td>3. Human health and environmental disasters</td>
<td>3. Human health and contamination</td>
<td>2.4 Public pollution control facilities</td>
</tr>
<tr>
<td>1.8 Land use and environmental restructuring</td>
<td>3.2 Impacts of environmental disasters</td>
<td>3. Prevention and hazard mitigation of natural disasters</td>
</tr>
<tr>
<td>2. Emissions, waste loading and application of biochemical</td>
<td>3.1 Human health and contamination</td>
<td>4. Private sector responses</td>
</tr>
<tr>
<td>2.1 Emissions and waste loading in environmental media</td>
<td>2.2 Application of biochemical</td>
<td>4.1 Enterprises</td>
</tr>
<tr>
<td>2.2 Application of biochemical</td>
<td>3. Natural events</td>
<td>4.2 households</td>
</tr>
</tbody>
</table>

Table 20.3 shows the core set of indicators that have been agreed upon by the fourth meeting of the intergovernmental working group on the advancement of environment statistics. Government found that the lists of statistical variables were too long for countries to embark on a national programme of environment statistics. UNSD, therefore, through an intergovernmental working group, developed a core set of indicators that was agreed on by the fourth meeting of the group in...
### Table 20.3 Core set of Indicators agreed by IGWG

<table>
<thead>
<tr>
<th>Agenda 21 Issues (clusters)</th>
<th>FDES information categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td><strong>Socio-economic activities, events (pressure/driving force)</strong></td>
</tr>
<tr>
<td></td>
<td>-Emissions of CO₂, SO₂, NOₓ</td>
</tr>
<tr>
<td>B</td>
<td><strong>Impact and effects (part of state)</strong></td>
</tr>
<tr>
<td></td>
<td>-Ambient concentrations of CO₂, SO₂, NOₓ, O₃, and TSP in Urban areas.</td>
</tr>
<tr>
<td>C</td>
<td><strong>Responses to impacts (response)</strong></td>
</tr>
<tr>
<td></td>
<td>-Area affected by soil erosion</td>
</tr>
<tr>
<td>D</td>
<td><strong>Inventories, stocks, background conditions (part of state)</strong></td>
</tr>
<tr>
<td></td>
<td>-Protected area as a percentage of total land area</td>
</tr>
<tr>
<td></td>
<td>-Arable land per capita</td>
</tr>
<tr>
<td>Air/Climate</td>
<td>-Weather and climate conditions</td>
</tr>
<tr>
<td>Land/soil</td>
<td>-Land use change</td>
</tr>
<tr>
<td></td>
<td>-Use of fertilisers</td>
</tr>
<tr>
<td></td>
<td>-Use of agricultural pesticides</td>
</tr>
<tr>
<td>Water</td>
<td>-Annual withdrawals of ground and surface water</td>
</tr>
<tr>
<td></td>
<td>-Domestic water consumption of water capita</td>
</tr>
<tr>
<td></td>
<td>-Concentrations of lead, cadmium, mercury and pesticides in fresh water bodies</td>
</tr>
<tr>
<td></td>
<td>-Concentration of faecal coliform in fresh water bodies</td>
</tr>
<tr>
<td></td>
<td>-Acidification of fresh water bodies</td>
</tr>
<tr>
<td></td>
<td>-BOD and COD in fresh water bodies</td>
</tr>
<tr>
<td>Other Natural resources</td>
<td>-Annual round wood production</td>
</tr>
<tr>
<td></td>
<td>-Fuelwood consumption per capita</td>
</tr>
<tr>
<td></td>
<td>-Catches of marine species</td>
</tr>
<tr>
<td></td>
<td>-Deforestation rate</td>
</tr>
<tr>
<td></td>
<td>-Threatened, extinct species</td>
</tr>
<tr>
<td></td>
<td>-Reforestation rate</td>
</tr>
<tr>
<td></td>
<td>-Protected forest area as % of total land area</td>
</tr>
<tr>
<td></td>
<td>-Forest inventory</td>
</tr>
<tr>
<td>Mineral (includes Energy) resources</td>
<td>-Annual energy consumption per capita</td>
</tr>
<tr>
<td></td>
<td>-Extraction of other mineral resources</td>
</tr>
<tr>
<td></td>
<td>-Depletion of mineral resources (% of proven reserves)</td>
</tr>
<tr>
<td></td>
<td>-Proven mineral reserves</td>
</tr>
<tr>
<td></td>
<td>-Proven energy reserves</td>
</tr>
<tr>
<td>Waste</td>
<td>-Municipal waste disposal</td>
</tr>
<tr>
<td></td>
<td>-Imports and exports of hazardous wastes</td>
</tr>
<tr>
<td>Human settlements</td>
<td>-Rate of growth of urban population</td>
</tr>
<tr>
<td></td>
<td>-% of population in urban areas</td>
</tr>
<tr>
<td></td>
<td>-Motor Vehicles in use per 1000 inhabitants</td>
</tr>
<tr>
<td></td>
<td>-Area and population in marginal settlements</td>
</tr>
<tr>
<td></td>
<td>-% of population with sanitary services</td>
</tr>
<tr>
<td>Natural disasters</td>
<td>-Frequency of natural disasters</td>
</tr>
</tbody>
</table>
|                           | -Number of injuries and fatalities related to natural disasters.
20.5 PRESSURE STATE RESPONSE FRAMEWORK (PSR) BY OECD.

The Pressure-State-Response is similar to the FDES. The PSR framework is based on a concept of causality which implies that human activities exert pressures the environment and change its quality and the quantity of natural resources. Society responds to these changes through environmental, general economic and sectoral policies. The responses form a feedback loop to pressure through human activities. In a wider sense, these steps form part of an environmental policy cycle which includes problem perception, policy formulation, monitoring and policy evaluation.

While the PSR framework has the advantage of highlighting these links, it tends to suggest linear relationships in the human activity-environment interaction. This should not obstruct the view of more complex relationships in ecosystems and in environment-economy interactions. Figure 20.1 below shows the conceptual framework for the PSR framework.

In the PSR framework an indicator is defined as follows:

"An indicator is a parameter, or a value derived from parameters, which points to/provides information about/describes the state of phenomena/environment/area with significance extending beyond the directly associated with a parameter value".

OECD

Hence in other words indicators are a selection of the statistical variables which are used to interpret various situations or aggregated for further analysis. The other important criteria for indicator selection are as highlighted in Box 20.1
Box 20.1 Criteria for indicator selection

**Policy relevance and utility for users**

An environmental indicator should
- Provide a representative picture of environmental conditions, pressures on the environment or society’s responses;
- Be simple, easy to interpret and able to show trends over time;
- Be responsive to changes in the environment and related human activities;
- Provide a basis for international comparisons;
- Be either national in scope or applicable to regional environmental issues of national significance;
- Have a threshold of reference value against which to compare it, so that users are able to assess the significance of the values associated with it.

**Analytical soundness**

An environmental indicator should
- Be theoretically well founded in technical and scientific terms;
- Be based on international standards and international consensus about its validity;
- Lend itself to being linked to economic models, forecasting and information systems.

**Measurability**

The data required to support the indicator should be
- Readily available or made available at a reasonable cost/benefit ratio;
- Adequately documented and of known quality; and;
- Updated at regular intervals in accordance with reliable procedures.

20.6 **DRIVING FORCE-STATE-RESPONSE FRAMEWORK**

The commission on sustainable development (CSD) is a UN institution that was set up to monitor the implementation of Agenda 21. The CSD has utilised a similar framework to the PSR they have selected a list of approximately 130 indicators and organised it as a Driving force - State - Response Framework. The driving force is utilised in this case instead of pressure, because pressure tends to have a negative connotation. The indicators are meant to be used at the national level by countries in their decision making process and it is emphasised that not all indicators are applicable for every situation. The list of indicators are as shown in the table 20.4 below.
### Table 20.4 Working list of indicators of Sustainable development.

<table>
<thead>
<tr>
<th>Categories of Agenda 21</th>
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<tr>
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<td>- Head count index of poverty</td>
<td>- GDP spent on education</td>
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<td>- Squared poverty gap index</td>
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<td>- Gini index of income inequality</td>
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<td>Chapter 5: Demographic dynamics of sustainability</td>
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<td>- Net migration rate</td>
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<td>Chapter 36: Promoting education, public awareness and training</td>
<td>- Rate of change of school-age population</td>
<td>- Children reaching grade 5 of primary education</td>
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<td>- Primary school enrolment ratio (gross and net)</td>
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<td>- Secondary school enrolment ratio (gross and net)</td>
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<td>Chapter 6: Protecting and promoting human health</td>
<td>- Basic sanitation: percent of population with adequate excreta disposal facilities.</td>
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<td>- Access to safe drinking water</td>
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<tr>
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<tr>
<td></td>
<td>human and economic loss due to natural disasters</td>
<td></td>
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<td>- Percent of population in urban areas</td>
<td></td>
<td></td>
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<td></td>
<td>- Area and population of urban formal and informal settlements</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Floor area per person house price to income ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic: Category</td>
<td>- GDP per capita net Investment share in GDP sum of exports and imports as a percent of GDP</td>
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<td>International cooperation to accelerate sustainable development in countries and related domestic policies</td>
<td>- Annual energy consumption</td>
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<td></td>
</tr>
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<tr>
<td></td>
<td></td>
<td>- Intensity of material use</td>
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<td>- Share of manufacturing value-added in GDP</td>
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<td>Changing consumption patterns</td>
<td>- Net resources transfer / GNP</td>
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<td></td>
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<td>-Share of environmentally sound capital goods imports</td>
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<td>Chapter 18: Protection of the quality and supply of freshwater resources</td>
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<td>-Waste-water treatment coverage -Density of hydrological networks</td>
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<td>Chapter 10 Integrated approach to the planning and management of land resources</td>
<td>-Land use change</td>
<td>-Changes in land condition</td>
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<td>Chapter 12 Managing fragile ecosystems: combating desertification and drought</td>
<td>-Population living below poverty line in dryland areas</td>
<td>-National monthly rainfall index -Satellite derived vegetation index -Land affected by desertification</td>
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<td>Chapter 13: Managing fragile ecosystems: Sustainable mountain development</td>
<td>-Population change in Mountain areas</td>
<td>-Sustainable use of natural resources in mountain areas -Welfare of mountain populations</td>
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</tr>
<tr>
<td>Chapter 14: Promoting sustainable agriculture and rural development</td>
<td>-Use of agricultural pesticides -Use of fertilisers Irrigation percent of arable land -Energy use in agriculture</td>
<td>-Arable land per capita -Area affected by salinisation and water logging</td>
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</tr>
<tr>
<td>Chapter 11: Combating deforestation’s</td>
<td>-Wood harvesting intensity</td>
<td>-Forest area change</td>
<td>-Managed forest area ratio -Protected forest area as a percent of total forest area</td>
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<tr>
<td>Chapter 15: Conservation of biological diversity</td>
<td></td>
<td>-Threatened species as percent of total native species.</td>
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<td>Chapter 16: Environmentally sound management of biotechnology</td>
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<td>-R&amp;D expenditure for biotechnology -Existence of national biosafety regulations or guidelines</td>
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<td>Chapter 9 Protection of the atmosphere</td>
<td>-Emissions of greenhouse gases -Emissions of sulphur oxides -Emissions on nitrogen oxides -Consumption of ozone depleting substances</td>
<td>-Ambient concentrate of pollutants in urban areas</td>
<td>-Expenditure on air pollution abatement</td>
</tr>
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<td>Chapter 21: Environmentally sound management of solid wastes and sewage-related issues</td>
<td>-Generation of industrial and municipal solid waste -Household waste disposed per capita</td>
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<td>-Expenditure on waste management -Waste recycling an reuse Municipal waste disposal</td>
</tr>
<tr>
<td>Chapter 19 Environmentally sound management of toxic chemicals</td>
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<td>-Chemically induced acute poisonings</td>
<td>-Number of chemicals banned or severely restricted</td>
</tr>
<tr>
<td>Chapter 20: Environmentally sound management of hazardous wastes</td>
<td>-Generation of hazardous wastes -Imports and exports of</td>
<td></td>
<td>-Expenditure on hazardous waste treatment</td>
</tr>
</tbody>
</table>
20.7 DIFFERENCES BETWEEN FDES, PSR AND DSR

FDES relates components of the environment information categories. The components of the environment consists of the natural environment, that is, flora, fauna, atmosphere, water and land/soil, and the man-made environment (human settlements). The information categories are based on the recognition the environmental problems are the result of human activities and natural events. The information categories are divided into four i) social and economic activities, and natural events; ii) environmental impacts of activities and events; iii) responses to environmental impacts; and iv) inventories, stocks and background conditions.

The PSR/DSR frameworks have three categories, pressure/driving force, state and response and cross-related to issues in the PSR and to chapter of Agenda 21 in the DSR. The main difference between the FDES and the PSR/DSR frameworks lies with the state categories. In the FDES this category is divided into two categories, the impacts and the invento-
ries/stocks/background conditions while in the PSR/DSR these two categories are combined to make one, state, category. The reasons for the FDES are twofold.

Firstly, it allows for the separation between the stocks and the flows or changes in stocks. The stocks would be contains the inventories category and the changes in stocks, both in qualitative and quantitative terms, in the impacts category. The term, state, impacts category of the FDES refers to changes in “states” of the environment (environmental quality) and their effects on human well-being, i.e. flow categories referring to a period of time.

Secondly, the inventories category provides a direct link between the stock data presented in this category and the flow categories of quantitative and qualitative change in stock by means of natural resource accounting. The resource accounting approach focuses on the stocks and quantitative changes. Stocks or reserves of natural resources are listed in FDES under the information category of inventories, stocks and background conditions. The extraction, harvesting and use of natural resources are shown as part of the category of social and economic activities, and changes in the availability and quality of natural assets are listed under the impacts category.

20.8 DISCUSSION OF SELECTED INDICATORS

A few of the indicators were discussed in depth for their policy relevance and applicability and data availability. The indicators that were selected arose from issues that were identified by the participants. These were natural disasters, every growing urban populations, land use changes and land degradation, biodiversity, soil erosion, water pollution/quality, air pollution, overgrazing, male agricultural practices, floods, droughts, population pressure. Two sources of materials were then reviewed these were the questionnaires developed by OECD and the methodology sheets co-ordinated by the UN Department for Policy Co-ordination and Sustainable Development. Below is a summary of the indicators, definitions, policy relevance and some of the remarks made by participants.
### Table 20.5 Remarks made on Selected Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Relevance to sustainable development</th>
<th>Remarks by participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Municipal waste disposal (tonnes per unit of Gross Domestic Product per annum)</td>
<td>This indicator relates to the volume of waste collected and disposed by official means, either landfilling, incineration or other processing. Adequate waste management indicates that the authorities are aware of the preventative nature and reduction of health and environmental risks.</td>
<td>High waste levels result from consumption and production. Adequate waste management indicates that the authorities are aware of the preventative nature and reduction of health and environmental risks.</td>
<td>This indicator is difficult to collect. Kenya has attempted to collect this variable but the results have not always been good. The methodology sheets do not explain why the denominator is GDP and what relationship GDP has to waste disposal.</td>
</tr>
<tr>
<td>2 Generation of industrial waste and municipal solid waste (Tonnes per capita)</td>
<td>The generation of industrial and municipal solid waste is derived from the production of waste on a weight basis at the point of production. Generation of waste is linked to economic activity. It is an indication of the patterns of consumption of raw materials. Wealthier economies tend to produce more waste. In many developed countries a reduction in the volume of waste generated is an indication of changes in consumption patterns with respect to raw material and increase in recycling and reuse.</td>
<td>This indicator unlike the first uses the population as the denominator. The OECD publication indicates the reverse. Municipal waste is measured in per capita and Industrial waste is measured per unit of GDP.</td>
<td></td>
</tr>
<tr>
<td>3 Land use change (Proportion of change of each category of land use)</td>
<td>Change with time of the distribution of land uses within a country. Information on land use change is critical for integrated and sustainable land use planning. Such information is useful in identifying opportunities to protect land uses or promote future allocation aimed at providing the greatest sustainable benefits for people. Changes in land use may result in changes in production from the perspective of economics whereas unsustainable land use leads to desertification.</td>
<td>Land use change is an important indicator which requires good record keeping. It was observed that there is no uniform classification of categories of land.</td>
<td></td>
</tr>
<tr>
<td>4 Use of fertilisers (Metric tons of fertiliser nutrients per 10km²)</td>
<td>Extent of fertiliser use in agriculture per unit of agricultural land area. The challenge for agriculture is to increase food production in a sustainable way. This indicator shows the potential environmental pressure from agricultural activities. Extensive fertiliser use is linked to eutrophication of water bodies, soil acidification, and potential of contamination of water supply with nitrates. The actual environmental effects depend on pollution abatement practices, soil and plant type and meteorological conditions.</td>
<td>The challenge for agriculture is to increase food production in a sustainable way. This indicator shows the potential environmental pressure from agricultural activities. Extensive fertiliser use is linked to eutrophication of water bodies, soil acidification, and potential of contamination of water supply with nitrates. The actual environmental effects depend on pollution abatement practices, soil and plant type and meteorological conditions.</td>
<td>Noted that data is available from the supply side and indirect techniques are used to estimate actual fertiliser use in the developing countries.</td>
</tr>
<tr>
<td>5 Forest Area change (ha)</td>
<td>The amount of natural and plantation forest area. Forests serve multiple ecological, socio-economic, and cultural functions. The deforestation rate suggested by the lead.</td>
<td>Forests serve multiple ecological, socio-economic, and cultural functions. The deforestation rate suggested by the lead.</td>
<td></td>
</tr>
<tr>
<td>Indicator</td>
<td>Definition</td>
<td>Relevance to sustainable development</td>
<td>Remarks by participants</td>
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<td>-------------------------</td>
</tr>
<tr>
<td>6 Threatened species as a percent of total native species (%)</td>
<td>Number of species at risk of extinction in proportion to the total number of native species</td>
<td>Maintenance of biodiversity is essential for an economic system well being. Species diversity is one of the three main levels of biodiversity, the others being ecosystem and genetic diversity.</td>
<td>National data are available for many countries although they are not reported by class.</td>
</tr>
<tr>
<td>7 Emissions of greenhouse gases (annual emission levels in gigagrams of CO₂ equivalents by using global warming potentials; annual percentage change in total greenhouse gases emissions beginning with 1990 as a base year would provide trends and rate of change in emission levels for each party to the climate change convention.)</td>
<td>National anthropogenic emissions of carbon dioxide, Methane and nitrous oxide.</td>
<td>Emissions of Greenhouse gases beyond normal considerations results in climate change. Such emissions are largely influenced by a country’s energy use and production systems, its industrial structure, its transportation system, its agricultural and forestry sectors, and the consumption patterns of the population. Methane and nitrous oxide emissions are particularly influenced by a country’s agricultural production, waste management, and livestock management.</td>
<td>Impacts of greenhouse gases are not felt in the short run. So there is a tendency for developing countries not to emphasise collection of data in this area. Secondly the developing countries are less industrialised hence do not contribute as much to greenhouse gases emissions.</td>
</tr>
</tbody>
</table>

### 20.9 DEVELOPMENT OF ENVIRONMENTAL STATISTICS/INDICATORS PROGRAMME.

The co-ordination aspects of programme development were emphasised. Groups of twos brainstormed on the establishment of a national co-ordination mechanism by answering the following questions.

- **Co-ordination:** What kind of co-ordinating mechanism is appropriate in your country? Can existing institutional arrangements be used or modified? Which agency is best suited to lead and be the focal point?
- **Agencies:** Which national and international agencies will be involved in the development of indicators and what roles will they play? What will be the link to agencies responsible for policy formulation?
- **Initial tasks:** What are the initial tasks that will require attention, to get the programme started?
- **Capacity building:** What are the specific capacity building requirements necessary to support the development of an environmental indicator programme?

With regard to co-ordination aspects it was observed that there are policy and legislative instruments which enable the smooth co-ordination of aspects. In most countries there is a centralised mechanism for co-ordinating environment statistics and indicators. In some countries the national statistics offices are the co-ordinating institutions for environmental indicators while in others is it the institution responsible for environmental matters.
The key actors in the co-ordination of environmental statistics were identified to be multilateral agencies such as the UN and its specialised agencies and the World Bank and European Union, training institutions such as CDG, bilateral agencies such as SIDA, GTZ and international NGOs.

The tasks for the agencies with regard to the mechanism were identified to be sensitisation, awareness raising, education, formulation of working committees, workshops, development plans and development projects.

The specific capacity building requirements were identified to be personnel, training, equipment, inclusion in syllabus of schools and other learning institutions and informal methods of education and information dissemination.

The development of a project was reviewed by analysing an example of Cote D’ivoire where UNSD provided technical advisory services to assist in the development of their Environment Statistics Programme.

20.10 CONCLUSION

The structures for some environment statistics compendia were reviewed to illustrate the different approaches to data presentation as well as the fact that even a few environmental indicators are sufficient to start with. These included Indonesia, Canada, Zimbabwe, Sweden and Zanzibar. In addition a case study on the co-ordination aspects of developing environmental indicators in Latin America and Caribbean Region presented by Mary Jane Holupka. In this regard therefore the participants were encouraged to start compiling environment statistics from available data sources. Emphasis was given therefore on the need to strengthen the co-ordination aspects.

20.11 REFERENCES

OECD, Environmental Indicators, 1994

UNSD, A Framework for the Development of Environment Statistics (UNSD), 1984


UNSD, Glossary of Environmental Statistics, 1997
21. INFORMATION SYSTEM ON SUPPLY AND USE OF MATERIALS

By Harlmut STAHN
and Sui-San LIM
Oko Institute of Ecology
(June 11 - 13, 1997)

21.1 INTRODUCTION

The targets for introducing the course topic on information system on supply and use of material was to sensitise the participants on how the information system on materials can be utilised to monitor and assess stocks, supply and use of energy and materials. To achieve this target an introduction to the material balances and flow concept was given. This was in addition to the characteristic and operations of the TEMIS model.

21.2 MATERIAL FLOW

Material flows occur at global and local levels. Economic operations are dependent on the various strengths of the different continents. For example iron is mined in different regions and processed in other parts of the world and the finished goods are later marketed to another country. Some of the quotations which enhance the global nature of materials balances are as highlighted below:

"The news agency informs: Steel for the production of motor vehicles in China falls into short supply."

"More Platinum from South Africa for the Industry"

"Asia has doubled its production capacity for the European market"

"The world oil trade gets into trouble."

The field of material flows means a comprehensive view of the world and the material flows. It calls for a principal change in the perspectives and the ways of behaviour. For example environmental quality objectives such as the globe shall attain 0.1°C global warming within 10 years, requires the political process to come up with a more definite environmental objective e.g. 25% reduction of CO₂. In order to lower the emissions to such an objective there is need manage the material flows this requires a tool for analysis and an enabling environment. Material flow management entails focusing on tough environmental objectives and interactivities between different product lines, media and actors. The tools for the realisation of the management of material flows are:

- Eco audits;
- Environmental laws;
- Financial tools (e.g. CO₂ Taxes); and;
- Climate protection concept.

21.3 QUESTIONS IN THE AREA OF MATERIAL FLOWS

One of the key questions in analysis of material flows of metals and their resulting emissions. The other is how to treat imports such as aluminium, magnesium, renewable resources and renewable energies.
21.4 ANALYSIS OF MATERIAL FLOWS

The basic requirement for attaining sound management of material flows is a comprehensive material flow analysis. The process chain computer based model TEMIS is one such tool that can enable the rigorous analysis of material flows. The TEMIS focuses on processes, it is demand side based, flexible, can be expanded and is transparent. The TEMIS model provides coefficients, emission factors, consistent data and integrated processes utilised up to the final product. The TEMIS enables the conversion of activities such as electricity, transport, process heat into environment impacts such as emissions, pollution of the media and land use changes. Country specific analysis can be carried out. For example the graph below shows the environmental impacts caused by the production of aluminium in specific countries, with German as the standard.

Figure 21.1 Environmental impacts caused by the production of aluminium in specific countries (Standardised for Germany)

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>100</td>
</tr>
<tr>
<td>CIS</td>
<td>250</td>
</tr>
<tr>
<td>Norway</td>
<td>150</td>
</tr>
</tbody>
</table>

NB. Materials include hidden materials

The average family in Germany for example uses a lot of materials to meet their needs. These are raw materials such as ores and biotic resources which are later combined with energy (gas, electricity or fuels) to come up with basic products. In addition to products the average family utilises services which use up the various materials and these include urban traffic, post and construction sector. For the average household therefore the environmental impacts of material flows can be defined in terms of CO$_2$ and SO$_2$ equivalents. These emissions can be categorised as follows: heating, hot water, transport (road and air) and materials.

21.4.1 Characteristics of the TEMIS model

The TEMIS model is a database system which contains data on quantitative and qualitative impacts. It is an analysis system which determines full life cycle impacts of energy, transport, and material technologies. TEMIS is also an evaluation tool which measures deviation from multiple objectives (trade-offs). This information can be used for calculating trade-offs.

The data base structure of TEMIS stores information of energy, materials, transport and this includes, technology, emission, cost data, location and references. The data base store information on unit processes reflecting activities for which efficiency, emission can be measured, calculated, or derived. No formal distinction is made between energy and material flows. They are all interlinked.
21.4.2 Results from the TEMIS

The results of TEMIS are of three types and these are quantitative data such as costs impact and flow data, qualitative data such as biodiversity status and environmental impacts in terms of emission and pollution and environmental impacts in terms of emissions, pollution and land use changes.

**Figure 21.2 Results From TEMIS**

TEMIS calculates life cycle costs of delivered products based on data for investment, operation and maintenance, and fuels. Capacity, load factor and life time of process are taken into account. For all processes a uniform (real) interest rate and a uniform time horizon are assumed to calculate annualised capital costs.

With regard to external costs the TEMIS monetarises the “core” emissions (air pollutants, greenhouse gases) based on abatement costs.

TEMIS can include also external cost factors for user-defined emissions and residuals, and can adjust the external cost data for “basic” emissions to user-specified data (e.g. those derived from damage costs).
21.4.3 Where does data come from?
Data collection from energy industry (oil, gas, coal), power equipment manufactures, and from industrial engineering. Emission data depends on the fuel definition and on whether it is controlled or not controlled. Green house gas emission inventories are also utilised by TEMIS. Other sources include environmental impact assessment studies, life cycle studies, operation experiences (measured data) specification of manufactures and regulation standards.

21.4.4 Where is TEMIS used
TEMIS is used in the European union in the countries Austria, Denmark, Finland, Germany, Italy, Luxembourg, Netherlands, Sweden, UK: Governmental agencies federal, states and municipal), research institutions (governmental and private), consulting firms, electric/gas utilities, NGO. Countries in Eastern Europe who utilise TEMIS include Czech Republic, Slovakia, Poland via “Environmental Manual” : Bulgaria, Croatia, Russia, Ukraine. Other countries include the United States. The use of TEMIS is free - the model and data installation files are available without charge via the internet for ÖKO Institute’s Website Http://www.oeko.de.

21.5 CONCLUSION
The participants were given exercise to gain an experience of how the model can be utilised to build scenarios and analyse the impacts of material flows. In addition the application of the model was discussed and the general observation made was that the TEMIS model is a useful tool for analysis of material flows however the data demands and available resources in the developing countries does not allow for such a system to be well established.
22. TRAIN THE TRAINER
by Michael Sindato
Eastern Africa Statistical Training Centre - Tanzania
and Mati Nemani
Bureau of Statistics - Fiji
(June 12 - 13, 1997)

22.1 INTRODUCTION
Train the trainer was a course topic that was introduced with the aim of enabling participants
to manage in-service training and to use didactical tools. In specific terms it was expected that
the participants would be able to

- Design training programmes of any topic learnt, with;
- Appropriate aims, objectives, and observable outcomes;
- Deliver or administer the training programme;
- Understand the need of the adult learner;
- Recognise different styles of learning; and
- Discuss evaluation of a course.

To achieve these objects the topic was arranged under the following sub-topics:

- What is training
- The training cycle
- Core skills for a trainer
- Learning styles
- Procedure for designing a training programme
- Evaluation

22.2 WHAT IS TRAINING
Training is about developing people as individuals and helping them to become more confident and competent in their lives and in their jobs. Training is carried out in order to build the
capacity of an individual, organisation or institution. Training is a vital investment in human
capital for the benefit of the individual and for the organisation. It promotes individual
workers and the organisation in the competitive world.

In many developed and developing countries training is on high demand in order to keep with
growing economy and technology. In the last decade for example, there have been several re-
ports on the provision of training in Great Britain as stipulated by Coopers and Leybrand “A
challenge to Complacency” highlighting two main areas of concern.

- The evidence of disturbingly low level of Investment in both Public and Private sector or-
  ganisations;
- The widespread complacent, ill-informed and sceptical attitudes to training at all organisational levels, including that of practitioners, which needs to be challenged.
22.3 THE TRAINING CYCLE
The training cycle can be viewed as on-going activity where individuals are committed to life-long learning. There are five distinct stages in the cycle.

- Analysing training needs;
- Planning and designing the training approach;
- Developing the training materials;
- Delivering the training; and;
- Evaluating the training.

The evaluation stage not only cycles back to the first stage (a) but also cycles back to the others. Evaluation must be an ongoing process if the quality of the training courses is meant to improve. Figure 22.1 below shows the training cycle.

![Figure 22.1 The Training Cycle](#)

22.4 CORE SKILLS FOR THE TRAINER
The core skills of a trainer are as listed below:

- Designing and developing a course;
- Recruiting for a course;
- Planning and organising a course;
- Writing and preparing course material; and;
- Practitioners skills;
- Inter-personal skills;
- Evaluating courses;
- Report writing skills; and;
- Management skills.

22.5 LEARNING STYLES
Any trainer would like to know his trainees very well before even starting the actual training. Among important things a trainer would like to know, besides their name, educational back-
grounds, health etc., is their learning style or characteristics when they want to learn something. Different people have different learning styles and at times trainer do not know how to help the different learners. The learners may be classified in the following groups:

**Activists** involve themselves full without bias in new experiences. They enjoy the here and now and are happy to be dominated by immediate experiences. They are open-minded, not sceptical and this tends to make them enthusiastic about anything new. Their philosophy is: “I’ll try anything once”. They tend to act first and consider the consequences afterwards. Their days are filled with activity. They tackle problems by brainstorming. As soon as the excitement from one activity has died down, they are busy looking for the next. They tend to thrive on the challenge of new experiences but are bored with implementation and longer term consolidation. They are gregarious people constantly involving themselves with others but, in doing so, they seek to centre all activities around themselves.

**Reflectors** like to stand back to ponder experiences and observe them from many different perspectives. They collect data, both first hand from others, and prefer to think about it thoroughly before coming to any conclusion. The thorough collection and analysis of data about experiences and events is what counts so they tend to postpone reaching definitive conclusion for as long as possible. Their philosophy is to be cautious. They are thoughtful people who like to consider all possible angles and implications before making a move. They prefer to take a back seat in meeting and discussions. They enjoy observing other people in action. They listen to other and get the drift of the discussion before making their own points. They tend to adopt low profile and have slightly distant, tolerant, unruffled air about them. When they act, it is part of a wide picture which includes the past as well as the present on other’s observations well as their own.

**Theorists** adapt and integrate observation into complex but logically sound theories. They think problems through in a vertical step by step logical way. They assimilate disparate facts into coherent theories. They tend to be perfectionists who won’t rest easy until thing are tidy and fit into a rational scheme. They like to analyse and synthesis. They are keen on basic assumptions, principles, theories, models and systems thinking. Their philosophy prizes rationality and logic, “if it’s logical it’s good’. Questions they frequently ask are : “Does it make sense?” How does this fit with that?” “What are the basic assumptions?” They tend to be detached, analytical and dedicated to rational objectivity rather than anything subjective or ambiguous. Their approach to problems is consistently logical. This is their “mental set” and they rigidly reject anything that doesn’t fit with it. They prefer to maximise certainty and feel uncomfortable with subjective judgement, lateral thinking and anything flippant.

**Pragmatists** are keen on trying out ideas, theories and techniques to see if they work in practice. They positively search out new ides and take the first opportunity to experiment with application. They are the sort of people who return from management courses bringing with new ideas that they want to try out in practice. They like to get on with things and act quickly and confidently on ideas that attract them . They tend to be impatient with ruminating and open ended discussions. They are essentially practical, down to earth people who like making practical decisions and solving problem. They respond to problems and opportunities ‘as a challenge”. Their philosophy is “there is always a better way’ and “if it works it’s good”.

It was observed that these skills can be identified through a structure questionnaire or the trainer can make the observations. It was also noted that a person can have more than one of the qualities in otherwords they are not mutually exclusive.
22.6 DESIGNING A TRAINING PROGRAMME

The following key questions can be considered in designing training programmes:

- Why should the programme exist?
- Who is it aimed at?
- What do you want people to get out of it?
- What is the content and sequence?
- When and where will you hold it?
- What methods will you use?
- What material/resources will you need?
- How will the trainees be assessed?
- How are you going to evaluate the programme?

An exercise was given to design a training programme for developing the areas management of communication and energy statistics. It was observed that most of the groups considered only one of the training methodologies that is workshops and seminars. All the groups emphasised the important elements of train the trainer and programme design.

22.7 EVALUATION

What do we mean? At the end of any activity one needs to revisit what has been going on. We answer the questions how are we doing? Are we accomplishing what we set out to do? These questions are answered in order to get the picture of what is happening in our training, say. We need to know if we are on target or not. We want to correct immediate mistakes before we are too much away from what we planned to do. Again evaluation helps us to make future adjustments.

Is evaluation part of planning and review? The objectives set in the course are our reference point. They help us know if certain training method leads us in accomplishing the task. Evaluation tries to interrelate the process of planning and implementation so as to get future inputs on decision making.
### Annex I List of Lecturers

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## Annex III Programme on Statistics for Environmental Policy

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<tr>
<th>Date</th>
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<td><strong>Quantitative Aspects of Sustainable De-</strong></td>
<td>Bartelmus UNSD, New York</td>
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<td><strong>Use of microcomputing for environmental</strong></td>
<td>Kronester CIB, Munich</td>
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<td><strong>Geographical Information System</strong></td>
<td>Schulze-Wolf IFB, Hannover</td>
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<td><strong>Information System on Land Use</strong></td>
<td>Narain FAO, Rome</td>
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<td>Data sources, classifications and compilation</td>
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<td>29</td>
<td><strong>Management of Communication</strong></td>
<td>King ONS, London</td>
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<td>31</td>
<td><strong>Information System on Supply and Use of</strong></td>
<td>Mayer STABA, Wiesbaden</td>
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<tr>
<td>April</td>
<td><strong>Energy</strong></td>
<td>Lim ÖKO Institut, Darmstadt</td>
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<td><strong>Activities of Industries</strong></td>
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<td><strong>Statistics on Water and Air</strong></td>
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<td><strong>Study tour</strong></td>
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<td><strong>Effects of agricultural activities on the</strong></td>
<td>Parris OECD, Paris</td>
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<td>Wright OFI, Oxford</td>
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<tr>
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<td>12</td>
<td><strong>Human Settlement and Environment</strong> Consumption of natural resources by households; access to drinking water and sanitation</td>
<td>Markandey, UNCHS, Nairobi</td>
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<td><em>Whitmonday</em>*</td>
<td>Allen, London</td>
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<td><strong>Environment and Economic Accounting</strong> Principles of SNA; evaluation; matrix presentation (IOT, SAM) cont.</td>
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<td><strong>Natural Resource Accounting</strong> Assessment of natural resources in satellite accounts with focus on forest accounts, subsoil assets and water accounts based on case studies</td>
<td>Vaze ONS, London</td>
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<td>June 2</td>
<td><strong>Environment Indicators</strong> Indicators according to agenda 21 and the Framework for the development of environment statistics; driving force-, state- and response indicators</td>
<td>Shah UNSD, New York</td>
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<td><strong>Report writing</strong> Production of a course related report by the participants</td>
<td>Munich Centre</td>
</tr>
<tr>
<td>10</td>
<td><strong>Information System on Supply and Use of Material</strong> Material balances; process analysis</td>
<td>Jenseit and Lim ÖKO Institut, Darmstadt Sindato and Mati</td>
</tr>
<tr>
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<td>GAOBOTSE Ditshupo Ms</td>
<td>National Resource Accounting in Botswana</td>
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<td>HOLUPKA Mary Jane Ms</td>
<td>Environmental Indicators and Statistics in Latin America</td>
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<td>Deforestation the Leading Environmental Problem in Tanzania</td>
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<td>Hongjuan Ms</td>
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## Annex VI Programme of Study Tour to Luxembourg and Berlin

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<th>Day</th>
<th>Activities</th>
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| **Sunday, April 27th** | Departure from the Munich Centre  
Guided visit of Trier  
Arrival in Luxembourg |
| **Monday, April 28th**  | **Eurostat**  
Welcome, Bernard Langevin  
Introduction to Eurostat, David Bond  
Introduction to Unit C3: Cooperation between Eurostat and ACP Countries, Roger Edmunds  
Sustainable Development Indicators, Eva Guinomet  
Effects of Transport on the Ecosystem, Graham Lock |
| **Tuesday, April 29th** | **Eurostat**  
Geographical Information Systems:  
Purpose and organisational aspects, Daniel Rase  
Geographical Information Systems:  
Technical Aspects, Kostas Giannakouris |
| **Wednesday, April 30th** | **Eurostat**  
Organisation of Environment Statistics  
Water statistics and the environment, Theo van Chruchten |
| **Thursday, May 1st**  | Departure from Luxembourg  
Arrival in Berlin |
| **Friday, May 2nd**  | **Federal Statistical Office (STABA)**  
Organisation and Structure of the German Statistics, Mr. Kaiser  
Overview on environment statistics in Germany, Mr. Steinfelder  
Guided City Tour |
| **Saturday, May 3rd** | **Friedrichstadt-Palast**  
„CINEMA“ Revue |
1. INTRODUCTION
The Munich Centre for Economic, Environmental and Social Statistics

1.1 INFORMATION ABOUT THE INSTITUTION

1.1.1 Munich Centre
The Munich Centre for Economic, Environmental and Social Statistics comes under the aegis of the Carl Duisberg Gesellschaft e.V. (CDG). The Centre was founded in 1972 jointly by the Federal Republic of Germany, the Commission of the European Communities and the CESD. The Munich Centre’s programme policy is agreed annually with representatives of these institutions. Over 1000 statisticians, mainly from African, Caribbean and Pacific countries, have taken the opportunity for advanced training Munich since the centre first opened its doors.

1.1.2 CDG - An Overview
The Carl Duisberg Gesellschaft e.V. is a non-profit organisation dedicated to international training, exchange and development. Together with partner organisations at home and abroad it forms an international association which runs practically-based training, exchange and foreign-language programmes for specialists and managers from all over the world. Since its foundation in 1949 more than 200,000 people have taken part in the CDG’s programmes. As part of its co-operation activities, the CDG plans and runs practical continuing education programmes and courses for the exchange of international experience for specialists and managers from developing countries. This work is mainly carried out at the request of the German Federal Ministry for Economic Co-operation and Development and the governments of the German Länder.

1.1.3 Mission of the Centre
Sustainable policies must be underpinned by a reliable information base which is adapted to requirements of the countries concerned. Sound decisions can only be made if data are firmly grounded in their context.

In our advanced training courses, therefore, the emphasis is not just on the pure techniques of data production but rather also on the political, social and economic concepts that underlie sustainable development, structural adjustment or efforts to combat poverty and that require quantitative information.

Statistics should contribute to the transparency and evaluation of social and political actions.

The aim of carrying out training activities is to generate information such that it serves as a basis for decision-making for sustainable policies and promote dialogue between representatives of government, public interests, the business community and international development organisations.

1.1.4 Training Courses
The focal areas of the training courses are

- monitoring economic activities;
- shaping social development; and:
• developing ecological information systems.
By providing better access to data for large sections of the population, statistics can assist in the democratisation of society.

The interests of the user are of prime concern in every course.

All courses are run in the lingua franca used in the country of origin of the course participants, these are generally in English or French.

1.1.5 Continuing Education in Germany
Methods and concepts associated with in specialist areas are taught in 3-4 month. Subjects such as the information base, the analysis of macroeconomics interrelations, social policy and environmental policy are covered for participants who already have professional experience in these fields.

1.1.6 Local Training
In order to address the specific needs of individual countries and regions we offer customised local seminars. They last 1-6 weeks and deal with topical issues such as “Household surveys with particular reference to poor social strata” in Abidjan or “Revision of national accounts” in Harare.

1.1.7 Seminars for Directors
Directors of statistical offices and senior civil servants from ministries have the opportunity to attend special seminars in which to exchange information and experience on the latest trends in statistics and current information requirements for decision-makers.

1.1.8 International Co-operation
The Munich Centre is in close contact with institutions and statistical offices at a national and European level and is a member of the “Centre Européen de Formation de Statisticiens Economistes des Pays en Voie de Développement” (CESD - European Centre for Training Economic Statisticians from Developing Countries). The dialogue with international organisations, universities and development co-operation institutions also guarantees that a high level of training courses is offered.

1.1.9 Lecturers
Our lecturers are highly competent in theoretical and particularly in practical aspects, including those relating to developing countries. This ensures that the topics covered in the training courses are current, and that the methods are taught in accordance with the relevant latest standards.

1.1.10 Prerequisites for Attendance
The prerequisite for attendance at one of the Munich Centre’s seminars is a university degree or equivalent qualification in statistics or an equivalent subject which is closely related to the course topic, together with several years of professional experience.

Invitations are forwarded via our partners (European Commission, German Federal Government, statistical offices) to institutions which nominate the applicants. Requests by individuals cannot therefore be considered.
1.2 THE 49TH COURSE ON “STATISTICS FOR ENVIRONMENTAL POLICY”

1.2.1 Background to the Course
The Munich Centre for the first time organised the course on “Statistics for Environmental Policy”. It was deemed necessary to organise this course because of the need to provide information on sustainable development to policy and decision makers.

In recent years, sustainable development aiming at combining ecological, social and economic aspects is evolving as a recognised strategy in international forums. Policy-makers have become increasingly aware of the fact that disaster prevention to reduce the danger of droughts or floods has to be supplemented by a strategy to fight against systematic environmental degradation. This is in the form of deforestation, desertification, soil degradation, the deterioration of water and air quality etc. The dangers posed not only threaten present but also future generations. The international community took up this issue at the World Summit in Rio de Janeiro in 1992 emphasising the need for maintaining the natural environment in the interest of the countries concerned, but equally as well in the interest of all countries to prevent global dangers, such as the change of climate.

An environmental strategy cannot be drawn up without reliable knowledge of facts focused not only on the results of natural disasters but as well of gradual ecological deterioration which will have serious long term effects on the well being of the population and the economic growth potential. This implies information on the status of the environment (soil and vegetation, water, air, subsoil assets) and its changes. A more policy oriented approach has to address itself to collection of information on pollution by industries and the consequences of human settlement to provide concrete results to decision makers.

The course treated the concept of sustainable development and the corresponding goals and the statistical tools such as information frameworks and geographic information systems. Focus was put on the questions why data on changes to the environment and the role of human activities are relevant; how to collect information, (preference on the use of records existing in the statistics office or in other departments) and how to analyse it and to present it in the form of short indicators. Furthermore material and energy balance sheets were discussed as well as the new approaches of integrated environmental and economic accounting.

1.2.2 COURSE CONTENT
The course content is summarised below:

1. **Programme Discussion:** Presentation of the course programme. Expectations and proposals of the participants related to the programme (10 hrs).
2. **Quantitative Aspects of Sustainable Development:** Policy aspects of environment, environmental degradation and resulting national needs of environmental management. The way towards quantifying sustainable development (10 hrs).
3. **Use of Microcomputing for Environmental Statistics:** Elaboration and layout of text, familiarisation with a spread-sheet, treatment of tables and graphics (25 hrs).
4. **Main Approaches to Monitor Environment:** Media approach, stress-response approach, observation of ecological areas and concept of metabolism, environmental accounting (10 hrs).
5. **Data Dissemination:** User-oriented and user-friendly publications and the principles of dissemination through different print media (10 hrs).
6. **Geographical Information System (GIS):** Concepts and characteristics of GIS, its use in analysis and presentation of environmental information; use in data collection (20 hrs).

7. **Information System on Land Use:** Data sources, classifications and compilation with focus on soil degradation, desertification, deforestation (10 hrs).

8. **Management of Communication:** Planning and implementation of a statistical programme and organisation of a statistical unit, methods to improve information flows (15 hrs).

9. **Information System on Supply and Use of Material:** Data on direct and indirect material flows; their calculation based on a model (10 hrs).

10. **Information System on Supply and Use of Energy:** Monitoring and assessing energy stocks and flows; supply and use of energy; construction of energy balances (15 hrs).

11. **Environmental Modelling:** Estimation and forecasts of the structure demand and supply of energy and its environmental implication (10 hrs).

12. **Statistics on Water and Air:** Structure of demand and supply on water, access, reserves, pollution, transport; monitoring quality air, urban air pollution (10 hrs).

13. **Quantification of Environment relevant Activities of Industries:** Effects of mining and manufacturing on the state of land, water and air; use of land through manufacturing and pollution caused by by-products, statistical methods utilised for monitoring; ecological effects of tourism (15 hrs).

14. **Effects of agricultural Activities on the Ecosystem:** Effects of livestock and crop production on land and water (erosion, overgrazing) (10 hrs).

15. **Information System on forestry:** Forces shaping forestry, forestry principles, concept of sustainable forest management, forest assessment, forest inventory, measurement of losses and quality (10 hrs).

16. **Human Settlement and Environment:** Consumption of natural resources by households; access to drinking water infrastructure and sanitation (25 hrs).

17. **Environment and Economic Accounting:** Principles of SNA; valuation; matrix, presentation (IOT, SAM) (20 hrs).

18. **Natural Resource Accounting:** Assessment of natural resources with focus on forest accounts, subsoil assets and water accounts based on case studies (20 hrs).

19. **Environment Indicators:** Indicators according to agenda 21, the framework for the development of environment statistics; the framework of indicators for sustainable development (25 hrs).

20. **Train the Trainer:** In service training, use of didactic tools (5 hrs).

21. **Final report:** Participants had to write individual reports on a subject related to environment statistics. These reports were presented and discussed (15 hrs).

22. **Study Tour:** The course included a one-week tour to EUROSTAT in Luxembourg, and to the Federal Statistical Office in Berlin.

### 1.2.3 Training Methodologies

The lecturers used a mix of methods with an emphasis on the visual impressions. The most commonly utilised aid was the transparencies. Some of the lecturers made presentations on slides. Other techniques that were utilised included video presentations and power point (a computer based presentation package) presentations.

A primary emphasis was given to interactive methods and participatory approaches. In this regard group discussions and brainstorming on cards were utilised. In addition, practical computer exercises were utilised. Most of the lecturers prepared papers which provided the summary of the contents. Additional background materials were also availed to the participants.
Some tutorial sessions were held during the evenings the topics discussed were:

- Power Point Presentation Package by Matthais Fischer;
- Additional tutorial lessons on EDP techniques by Harold Kronester;
- The Construction and Uses of Energy Balance Sheets by Dieter Stentzel; and;
- Internet and E-mail presentation by Clemens Schröter.

The following excursions to environmental related institutions were organised:

- Soil Cleaning at the GHB Gebr. Huber Bodenrecycling GMBH;
- Meeting with Green Party in the Bavarian parliament;
- Discussion with an ecological farming family; and;
- Explanations of the household waste disposal system by Dieter Stentzel.

1.2.4 Evaluation

Two methodologies were utilised to evaluate the course. These were a topic by topic evaluation and an overall evaluation. The topic by topic evaluation determined the interest and relevance of topics and efficiency, effectiveness and qualification and degree of preparation by the lecturer. The overall evaluation was carried out by an external evaluator namely Mr. Phil Crook from DFID. Participants in the overall evaluation filled in a general evaluation questionnaire and were also invited to offer suggestion for the improvement of the course.
2. QUANTITATIVE ASPECTS OF SUSTAINABLE DEVELOPMENT

by Peter Bartelmus
United Nations Statistical Division, New York
(March 13 - March 14, 1997)

2.1 INTRODUCTION
The quantitative aspects of sustainable development was a topic introduced to serve as a framework for the rest of the course and give the participants a broad overview of what sustainable development is and a broad understanding of its importance to the environment. In this regard the purpose of this topic was to raise awareness on environment in terms of sustainable development and emphasis was given to sustainability concepts to guide in formulation of environmental policies.

In order to achieve the aims above, the discussion was tailored as follows;

- From Stockholm to Rio;
- Operationalising sustainability-dichotomy of approaches;
- Data systems;
- Data use;

2.2 FROM STOCKHOLM TO RIO
The United Nations Conference on the Human Environment (Stockholm, June 1972) noted that environmental concerns have increasingly become the subject of mainstream socio-economic policies, both at the national and international level. In the following years there was little or no change with regards to environment concerns. The World Commission on Environment and Development was to develop new ideas on how to improve environment. In their report “Our Common Future”, (Brundtland Report) it was recommended to focus both on environment and on economic development. One of the consequences was the United Nations Conference on Environment and Development (UNCED) (Rio de Janeiro, June 1992). In this conference a consensus, that strategies for sustainable development should integrate environmental issues into development plans and policies, was reached. The major outputs were the “Rio Declaration on Sustainable Development”, “Agenda 21” and several conventions. These are as summarised in the Figure 2.1.

2.3 OPERATIONALISING SUSTAINABILITY-DICHOTOMY OF APPROACHES.

2.3.1 Definition
It is worth noting that although there have been global attempts to address issues of sustainable development, there is no consensus on the definition. The popular definition of sustainable development by World Commission on Environment and Development is stated as “development that meets the needs of the present without compromising the ability of future generations to meet there own needs” (Brundtland Report). The following limitations in operationalising popular definition were observed:
- The needs are not identified nor quantified;
- The time horizon of future generation is not specified; and;
- The role of the environment has not been indicated.
2.3.2 Dichotomy of Views

In operationalising sustainability two views emerge which can be crudely categorised as “economists” and “environmentalists”. The “economists”, in operationalising sustainability, treat the environment as scarce goods and services which can be monetised or valued. The premise of “economists” is that the environment is treated as a commodity because this is how people perceive it.

The environmentalists, particularly the “deep”¹ kind, contest the notion that the environment should be treated as a commodity. They believe that people should rather see environment as an indivisible good to which a price should not be tagged.

The divergent views have therefore led to a lack of consensus in the quantification of sustainable development. The “economists” therefore are in the processes quantifying sustainability.

¹ Deep ecologists emphasise the need for a “comprehensive religious and philosophical world view” and the intrinsic equality of all species.
more in terms of monetary measures whereas the “environmentalists” develop methods of quantifying sustainability in terms of indicator systems and frameworks
Figure 2.2 shows a broad conceptual framework and possible indicators of sustainable development. The measures that can be quantified from the economic viewpoint are in shaded boxes. Whereas those in white boxes indicate the physical or non-monetary concepts and measures. The framework further categories sustainability in terms of supply, use and users, referring to a possible distinction between the sustainability of economic supply and use and human (users/populations) developments. The distinction is a useful reminder that the ultimate objective of sustainability is not human activity but of human beings themselves as well.

**Figure 2.2 Sustainability Concepts and Measures**

<table>
<thead>
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<th>Sources</th>
<th>Supply</th>
<th>Use</th>
<th>Users</th>
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<tbody>
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<td>Natural Resources</td>
<td>Depletion</td>
<td>EF CC</td>
</tr>
<tr>
<td></td>
<td>Env. services</td>
<td>Degradation</td>
<td></td>
</tr>
<tr>
<td>ECONOMY</td>
<td>Goods and services</td>
<td>Final demand</td>
<td>ENI NI GS.</td>
</tr>
<tr>
<td></td>
<td>EDP, NDP</td>
<td>ENI, NI</td>
<td>Economic distribution</td>
</tr>
<tr>
<td>SOCIAL SYSTEM</td>
<td>Social values and amenities</td>
<td>Use</td>
<td>ENI, NI Per capita</td>
</tr>
<tr>
<td></td>
<td>SI</td>
<td>SI QOL</td>
<td>Equitable QOL</td>
</tr>
</tbody>
</table>

Flows of goods, services and amenities: GPI Genuine Progress Indicators
CC Carrying Capacity
EDP Environmentally Adjusted net Domestic Product
EF Ecological Footprint
ENI Environmentally adjusted National Income
EI Environmental Indicators
ES Environmental Statistics
GS Green Savings

Figure 2.2 shows sustainability therefore in terms of environmentally adjusted national accounts aggregates as possible measures of economic sustainability. These include ENI (environmentally adjusted national income) and EDP (environmentally adjusted net domestic product). The non monetary measures of sustainability presented in the same Figure include carrying capacity of a territory, which measures human populations that can be sustained by a particular geographic area. Other attempts at capturing ecological sustainability include the development of frameworks or lists of social and environmental indicators to measure significant aspects of economic and ecological sustainability.
One way of operationalising sustainability is by defining what is not sustainable as shown in box 2.1

**Box 2.1 Indicators of non-sustainability**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Description</th>
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<tr>
<td>Climate change</td>
<td>1-3.5 °C global warming (2100)-caused by the emission of CO₂ and other greenhouse gases (1995) assessment by the Intergovernmental Panel on Climate Change. [business-as-usual might produce catastrophic consequences for socio-economic structures-UNEP 1992]</td>
</tr>
<tr>
<td>Ozone layer</td>
<td>30-40% decrease of ozone Column over Antarctica- resulting from use of CFCs and Halons as propellants in refrigeration, insulation and packaging. [Cosmic holes indicate damage to our life support system- Goodland 1991]</td>
</tr>
<tr>
<td>Land degradation and Desertification:</td>
<td>500 billion tons of top soil lost since 1972; 10 million environmental refugees from degraded lands; 5 Million hectares lost annually to desertification-caused by agriculture, forestry, and urbanisation [carrying capacity of the population exceeded in most developing countries-FAO, UNFPA, IIASA 1982]</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>1/4 of species in danger of extinction; 5,000 to 15,000 species lost annually due to destruction of biomas and habitat through agriculture, deforestation, pollution and other land uses. [will compromise the ability of future generations to meet their needs-UNEP 1992]</td>
</tr>
<tr>
<td>Deforestation</td>
<td>16.8 million hectares lost annually- due to logging and land clearance for agriculture and settlement [approaching the limits of wood consumption - UNEP 1992]</td>
</tr>
<tr>
<td>Energy</td>
<td>90 years of proved recoverable (mineral reserves), 243 years of proved reserves in place, and 800 year of total (including additional estimated) reserves left. [meeting the burgeoning demand for conventional fuel is quite feasible, at least for the next few decades - WRI et. al 1996]</td>
</tr>
</tbody>
</table>

Box 2.1 describes phenomena typically presented when arguing “non sustainability” of current patterns of production, consumption and economic growth. It was observed that answers cannot be found by simply listing disparate indicators, expressed in so many centimetres of sea-level rise, degrees of global warming or hectares of advancing deserts. An operational definition of sustainability which is capable of combining or comparing all these phenomena among each other with the costs and benefits of related economic activities is needed. It was noted, however, that indicators on non-sustainability have an alert and/or score keeping function if standards/targets have been set.
2.3.3 Data Linkage And Interaction Of Statistical Frameworks And Systems

![Figure 2.3 Data systems](image)

For the three main areas, namely the economy, environment and population, data frameworks or systems have been developed. The key data gaps are in linkage of all three aspects for development to measure sustainable development phenomena. Below is a brief description of the system framework identified and its status.

**The System of National Accounts (SNA)** is the internationally adopted system that not only provides a framework for accounting aggregates but is a tool used to calculate underlying statistics for the different fields such as industry, agriculture, finance or trade.

**System of Social and Demographic Statistics (SSDS):** An attempt was made to develop an accounting system for social and demographic concerns however due to the absence of natural numeraire and a comprehensive theory in the field, the system was soon abandoned.

**Framework for Developing and Integrating Social and Demographic Statistics (FSDS):** This framework was adopted because of its flexibility. However it is just a listing of “social indicators” under headings of “social concerns” taken from SSDS.

**Framework for the Development of Environmental Statistics (FDES):** Due to problems of data integration similar to those that were encountered in developing the SSDS, the United Nations, in 1984, was prompted to develop a framework rather than a system for the development of environmental statistics. Table 2.1 indicates the broad categories of these indicators.
Social Accounting Matrix (SAM): The SAM is a presentation of SNA accounts in a matrix which elaborates the linkages between a supply and use table and institution sector account. It is an alternative way of measuring national accounts aggregated with a view to assessing human capital and related concerns of employment, labour cost and income distribution. An attempt has been made by the Netherlands Central Bureau of Statistics to incorporate physical and monetary indicators of the environment into SAM without attempting to account for human capital, possibly, this approach could lead to a broader integrated accounting system.

System of Integrated Environmental and Economic Accounting (SEEA): The SEEA addresses the concern that the conventional national accounts neglect the role of natural capital in economic production and growth. This is done by costing fixed and natural capital consumption and by introducing broader concepts of capital and capital accumulation.

Population, Resources, the Environment and Development (PRED) is less developed than any of the systems/frameworks listed above. The Population Division of the United Nations is currently developing PRED data base which aims at capturing some of the relationships between environment, resources and population.

2.3.4 Proposed Operational Measures of Sustainable Development

The indicators described in Figure 2.2 and their parent systems Figure 2.3 also reveal the basic dichotomy in measuring sustainable development. The indicators are developed either on the basis of monetary or non-monetary terms which further stresses the two view points of “environmentalists” and the “economists” which are discussed in section 3.2

The monetary systems use monetary numeraire for aggregating diverse activities and results. However, on the other hand, the non-monetary or physical indicators resort to some kind of weighting to derive more aggregate indices.

Two operational definitions were suggested as a measure of sustainability in monetary and non monetary terms respectively.

2.3.5 Sustainable Economic Growth

Sustainable economic growth can be defined in operational terms as

“Increase in EDP, assuming that environmental cost allowances can be used for the maintenance of produced and natural capital and taking into account that past trends of depletion and degradation can be offset or mitigated by technological progress, substitution, discovery of natural resources and changes in consumption patterns”

2.3.6 Sustainable Development

Sustainable development on the other hand can be defined in operational terms as follows:-

“The set of development programmes that meets the target of human needs satisfaction without violating long-term natural resource capacities and standards of environmental quality and social equity.”
2.4 OPPORTUNITIES FOR MEASUREMENT OF SUSTAINABILITY

2.4.1 System For Integrated Environmental And Economic Accounting (SEEA)

The system for integrating environmental and economic issues has arisen from the fact that various flaws of conventional accounts may have sent wrong signals to decision makers who may have set society on a non-sustainable path of development. In assessing cost and capital, national accounts have neglected, on the one hand, new scarcities of natural resources which threaten the sustained productivity of the economy and, on the other hand, the degradation of environmental quality and consequential effects on human health and welfare.

Several environmental organisations have argued that the traditional system of national accounts be replaced by green accounts. National accountants and mainstream economists disagree, pointing out that conventional accounts serve many short and medium term purposes of market observation and business cycle assessment. Moreover, these accounts are based on observable data whereas environmental accounting would require numerous and controversial estimations and valuations.

Therefore in absence of an international consensus the SEEA was developed as a satellite system of the 1993 SNA.

The main objectives of the SEEA can be summarised as follows:

- Segregation of all environment related flows and stocks of traditional national accounts, notably environmental protection expenditures;
- Linkage of physical natural resource accounts and indicators with monetary environmental accounts and balance sheets;
- Incorporation of environmental costs and benefits of natural resource depletion and environmental quality degradation in income and production of the SNA;
- Accounting for the maintenance of tangible wealth, extending the concept of capital to cover not only man-made but also natural capital; and;
- Elaboration and measurement of environmentally-adjusted indicators of cost, capital, income and production, and as the sum total, an Environmentally Adjusted Net Domestic Product (EDP).

Various components of the SEEA have been tested in several country studies and were found to provide a valuable information base for integrated (sustainable) development planning and policies. Integrated accounting can be used, in particular to assess the sustainability of economic growth and the structural distortion of the economy by environmentally unsound production and consumption patterns. Country projects have been carried out by UNSD in collaboration with the World Bank, UNEP and UNDP in Mexico, Papua New Guinea, Thailand, Indonesia, Colombia, Ghana, the Republic of Korea and the Philippines.

2.4.2 Pricing The Priceless: Method and Limits of Monetary Valuation.

Market Valuation: This kind of valuation focuses on the income generation capacity of natural assets whose products are sold in the market irrespective of private or collective (public) ownership. The limitation of this method is that it deals with economic assets only and therefore excludes all other “environment” assets.

Maintenance Valuation: Environmental maintenance costs are defined as the cost that one would have had to incur in order to avoid the deterioration of the environment during the ac-
counting period. The maintenance cost concept reflect a conservationist view of the environment.

**Contingent Valuation:** This valuation method focuses on costs of environmental damage done. The information for this valuation can be attained through a willingness to pay survey. However this approach to valuation has not conventionally been used by national accounts.

### 2.4.3 Framework For Indicators Of Sustainable Development

The framework for indicators of sustainable development combines the concerns of the Earth Summit’s Agenda 21 with an internationally endorsed data framework, the Framework for the Development of Environment Statistics (FDES). FISD is then used to present the “starter kit” of indicators. It is anticipated that this initial listing will eventually evolve into standard indicators for recurrent compilation and use at national and international levels.

Tables 2.1 and 2.2 shows the information categories and components of the FDES and FISD.

#### Table 2-1 Framework of the Development of Environment Statistics (FDES)

<table>
<thead>
<tr>
<th>Components of environment</th>
<th>Information Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social and economic activities,</td>
</tr>
<tr>
<td></td>
<td>Environmental impacts of activities/events</td>
</tr>
<tr>
<td></td>
<td>Responses to environmental impacts</td>
</tr>
<tr>
<td></td>
<td>Inventories, stocks and background conditions</td>
</tr>
<tr>
<td>1. Flora</td>
<td></td>
</tr>
<tr>
<td>2. Fauna</td>
<td></td>
</tr>
<tr>
<td>3. Atmosphere</td>
<td></td>
</tr>
<tr>
<td>4. Water</td>
<td></td>
</tr>
<tr>
<td>5. Land/soil</td>
<td></td>
</tr>
<tr>
<td>a) surface</td>
<td></td>
</tr>
<tr>
<td>b) Sub-surface</td>
<td></td>
</tr>
<tr>
<td>6. Human settlements</td>
<td></td>
</tr>
</tbody>
</table>

#### Table 2-2 Framework for Indicators of Sustainable Development(FISD)

<table>
<thead>
<tr>
<th>Agenda 21 clusters</th>
<th>FDES Information Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Social and economic activities</td>
</tr>
<tr>
<td></td>
<td>Environmental impacts of activities/events</td>
</tr>
<tr>
<td></td>
<td>Responses to environmental impacts</td>
</tr>
<tr>
<td></td>
<td>Inventories, stocks and background conditions</td>
</tr>
<tr>
<td>Economic issues</td>
<td></td>
</tr>
<tr>
<td>Social/</td>
<td></td>
</tr>
<tr>
<td>Demographic issues</td>
<td></td>
</tr>
<tr>
<td>Air/climate</td>
<td></td>
</tr>
<tr>
<td>Land/Soil</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
</tr>
<tr>
<td>Other Natural resources</td>
<td></td>
</tr>
<tr>
<td>Waste</td>
<td></td>
</tr>
<tr>
<td>Human Settlement and Natural Disasters</td>
<td></td>
</tr>
<tr>
<td>Institutional Support</td>
<td></td>
</tr>
</tbody>
</table>
Chapter 2  Quantitative Aspects of Sustainable Development

2.5 DATA USE
The lecturer pointed out that environmental accounting and indicators for sustainable development are both relatively new methodologies. They have been tested in a few concrete cases but experience with their use and usefulness in decision making is still lacking. This is because, on one hand, there is not yet full consensus on concepts, classifications and methods of compilation and, on the other hand, statisticians are typically quite reluctant to enter the less objective arena of policy analysis. However, some theorising on potential uses and applications might open the door to further explorations of how integrated data systems and frameworks can support rational policies of sustainable development.

Integrated accounts, on the one hand, can specifically be used to assess two major aspects of economic policy. These are the sustainability of economic growth as conventionally measured and the structural distortion of the economy by environmentally unsound production and consumption patterns. Indicators for sustainable development, on the other hand, assess sustainable development in comparison to standards and targets set and therefore can be used for environmental management.

2.6 CONCLUSION
To strengthen the understanding of the concepts embedded within sustainable development two participants from Uganda and Surinam made presentations. These were entitled “The Role of Environmental Economics in Implementation of the NEAP in Uganda” by Eugene Muramira and “Sustainable Utilisation of Forests in Surinam” by Winston Wirht. The main reinforcing issues of the presentation from Uganda to the topic were

- “Polluter pay principles” in environmental policy costs are also defined in the SNA; and;
- Cost benefit analysis can be done at micro level. This analysis is, however, not clearly defined in SNA accounts and therefore does not necessarily apply at the aggregate level.

The main reinforcing issues from the presentation from Surinam to the topic were

- Depletion can be exported to other countries;
- There are different uses of forests both economic and non-economic;
- Transfer pricing affects economy and environment impacts and the exporting/developing country does not necessarily stand to gain;
- Environmental issues have high political pressures; and;
- Informal sector, which is largely unaccounted for, sometimes has serious environmental issues.

To conclude the course topic, the paradigms that can be utilised in quantification of sustainable development were highlighted. These were, sustainability as an overarching process which combines the functioning of a market in the process of conventional economics; ecological economics (Economics) which emphasises that the market has a role to play in behaving in a more environmentally sound way; and; eco-development which takes into account the geographical aspects of sustainability and people’s participation, sometimes referred to as the bottom up approach to development.
2.7 REFERENCES


Bartelmus P., “Greening the National Accounts”, 1996


3. USE OF MICRO COMPUTING FOR ENVIRONMENTAL STATISTICS

by Harold Kronester
CIB, Munich
(March 17 - 21, 1997)

3.1 INTRODUCTION

Microcomputing is a basic tool required for a statistician to fulfil his functions. The aims of introducing the course topic was to enable participants to gain an understanding of the use of Microcomputing operation system and also to be familiar with modern word processing and spreadsheets.

The main contents of the course topic were

- The use of the windows programme as an operating system;
- Microsoft Word as a word processing language; and;
- Microsoft Excel as a spreadsheet programme which utilises the windows operating system.

3.2 WINDOWS

There was a brief introduction to “Windows” and its advantages over DOS were explained. However, it was also pointed out that Windows could not operate without the presence of DOS. The usage of the mouse (and the various types of pointers the user is likely to encounter) was considered one of the more important things to learn when operating within Windows. There are alternative keyboard punches but this is considerably more cumbersome and time consuming. The importance of the applications, accessories and programs in the various groups were also explained.

The next step was file management and organisation which was done with the “File Manager”; one of the items in the “Main” group in Windows. File manager mainly is used to move and copy files. Formatting diskettes is also done in this aspect of Windows.

The definition and the uses of “Icons” were given to the participants. They were also shown how to create new groups and how to put new items in these groups.

Accessing and organising directories were also covered. File structures (directory and sub-directory) were introduced and the recognition of windows and non-windows files was also touched on. The different file types, their extensions and how they can be used to execute programs (in the absence of icons) were also explained.

3.2.1 Why Use Windows

There are many advantages to using windows. Some of these are:

- Usage of the mouse (makes moving around the screen very easy);
- Completely menu-driven (every command that is available in windows is accessible through the menu);
- Multi-tasking (simultaneous use of many programs);
- On-line help system (provides help for every command);
• Copy, cut and pastes commands (allows the user to copy or move parts of a document to other part of the document or other documents; whole document can also be copy or moved to other documents);

• Drag and drop capabilities; (parts of or whole documents can be copied or moved by marking them with the mouse, holding them, dragging them and dropping them to the desired location in the document.

• Scroll bars; (allows the user to go from line to line or page to page of a document by just pressing a button with the mouse pointer).

• Alternate keyboard punches (most of the tasks that can be done with the mouse, windows offer alternate keyboard punches that allow the user to complete the task; most of these require the pressing of two keys [some key + the CTRL, ALT or Shift keys] or the use of the functions key).

The main advantage of windows, however, is multi-tasking (the ability to simultaneously run several applications/programs). This ability was discussed and demonstrated. In addition all windows based software have the same structure therefore once one is introduced to the windows environment it easy to adopt to various software that are windows based if the initial windows logic has been well understood. It was indicated that windows makes the use of the micro-computer simpler and more powerful.

3.3 **WORD PROCESSING (WINWORD)**

This session started out with explanations about the contents of the “WINWORD” screen. The different bars, buttons and menus were introduced. The advantages of using the toolbar and the buttons, as opposed to using the menus, were explained.

Typing and formatting text came next. Instructions for formatting the page, paragraphs, margins and frames and tables were also given. There was an introduction to a new tool called “Auto Correction”. This tool allows for the correction of words, punctuation and capitalisation as the user types. For example, the user is allowed to add commonly used words to the existing list of words that will be automatically corrected by Word. Deletions from this existing list is also allowed. There is also the possibility of including special characters to documents. Word displays a ruler in the top border of the screen. The grey area of this ruler indicates the border area (margins) while the white area shows the text area. These areas can be adjusted by using the mouse to drag them in any direction. This approach represents a faster alternative to setting margins from the menu.

By the end of the session the participants were familiar with the following concepts about word processing in the Microsoft word environment;

• Writing a text;
• Saving a text;
• Copying text;
• Formatting the text and changing the fonts;
• Formatting paragraphs;
• Inserting frames; and;
• Inserting page numbers, data and time.

To ensure that all these concepts had been adequately understood each of the participants was required to reproduce the letter.
3.4 **MICROSOFT EXCEL**

Microsoft Excel is a spreadsheet package that has various functions ranging data entry to data analysis such as calculation of sums, percentages and regression analysis. The package has the capability of generating graphical presentations as well.

The session started with explanations of the different tool bars. The main concepts of columns and rows in the excel environment were explained. Many of the useful tools in Excel were explored as follows:

- Multiple sheets (many sheets available that can be selected with a click of the mouse; useful for organising work - i.e. data can be in one sheet, tables in another, and graphics in another; all sheets can be named for easier recognition).
- Copy cell (cells could be copied in sequence by just selecting the right corner of the source cell [the pointer assumes the shape of a cross] and dragging to select the appropriate number of cells to which you want the contents of the source cell copied);
- Copy and paste (can copy cells contents to other locations on the spreadsheet);
- Paste special (can copy all the cells contents, just the formulas, or just the values);
- Drag and drop (with the mouse, a cell, selection of cells, table or graphics can be copied, moved to anywhere in the document, to another sheet, another spreadsheet, or another document);
- Formulas (simple formulas could be typed directly into the cells)

The participants were taught how to enter data in the excel environment through a practical entry of data which was later utilised to learn some of the aspects mentioned above in addition to drawing graphs. One of the graphs (namely pyramid) was introduced to the participants. This required entry of data in a special format to enable the chart wizard turn the ordinary bar graph to a pyramid\(^2\). Below is an illustration of a pyramid.

---

**Figure 3.1 Population Pyramid as Produced by Excel**

![Population Pyramid as Produced by Excel](image)

\(^2\) The male figures were changed to negative and the gap width between the bars changed to zero and the overlap to 100.
By the end of the session participants were able to:

- Select cells and choose commands;
- Create formulas and use relative and absolute references;
- Create charts; and;
- Sort and filter data.

3.5 REFERENCES
Microsoft “Microsoft Word Users Guide”, 1994
4. MAIN APPROACHES TO MONITOR ENVIRONMENT

by Oswald Angermann

Federal Statistical Office Germany

Wiesbanden

(March 24 - 25, 1997)

4.1 INTRODUCTION

The main aim of introducing the course topic on “main approaches to monitor the environment” was to enhance the understanding monitoring environmental changes and their statistical implications. An overview to cover the main approaches of monitoring was given over a two day period. The course covered the following main areas national accounts as a measure of welfare and its deficiencies, the three approaches to monitor environment (i.e. OECD, Pressure-State-Response, the UN system of environment accounting) and resource accounting. The topic was concluded by discussing the concept of sustainability as a basic principle to be utilised in environmental monitoring.

4.2 NATIONAL ACCOUNTS AS A MEASURE OF WELFARE

National Accounts was introduced so that all participants would have a common understanding before introducing the monitoring approaches. National accounts was described as “a system to measure stocks at the beginning of the year (or an accounting period), the flow of goods and services between the different sectors of the economy in the course of the year, and again to measure stocks at the end of the year”. It was emphasised that the national accounts restrained itself to accounting only the measurable part of the national economy which is expressed or can be expressed in money terms.

The main deficiencies of the present system of national accounts were identified as the non valuation of stocks and flows coming from environment as a public good and exclusion of external effects of economic activities which concern environment.

The concept of economic metabolism was briefly given in terms of considering all that goes into the economy both monetary and non-monetary and all that comes out of an economy including the emissions and wastes apart from the economic goods and services.

4.3 OECD PRESSURE-STATE-RESPONSE (PSR)

The OECD PSR approach is a framework that classifies indicators according the key environmental issues in the OECD countries by type of indicator (a pressure, state or response). Pressure indicators show the extent to which human activities exert pressure on the environment. The state indicators depict the condition of the environment while the response indicators are measurements which show to what degree society has been responding to environmental changes and concerns.

The OECD approach was described as having the following main features;

- A range of the most important environment themes.
- A set of indicators which seem to represent a clear picture of the situation of a special topic in a given country which is suitable to show both, the level as compared to other countries and the development of the environmental state in one country.
- Indicators would also include information on the driving forces which induce the pressure on the environment. Here also OECD tries to connect environmental problems to the traditional sectors of the economy.
A set of indicators to give a general view of the responses given by governments, private enterprises and households to the pressures, e.g. measures taken to avoid environmental problems from the beginning (expenses and investment in end–of–pipe technologies).

The Figure 4.1 below shows the structure of indicators by Environmental issues.

**Figure 4.1 Structure of Indicators by Environmental Issue**

<table>
<thead>
<tr>
<th>PRESSURE</th>
<th>STATE</th>
<th>RESPONSE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Issues</strong></td>
<td><strong>Indicators of environmental pressures</strong></td>
<td><strong>Indicators of environmental conditions</strong></td>
</tr>
<tr>
<td>1 Climate change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Ozone layer depletion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Eutrophication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Acidification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Toxic contamination</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Urban environmental quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 Biological diversity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Landscape</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 Waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Water resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11 Forest resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 Fish resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 Soil degradation(desertification and erosion)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14 General indicators, not attributable to specific issues.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The OECD approach was further outlined as one which utilised indicators which are easily available in each of the member countries, represents the environmental problem well and in addition gives information on the measurability of the indicator.

The limitations of the OECD approach were pointed out as follows:-

- Aggregation and prioritisation of indicators is not done, hence it is very difficult for policy makers to set priorities;
- The system concentrates only on the environment and does not include social and economic issues; and;
- Different countries have different problems.
4.4 ECONOMICS AND ENVIRONMENTAL ACCOUNTING

Three system which utilise economics and environmental accounting were discussed and these included the SEEA, NAMEA and the German System of Environment and Economic Accounting.

4.4.1 Satellite System for Integrated Environmental and Economic Accounting (SEEA)

The Satellite System for Integrated Environmental and Economic Accounting was further discussed as one of the approaches that can be utilised for environmental monitoring.

The steps in inclusion of environmental topics were outlined as shown below:-

- Additional disaggregation of conventional national accounts to adjust it for the inclusion of environmental topics;
- Collection of physical data on environment–relevant production and consumption processes and on the exchange of goods and services between environment and economy;
- Additional valuation of the economic use of the environment; and;
- Extension of the production boundary of the SNA.

On the one hand the main advantage of the SEEA system was noted to be the complete system of environmental accounting and the aggregation of environmental issues. On the other hand, however the main limitation of the SEEA system was noted to be that not all four steps could be developed together.

4.4.2 The Dutch -National Accounting Matrix including Environmental Accounts (NAMEA)- Approach

It was noted that the NAMEA approach was developed by the Central Bureau of Statistics (CBS) of the Netherlands. The NAMEA is model which shows the interaction between environment and economy. The core part of the model is the Netherlands Input–Output–Table extended by information of emissions by sectors of the economy as defined in the SNA and factors which connect specific emissions to environmental problems. By defining sustainability standards for different environmental problems, the system allows (under many assumptions) to evaluate how the economic activity of a sector has to change in order to fulfil the standards in a given span of time.

4.4.3 German system of Economic and Environmental Accounting

The German System tries to integrate the different approaches (SEEA, OECD, EUROSTAT) in a complete system, but is far from being complete in all subject matters. It is intended to give, also with partial results, support to political and economic decision makers.

Similar to the Dutch NAMEA approach, one main feature is the collection of information in physical terms, mainly emissions by economic sectors, which allow to connect economic activities to environmental problems. But, as in Germany there is no commonly accepted set of environmental standards, the complete NAMEA model can only be accomplished by defining additional standards. This task is carried out by different scientific research institutions with interesting results. The German approach exceeds in many aspects the mere collection of physical data. There are five main topics that are covered in the system include;
• Material and energy flow accounts, including use of natural resources and emissions by sectors;
• Use of land and space;
• Environmental indicators;
• Measures to protect environment (investment and current expenditure); and;
• Avoidance cost calculations.

4.5 RESOURCE ACCOUNTING

In some countries, mainly those larger natural resources, it was noted that resource accounting has been developed very early as a means of getting an information on the depletion of resources and answers on whether resource use is sustainable. Two kinds of resources are to be distinguished, these are, exhaustive resources, e.g. coal, oil, gas and minerals, and self–renewable resources like forests or water.

A country with a highly developed system of resource accounting is Norway. A survey of the methods and results can be found in Longva. The main problems that need to be resolved by resource accounting are:

• Valuation of stocks by current selling prices less exploration and extraction costs;
• New explored reserves have to be added to the stock of the current year and all previous years; and;
• Exploration cost is investment which has to be depreciated in the extraction period.

Environmental statistics is a basis for environmental accounting, the statistics on environment apply mainly to four fields namely; waste; air pollution; water and sewage; and; economic data (expenditure and investment for environmental protection).

Designing statistical data collection requires decisions on three main questions:

• Who is respondent and how many should be included (full survey or sample)?
• How many items should be asked and in what detail?
• How often should the data be collected (periodicity yearly, more or less)?

4.6 SUSTAINABILITY

The interpretation of sustainability mostly reflects the economical, political and social interest of the interpreter of sustainability. That can be shown by subdividing environmental pressures in three main components:

\[ U = A \times k \times e \]

\( U \) = total environmental process
\( A \) = number of human actors
\( k \) = activity level per capita
\( e \) = emission per activity unit

Industrialised countries have an activity level per capita far above world average and consume with this high level of activity a larger part of natural resources. On the other hand, the number of actors, the population, is relatively stable and the emissions per activity unit are, due to environmentally adjusted and efficient techniques, lower than in developing countries.


In developing countries the main reasons for the increasing environmental problems are the high population growth rates and less efficient technologies which stress the environment.

Global environmental policies have to concentrate on these deficiencies. In developing countries it is clear that population growth and poverty go hand in hand, and that there is a strong interdependence between development and environmental problems.

4.6.1 Practical recommendations

STAHMER, one of the co-authors of the United Nations SEEA handbook interprets sustainability in three dimensions: economic, environmental and social. He defined some very simple rules on how to obtain sustainability which are listed under the three dimensions as follows:

Environmental Sustainability Rules
- Minimise extraction of mineral resources;
- Substitute fossil by renewable energy sources (wind, water, solar);
- Stop decreasing groundwater level;
- Balance growth and depletion of biological resources (plants, fish, forest);
- Save ecosystems and biodiversity;
- Care for agricultural land quality to avoid soil erosion;
- Reduce wastes by prolonging lifetime of products (recycling); and;
- Respect the absorption limits of pollutants in water, air, soil.

Economic Sustainability Rules
- Support small or medium sized enterprises of the region;
- Prefer regional products;
- Travel - if possible - by foot or bicycle;
- Avoid unemployment by planning the right degree of labour productivity;
- Support progress in basic and applied sciences;
- Minimise price increases;
- Balance public budgets for avoiding public debts; and;
- Balance foreign trade for avoiding foreign debts.

Social Sustainability Rules
- Reduce population growth and balance rural / urban population distribution;
- Strengthen informal social networks and family life;
- Achieve same rights for men and women;
- Reach high level education standards;
- Create optimal health conditions;
- Keep high security standards;
- Balance equal income and wealth distribution; and;
- Save cultural heritage and traditions.

4.7 CONCLUSION

One of the participants, Fatty Lamin, presented a paper entitled “Gambia Environment Action Plan: Monitoring and Assessment Strategy”. Key to the process of evolving a monitoring and assessment strategy for Gambia it was observed the a multi-sectoral approach was used, and various sources of information for evolution of indicators was necessary. The second aspect was that the framework of monitoring was based on the environmental action plan.
4.8 REFERENCES

Mark de Haan, Steven J. Keunin and Peter R. Bosch, “Integrating Indicators in National Accounting Matrix Including Environmental Accounts, NAMEA”, 1993

5. DATA DISSEMINATION
by John Wright
(March 27 - 28, 1997)

5.1 INTRODUCTION
The targets set for the course topic on data dissemination were; to enable participants to under-stand the aim of data dissemination; to be familiar with the options for dissemination and to produce user friendly documents. In order to meet the above mentioned targets, the course was discussed under the topics of dissemination for national statistical offices, presentation of dissemination plan and dissemination using the news media.

5.2 DISSEMINATION FOR NATIONAL STATISTICAL OFFICES
Why Disseminate? It was noted that national statistical offices disseminate information because it justifies their existence, it is a public duty, safeguards their independence, it is obligatory and is a vital barometer for the efficiency of such an office.

What to disseminate? The characteristics of information that needs to be disseminated were highlighted. In this regard, it was noted that such data may have economic and social implications which affects the lives of ordinary people and should be obvious and newsworthy e.g. effects of industry on people’s health. In other words, the information should not be boring.

How do you disseminate? The key elements on the methodology of disseminating were noted to be, keep it simple; user friendly and remember your audience. The participants were reminded that if the statistics affect the lives of ordinary people, they are probably worth disseminating because they will be of interest to ordinary people. The ways of disseminating were identified as follows: news releases, short bulletins or rapid reports; key data cards e.g. country in figures; and; electronic media, major publication in print, on disk, or on-line e.g. statistical year book, broad mass of basic output available to public typically on databases. It was observed that the criteria for selection of dissemination method should include a pricing and marketing strategy.

5.3 MAKING A DISSEMINATION PLAN
In making a dissemination plan, it was pointed out that it is important to start from basic and simple questions for example “why are we doing this?” The following key points in making a dissemination plan were identified:

• Keep the plan simple;
• Keep the product simple and user friendly;
• Remember your audience; statistics that are not of interest to people or of use to them are not worth disseminating.
The key elements of a dissemination plan, therefore, are as highlighted in box 5.1.

**Box 5.1 Key Elements of a Dissemination**

**AIM**
- Ask: Why?
- Target audience?

**METHOD**
- Book?
- Electronic
- Bulletin or rapid report
- News release

**PRICING POLICY**

**MARKETING AND PUBLICITY**

**MEASURING SUCCESS.**

### 5.4 DISSEMINATION USING THE NEWS MEDIA

The reasons for ensuring that statistics office get it right were listed as follows:

- Official statistics record matters of great significance to the nation and to individuals;
- It is one way ordinary citizens can judge the state of their nation and how well (or badly) the Government is running things;
- It is objective;
- Politicians are wary of statistics, which is a good thing, and therefore, it is worth noting that “unacceptable” statistics are suppressed;
- Politicians unease about official statistics underline their importance for the public good, but the public often finds them boring or difficult to understand. The media tend to reflect this attitude. Newspaper don’t sell by boring people. This can make it easier for politicians to avoid publicity for “difficult” statistics.

The major aim of utilising the media for dissemination through news was pointed out as to show the public, through the news media, that statistics are important by making them interesting and exciting.

It was noted that it is a prerequisite to ensure that statistics are free from political manipulation. This ensures that people believe in them. To this effect, two quotations were made:

> “If the Government tried to change the rules this would create a debate that would make it impossible” Jan Carling, Director General

> “independence from the political processes one of the basic principles in this kind of work in all western countries” Tim Relander, Director General Statistics Finland.
The key elements required for utilising the media were outlined as follows:

- Statistics should be highest quality;
- Clear separation between statistics and the political process;
- Clear rules for release of data to news media e.g. A statistics act;
- A Director-General recognised as independent with access to the head of government and is prepared to resign if the integrity of statistics is threatened;
- A culture in which there would a public outcry if the above happened;
- Statistical advisory committee- for added protection;
- No connection between statistical news releases and political comment;
- High standard of professionalism in dealing with the news media; and;
- An appreciation that the best way of protecting the integrity of official statistics is by publicising them as much as possible through the news media.

Therefore the following are crucial to disseminating through the news media.

RIGHT PRODUCT
RIGHT WAY
RIGHT PLACE
RIGHT TIME

5.4.1 Establishing an effective news media

In establishing an effective news media it was noted that the media personnel look for a “story” and if everything is given to them without “signposting”, they have problems finding a story. In addition they may not be sure of the messages given by all the data because they are too busy to bother finding the story and even if they do find the story it might not be the best result. To avoid such occurrences statisticians were advised to ensure that articles are attractive and to utilise a journalistic judgement in doing so.

5.4.2 How are you going to release your product to the news media

The news release was noted to be the best procedure for disseminating through the news media. The main methods of using news release was noted as briefing/news conference; electronic transmission; advance notice of release date and timing of release.

The factors to consider in writing a press release were highlighted as follows:-

- Who should write the news release? Is it the press officer or statistician?
- Who answers media question? There should be prompt response and ease of contact.
- How will release be produced/distributed?
- Press briefing; News conference; television and radio; photographs; creating a media event.

5.4.3 Characteristics of a good news release

A good news release was noted to have the following characteristics

- Attracts a journalist’s attention immediately;
- Has colourful headed paper with logo;
- Says it is a news release;
• Is uncluttered;
• Has a date/serial number;
• Has an eye catching headline;
• Carries main point in headline/first paragraph;
• Is short;
• Is written in language of ordinary people;
• Has figure presented in simple way; and;
• Give follow up contacts.

A classical example of a short news release was quoted as follows:

"Veni, vidi, vici" (I came, I saw, I conquered) (Julius Caesar)

5.5 CONCLUSION

One of the participant namely Ah Poe presented a short paper of the experience in Western Samoa entitled “State of the Environment Report in Western Samoa”. The participants were also divided into four groups and given an exercise to come up with a plan for disseminating data on the environmental audit of a hypothetical country of their choice. It was noted that the plan had to have maximum dissemination of data collected because it is considered an important event. As part of the plan the groups were required to produce a press release of the country which had some key characteristics. The participants utilised the knowledge which had been acquired during the two day period and Box 5.2 gives the results of the news release that was prepared by the lecturer.

5.6 REFERENCES


First ‘green audit’

ELEPHANT SPIDER ALIVE AND KICKING
-IT’S OFFICIAL

wide distribution of environmental data planned.

A ‘green’ or environmental statistical ‘audit’ of [country] has been conducted for the first time by CSO.

Here is a taste of some key findings

• The elephant spider- symbol of national pride- is now thriving. In 1985 it was nearly extinct. In 1995 Sunshine Province reported 100 breeding couples.
• [Country] has three of the most pollution-free rivers in the world. On, the Fruit River, is the only known habitation of the giant pear fish.
• Between 1985 and 1995 we lost 20% of our forests
• 70% of goods are now transported by road
• Number of private cares rose by 55% between 1985 and 1995
• Garbage per person now equals Germany!

The CSO plans to produce summary findings of the ‘green audit’ in [form] [time scale]. A major publication is planned for [   ]

Mr. [  ]. Head of CSO, says: “this is a major statistical development for the country. I want as many people as possible to see the figures.”

Further detail from [contact] 

Issued by etc. etc.
[name/phone & fax number]
6. GEOGRAPHIC INFORMATION SYSTEMS

by Tilmann Schulze-Wolf,
IFB - Hannover
(April 1 - 4, 1997)

6.1 INTRODUCTION
Geographic information systems tool was introduced to the participants to enable them to gain an understanding of its functioning and use in decision making on environmental issues. The main areas that were covered in the topic were itemised as follows:

- What is a geographic information system;
- Basics of data processing;
- Acquisition and availability of spatial data;
- Decision making; and;
- Sample project.

6.2 WHAT IS A GEOGRAPHIC INFORMATION SYSTEM?
The geographic information system was defined as “a computer based system that is capable of managing, analysing and reproducing large amounts of spatial data and thematic attributes”. Muhar 1992. The different elements of geographic information were itemised therefore as: hardware, software, data and personnel.

6.3 BASICS OF SPATIAL DATA PROCESSING.
The basic principles underlying the spatial data processing were introduced under the topics of thematic mapping and basic types of digital data. Thematic mapping was introduced as a concept that deals with different themes of maps. Examples of thematic maps were given as, streets, utilities, land use, surface water and soil maps.

6.3.1 Basic types of digital data
Two types of data were introduced and these were grid and the vector data. Vector data was described as data that is characterised by a co-ordinate, length and direction. Grid data on the other hand is characterised with grid lines. Vector data was noted to be more precise than grid data. It was also observed that grid data is usually converted to vector data.

The different forms of vector data were outlined as follows:

- Node: A point sometimes referred to as a knot.
- Line: Points between two nodes.
- Arc: A curved line between two nodes.
- Vertex: Connecting points on the same line.
- Polygon: The end point and beginning point are the same.

It was noted that only straight lines are available in a vector system; no lines overlap; every ground area is covered once (the borders of adjacent areas are stored once therefore any changes in one border will automatically change both ); the vertex connects the same line whereas a node appears at the beginning and at the end of one line. It was also pointed that vector data was concurrently stored in numerical forms as well.
To strengthen the understanding of GIS a short documentary on the origin of GIS was shown. This documentary emphasised that vast amounts of information, that require high levels of personnel and time, are easily stored and analysed with the GIS tool. It was pointed out that the geographical features that are normally described as longitude and altitude are stored as numbers in the GIS.

### 6.3.2 Data capture

Three elements of data were highlighted and these were

- “Data take over” which is uses already existing information and converts it to the system or software being used.
- Scanning which provides grid data and is useful for background information and not for evaluation and analysis purposes.
- Digitising which uses devices such as the mouse to outline the main features of aerial maps or polygons to be entered.

Types of digitising were highlighted as; on screen digitising and remote sensing for background purposes followed by digitising.

### 6.3.3 Analysis of Data

Figure 6.1 below was introduced as the general framework for analysing information using the geographic information systems:

![Figure 6.1 Framework for Analysing Information with GIS](image)

**Figure 6.1 Framework for Analysing Information with GIS**

### 6.3.4 CARTOGRAPHIC display and reporting

The different cartographic functions of a GIS system were listed as follows:

- Pre-defined polygons, lines and point symbols.
- User defined symbols
- Simultaneous presentation of vector and raster data
- Layout and placement of text
- Autolabel function e.g. names of cities etc.
- Sparing text and symbols.

### 6.4 GIS SOFTWARE

The distinctive features of a GIS system were noted to be the hardware and operating system; function and application and projects. The operating systems that distinguish the various the computer aided designs (CAD) and the GIS were pointed out as the UNIX, MSDOS/Windows and Macintosh.
6.4.1 Functions of a GIS

The functions of GIS were categorised as; vector based functions, raster based GIS, hybrid GIS and CAD based GIS. These are further outlined below:

Vector based GIS Functions: Digitising, overlay and intersection, buffers, vector topology and raster data for background purposes.
- Raster based GIS: Grid cell analysis, raster algebra, filtering functions, triangulated irregular network, 3 dimension, raster editor, raster/vector conversion utilities.
- Hybrid GIS: Full vector GIS functions, full raster GIS function, all functions are integrated in one, raster/vector conversion.
- CAD based GIS. CAD data model, no topology, reduced vector and raster GIS functions, digitising.

6.4.2 Types of software

Some of the basic GIS software available were highlighted in different categories as shown below:-
- Universal systems: ARC/INFO, SICAD OPEN, SPANS, MGE(Microstation Integraph), SmallworldGIS.
- Land registry, survey: ALK/GIAP, SICAD, GRIPS, gradis-gis, geo-graph, PROCART, STRINGS.
- Remote sensing and image processing: ERDAS, idrisi, grass, ER-mapper, EASI/PACE.
- Smaller projects: Atlas-GIS, Topol, polyplot, TNTmips, Winkat, GSMapper, PolyGIS.
- Cartography: MGE, Mapgrafix, LANDCADD, GeoMap
- Desktop-Mapping, ArcView, MapInfo.

The GIS software were divided into major groups of software namely GIS, and Desktop Mapping Systems: The table below shows the distinguishing factors between the GIS and desktop mapping systems:

<table>
<thead>
<tr>
<th>Functions</th>
<th>GIS</th>
<th>Desktop Mapping Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data capture and processing</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Data base management</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Analysis</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manipulation of Maps</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Cartographic display</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Easy to learn and use</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Inexpensive</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Many customers world wide</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
6.5 ACQUISITION AND AVAILABILITY OF DATA
The various forms of data required for running a GIS system were pointed out

- Satellite data;
- Official data which includes, demographic data, cadastral data, geographical maps, topographical maps and survey from solid and geological surveys and administrative borders; and;
- Privately owned data such as marketing data and digital road maps.

The source of the various forms of data were identified as raster data which can be collected from satellite images utilising the remote sensing technique; vector data which can be retrieved from geological maps using the digitising technique or the scanning and automated vectorising technique; and; utilising already existing digital data.

The sources of satellite information on land use were identified as the digital chart of the world, internet and National Aeronautic Space Agency (NASA), Intelligent Address Matching, Customisation and Application Development Tools and Inter-Application Communications

6.6 DECISION MAKING
Given the wide variety and different features of systems the participants were given some steps in ensuring that the right kind of software is selected depending on the functions that are intended to be achieved. The five steps in selection of software and setting up a GIS system were outlined as stock taking; system specification, pre-selection, calculation costs and decision making.

The stocktaking exercise was defined as the stage when all tasks required for the performance of a GIS and all available sources of GIS software listed. It was noted that it is important to list institutions utilising the GIS systems were of crucial sources of information on the disadvantages of various software programme. The various data sources including digitising both internal and external and their ability to be transferred to other noted as critical stages of stocktaking.

The system specification stage was noted as the stage whereby tasks are matched with available software and the required specifications such as for the computer equipment, manpower and data are set.

It was noted that the pre-selection is based on information obtained on the stock taking exercise and the system specification stage. Current market analysis of various items within the GIS system and the financial outlines were identified as critical elements of the pre-selection stage.

The decision making process was defined by the characteristics of evaluating the results of the pre-selection stage and calculating the cost of independent project before the final selection is done. Some of the broad points to help in decision making are as shown in Table 6.2.

Table 6-2 Key Factors to Consider in selecting GIS software.

<table>
<thead>
<tr>
<th>Software</th>
<th>Actual Prices</th>
<th>training Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workstation GIS</td>
<td>30 - 70,000 US$</td>
<td>6 - 12 months</td>
</tr>
<tr>
<td>PC-GIS</td>
<td>4 - 10,000 US$</td>
<td>4 - 8 months</td>
</tr>
</tbody>
</table>
Box 6.1 and 6.2 show samples of calculations utilised in calculating costs for beginning a GIS system. Example I shows the more expensive approach and example II shows the cheaper approach. The assumptions made for the examples are:

**Assumptions for Example I**
- Large amounts of data will be processed;
- In the beginning workplace 60% of the system administration costs will be used;
- There will be need for digitising; and;
- Full scale plotting.

**Assumptions for Example II**
- Small to mid range amounts of data;
- Outsourced gathering; and;
- Desktop mapping system will be used.

**Box 6.1 Example I**

<table>
<thead>
<tr>
<th>First Investment Costs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>5,000 DM</td>
</tr>
<tr>
<td>Software</td>
<td>3,000 DM</td>
</tr>
<tr>
<td>Peripheral equipment</td>
<td>6,000 DM</td>
</tr>
<tr>
<td>Training Courses</td>
<td>2,500 DM</td>
</tr>
<tr>
<td>Training on Job</td>
<td>5,000 DM</td>
</tr>
<tr>
<td><strong>Total Initial Funding</strong></td>
<td>21,500 DM</td>
</tr>
</tbody>
</table>

| Resultant Costs                               |       |
| Additional software                           | 2,000 DM |
| Additional hardware                           | 4,000 DM |
| **Total resultant costs**                     | 6,000 DM |

| Additional investment costs                   |       |
| Staff                                         | 5,000 DM |
| Further training                              | 1,000 DM |
| Software maintenance                          | 700 DM |
| Hardware Maintenance                          | 400 DM |
| **Total current costs**                       | 7,100 DM |

**Box 6.2 Example II**

| First Investment Costs                        |       |
| Hardware                                      | 30,000 DM |
| Software                                      | 115,000 DM |
| Peripheral equipment                          | 40,000 DM |
| Training courses                              | 10,000 DM |
| Training on job                               | 60,000 DM |
| **Total**                                     | 255,000 DM |

| Additional investment costs                   |       |
| Additional software                           | 8,000 DM |
| Additional hardware                           | 10,000 DM |
| **Total**                                     | 18,000 DM |

| Current Costs                                 |       |
| Further education                             | 72,000 DM |
| Software maintenance                          | 8,000 DM |
| Hardware maintenance                          | 6,000 DM |
| **Total**                                     | 96,000 DM |
6.7 SAMPLE PROJECT

An overview of how to utilise TNTmips PC based GIS software was introduced to the participants. TNTmips GIS software was described as one which could be used with any system ranging from the workstation to the ordinary PC. The TNT mips GIS introduced has a graphical interface like windows and hence is more user friendly. The lecturer guided the participants through a sample project which is shown in box 6.3

Box 6.3 Sample project exercise

In Southern Africa there are plans for a larger border crossing a highway project. With this highway the countries of South Africa, Swaziland, Mozambique and Lesotho are going to be connected. It is planned that the cities of Johannesburg, Pretoria, Baberton, Mbabane, Maputo, Durban, Pietermaritsburg and Maseru shall get direct access to this highway. In the sample project the influences on the natural resources have to be evaluated.

Besides dry and inhabited zones probably valuable wetlands and inundation areas will crossed by the highway. The following influences on the natural resources are expected:

- Destruction of nature because of highway traffic and construction activities.
- The highway has a width of 40 meter an the destruction of natural resources takes place in an are of 200 meters all together.
- Traffic fumes and traffic noises pollute an area of 1400 left and right to the highway.
- Big game reservations and National parks will be cut through the minimal size big game reservations and national parks is due to the migration habits of the animals 170 sq. km.

The questions are

- How many sq. km of land will be covered by the highway itself?
- How many sq. km of wetlands and big game reservations will be destroyed by the building of the intended highway?
- Will there be any big game reservations but through by the planned highway?
- If so: Are the resulting parts large enough for developing wildlife:?

ArcView is a desktop mapping software which was introduced to the participants to have an idea on how it works. A sample project was analysed utilising data that had been manipulated using the TNTmips PC based GIS software system.

ArcView is a complete system for accessing, displaying, querying, analysing, and publishing your organisation’s data. ArcView links traditional data analysis tools, such as spreadsheets and business graphics, with maps for a completely integrated analysis system. ArcView can be used as a stand-alone project system, or extended into an entire department, division, or organisation.

6.8 CONCLUSION

The GIS was a topic treated only to give the participant an insight of geographical information systems as another tool for managing spatial data which is crucial to environmental statistics. The importance of selection and key points to consider for further training were points of training. The 4 day session was by no means meant to equip participants with the ability for the GIS software.
7. INFORMATION SYSTEM ON LAND USE

by Pratap Narain
FAO-Rome
(April 7 - 8, 1997)

7.1 INTRODUCTION
Information on land use is basic to the development of an environment information system. The aim of introducing information systems on land use was to create an understanding of the dangers resulting from non-sustainable land use in order to provide essential information to decision making. In addition there was need to develop the capability to provide up-to-date information on soil and land.

To achieve the targets for the course the main areas covered were:

- Concepts and overview;
- Classification of land and soil;
- Data needs for an information system on land use; and;
- Collection of statistical data.

7.2 CONCEPTS AND OVERVIEW

7.2.1 Land Use Information System
An information system is defined as a group of different data bases and other documentation put together in a systematic manner for transfer of knowledge and communication of data on any subject. Such a system is generally created to identify and analyse problems, set priorities and formulate policies and programme, and monitor and evaluate policies and programme performance.

Therefore an information system on land use should have information on

- Land use;
- Land cover;
- Associated land-soil-water data bases giving its agro-climatic and agro-ecological characteristics;
- Social and demographic data to know the overview of needs of the region; and; scientific and technical data for all activities in general and detailed data on economic activity of specific interest.

7.2.2 Land
There are two main ways in which land is defined. The first definition is based on national accounts and the second is based on Agenda 21.

According to the System of National Accounts land is defined as an economic asset for clear evaluation in value terms so that it can be included along with other physical and financial assets and used for making macro-economic analysis along with other economic data such as output, input, labour. According to the 1993 SNA, land is defined in the system as the ground itself including the soil covering and associated surface water but excluding:
• Buildings or other structures constructed on the land or through it e.g. roads, offices, buildings, tunnels, etc.;
• Vine yards, orchards, or other plantations of trees and any growing crops etc.
• Subsoil assets;
• Non-cultivated biological resources; and;
• Water resources below the ground.

According to the Agenda 21 “land is normally defined as a physical entity in terms of its topography and spatial nature; a broader integrative view also includes natural resources: the soil, mineral, water biota that the land comprises. These components are organised in ecosystems which provide a variety of services essential to the maintenance of life-support systems and the productive capacity of the environment”.

The holistic approach of as used by the Agenda 21 has many functions and these include the production function; environmental function; climate regulative function; hydrologic function; waste and pollution control function; space function in terms of human settlements; archive or heritage function whereby land is a medium to store and protect the evidence of cultural history of mankind; and; the connective space function in terms of providing space for transport of people, goods and services and for movement of plants and animals between discrete areas of natural resources.

The integrated approach is the most ideal for building an information system on land use, however, to develop a comprehensive and exhaustive system would have a very large scope. Hence, subsystems using concepts and definitions which interlink through a framework is recommended. A purely sectoral approach is not recommended for it can easily lead to irreversible degradation.

Figure 7.1 below gives an overview on building an information system for land use. In this figure there are two approaches which can be used to develop an information system the first is based on economic theories and models while the second is based on issues that are actually at hand. In either system there are performance measures for analysis and monitoring purposes. The figure shows the rest of the key factors to consider in building and information system on land use.
Chapter 7 Information System on Land Use

Figure 7.1 An Overview of Information System for Land Use Planning

With regard to the economic models it was noted that two types of modal exists one is the income approach and the second is the Nutrition approach. One useful way of aggregating economic information on land use was noted to be the SNA. In this regard an example of the system of economic accounts for food and agriculture was discussed.

7.2.3 System of Economic Accounts for Food and Agriculture (SEAFA)

The SEAFA is a specific application of System of National Accounts (SNA). It is designed to meet the requirements of analysts, policy makers and planners dealing with food and agriculture. It provides concepts, definitions, classification and accounting framework. It can be systematically related to social, scientific and technological data.

The system of accounts for SEAFA consists of three types of tables for food and agriculture:

These are:-

Part I  Selected accounts for Agriculture defined as a sector of the total economy including, in particular, production and primary income accounts for the sub-sector of the SNA household sector consisting of Agricultural Households, and also their capital formation;

Part II  Production and generation of income accounts for all establishments whose principal activity is agricultural production; also goods and services accounts for food and agricultural products;

Part III  Satellite accounts and supplementary tabulations relating to food and agriculture.
7.3 CLASSIFICATION OF LAND AND SOIL

7.3.1 Land Cover Classification
Land cover classification corresponds to bio-physical description of land giving details such areas under vegetation (tree, bushes, fields, lawns), bare soil and hard surfaces (dunes, rocks, buildings), water bodies, etc. Land cover classification provides physical features of land for study of environment. The types of information it provides can be seen by looking at the “Coordination of information on the environment” (CORINE) program of the European Commission which includes information on land cover.

The classification of total land area is a systematic arrangement for grouping together different pieces of land based on similar characteristics for identifying and understanding their utilities. Such classifications take into account issues such as present use, the purpose for which it is being used or technical attributes reflecting differences in soil profile, soil texture and factors connected with environmental and agro-climatic issues. The first level (five items) indicates major categories (abstract to greater or lesser degree) of land cover. The second level (15 items) and third level (44 items) provides further details and depends on use of scale for mapping the area. The theoretical land cover classification used in the CORINE project is outlined below:

- Earth
  - Water
    - Ocean, Sea
    - Continental water
      - Rivers
      - Water bodies
  - Land
    - Without plant cover
      - Bare rock or ground
        - Outcrops
        - Open cast mines, dump sites, construction sites
      - Artificial surfaces
    - With plant cover
      - Permanent
      - Seasonal (arable land)

7.3.2 Land use classification
Land use classification corresponds to the description of the land in terms of their socio-economic purpose. Such information is required at three level: local level - physical planning & management, national level - overall resource policy and management, planning for future use of land and for protection of environment and international level - comparative descriptions and analysis of national patterns, extending and monitoring assistance programs. The Economic Commission for Europe (ECE) released a Standard Statistical Classification of land use mixing some categories of land cover and taking into account economic activities. This effort was made in 1989 while developing the set of ECE environmental indicators. The recommended ECE classification of land use is given below:

Agricultural land
- Arable land
- Land with permanent crops
- Land under permanent meadows and pastures
Chapter 7 Information System on Land Use

- Other agricultural land, n.e.s.
- Total agricultural land of which: Fallow agricultural land

**Forest and other wooded land**
- Total land under forest and other wooded land of which: stands of exotic species; Particularly fire-prone stands
- Land under coniferous forest
- Land under non-coniferous forest
- Land under mixed forest
- Other Wooded land

**Built-up and related land (excluding scattered farm building)**
- Residential land
- Industrial land (excluding land under 3.3)
- Land used for quarries, put, mines and related facilities
- Commercial land
- Land used for public services (excluding transport, communication and technical infrastructure)
- Land under mixed use
- Land used for transport and communication
- Land used for technical infrastructure
- Recreation and other open land

**Wet open land**
- Mires (swamp)
- Wet tundra
- Other wet open land, not elsewhere specified (n.e.s)

**Dry open land with special vegetation cover**
- Health Land
- Dry tundra
- Mountainous grassland
- Other, n.e.s

**Open land without or with insignificant vegetation cover**
- Bare rocks, glaciers, perpetual snow
- Sand beaches, dunes, other sandy land,
- Other n.e.s

Data on land use available in FAO’s data bank (the statistics division) relate to the following categories
- Total area (i.e. area including area under inland water bodies)
- Land area (i.e. area excluding are under inland water bodies)
- Arable land
- Land under permanent crops
- Permanent meadows and pastures
- Forest and woodland
- Other land (includes built-on area, roads, barren land, etc.)

This data is published regularly and is based on questionnaires sent to the national offices. The data base is not always up-to-date for several reasons. In many countries there is no established statistical system to generate such data. In some cases the primary sources go back more than twenty years. It is also clear that no single source can provide all the data required to study land use patterns which introduces additional problems of consistency.
Other problems include non reporting (in a given year only about two thirds of countries are providing some data on land use), incomplete coverage (in particular data on fallow areas, pasture, forest and shifting cultivation are very rarely available) and there no universally accepted standards or definitions for some of the classifications hence making it difficult to come up with aggregate figures.

### 7.3.3 Agro-climatic and Agro-ecological Zones

The agro-ecological zones (AEZ) is a system which aims at more scientific utilisation of resources, both natural and man made. The conceptual framework for agro-ecological zones is as stated below:-

- Characterisation of environments and land utilisation practices;
- Quantification of the extent to which specific AEZs can support defined land utilisation practices;
- Quantification of susceptibility of the environment to the impacts of given land utilisation practices; and;
- Identification of optimum land use patterns which meet specified social or technical goals.

Since the AEZ is often used as a tool to explore the sustainability of land uses, AEZ studies usually incorporate environmental degradation assessment. It may also be mentioned that while land use suitability/constraint are made at the level of individual cells using agro-climatic factors, optimum land use allocation within larger administrative/political regions has always been an AEZ application priority which has become possible now with the advancement in mathematical programming and use of computers.

### 7.3.4 Classification of soil degradation

Soil degradation can be described as a process by which one or more of the potential ecological functions of the soil are harmed. These functions relate to biomass production (nutrient, air and water supply, root support for plants) to filtering, buffering, storage and transformation (e.g., water, nutrients, pollutants), and, to biological habitat and gene reserve. Two categories of soil degradation process are recognised, viz., displacement of soil material (e.g., soil erosion by water forces or by wind forces) and in-situ soil deterioration covering chemical or physical soil degradation. Classification of soil degradation types, subtypes and symbols for use are given below:-

**W: Water erosion**
- Wt: Loss topsoil
- Wd: Terrain deformation/mass movement
- Wo: Off-site effects
  - Wor: reservoir sedimentation
  - Wof: flooding
  - Woc: Coral reef and seaweed destruction

**E: Wind erosion**
- Et: Loss of topsoil
- Ed: Terrain deformation
- Eo: Over-blowing

**C: Chemical deterioration**
- Cn: Loss of nutrients and/or organic matters
- Cs: Salinization
- Ca: Acidification
- Cp: Pollution
- Ct: Acid sulphate soils
Ce: Eutrification

**P: Physical deterioration**
Pc: Compaction, sealing and crusting
Pw: Water-logging
Pa: Lowering of water table
Ps: Subsidence of organic soils
Po: Other physical activities such as mining and urbanisation

**B: Degradation of biological activity**

7.4 DATA NEEDS FOR AN INFORMATION SYSTEM FOR LAND USE PLANNING FOR SUSTAINABLE AGRICULTURE:

There are five basic principles fundamental to any sound evaluation of land, namely: land suitability, sustained use, evaluation, economic implications of different kinds of land use and the need for a multidisciplinary approach. The possible composition of the data bank which needs to be created for comprehensive land use plan for agriculture is given below:

**A: Atmospheric qualities**
A1. Atmospheric moisture supply: rainfall, length of growing season, evaporation, dew formation.
A2. Atmospheric energy for photosynthesis: temperature, day length, sunshine condition.

**C: Cover quality**
C1 Value of standing vegetation as “crop” such as timber.
C2 Value of standing vegetation as germ plasma: biodiversity value (inter-specific variability and number of species).
C3 Value of standing vegetation as regulator of local and regional climatic conditions.
C4 Value of standing vegetation at introduction of crops and pastures: the land development cost.
C5 Incidence of above ground pest and vectors of diseases: health risk to humans and animals.

**T: Land surface and terrain qualities**
T1 Surface receptivity as seedbed: the tilth condition
T2 Surface tradability: the bearing capacity for cattle, machinery, etc.
T3 Surface limitations for the use of implements (stoniness, stickiness, and arability).
T4 Spatial regularity of soil and terrain pattern, determine size and shape of field with a capacity for uniform management.
T5 Surface liability to deformation: the occurrence or hazard of wind and water erosion.
T6 Accessibility of the land: the degree of remoteness from means of transport.
T7 Surface water storage capacity of the terrain: the presence of potential of pounds, on farm reservoirs, bunds, etc.
T8 Surface propensity to yield runoff water for local water harvesting or down stream water supply.
T9 Accumulation position of land: degree of fertility renewal or crop damage by overflow or overblown.

**S: Soil profile qualities**
S1 Physical soil fertility: the net moisture storage capacity in rootable zone.
S2 Physical soil toxicity: the presence or hazard of water logging in rootable zone.
S4 Chemical soil toxicity: the availability of plant nutrients.
S4 Chemical soil toxicity: salinity or salinization hazard; excess of exchangeable sodium.
S5 Biological soil fertility: the N-fixation capacity of soil biomass; and its capacity for soil organic matter turnover.
S6 Biological soil toxicity: the presence or hazard of soil-borne pests and diseases.

**U: Substratum or underground qualities**
- U1 Groundwater level and quality in relation to (irrigated) land use.
- U2 Substratum potential for water storage (local use) and conductance (downstream use).
- U3 Presence of unconfined freshwater aquifers.
- U4 Substratum (soil profile) suitable for foundation works (buildings, roads, canals, etc.).
- U5 Substratum (soil profile) as source of construction materials.
- U6 Substratum (soil profile) as source of minerals.

### 7.4.1 Land use planning using crop production approximation

The data required for making a detailed land use plan for sustainable agriculture requires a large amount of resources for collection of data. However, in general the exercise could be initiated by making a first approximation of the present and potential use of land with available data. This is illustrated by taking the crop production example.

The first step requires getting basic data maybe through a land survey to delineate and/or demarcate parcels and provide information on parcels. Delineation of land provides an approximate geographic description of the parcel; distinguishes the parcel and it describes the dimensions including area of parcel. The second set of information required is related to crops. This information includes growing period, growing season, input cost, amount of inputs used for important crops. The third major set of data relates to climate inventory of the area. This data includes rainfall, temperature, sunshine hours.

Combining of the climatic and soil requirements of crops, with the climatic condition of the agro-ecological zones, is the basis of the suitability assessment. The agro-climatic suitability for each crop can be assessed by comparing anticipated yields (available from agricultural universities/research stations) with the actual yield. The whole agro-economically possible yield can be classified in four classes defined in terms of percentage range of maximum attainable yield (MAY) without constraints for each major growing period. A general rule of thumb is given below:

<table>
<thead>
<tr>
<th>Growing period zones capable of yielding</th>
<th>Agroclimatic suitability</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 percent or more of the MAY</td>
<td>very suitable;</td>
</tr>
<tr>
<td>between 80% to 40% of the MAY</td>
<td>suitable</td>
</tr>
<tr>
<td>between 40% to 20% of the MAY</td>
<td>marginally suitable</td>
</tr>
<tr>
<td>less than 20% of the MAY</td>
<td>not suitable</td>
</tr>
</tbody>
</table>

Such information when compiled for major agricultural land use can provide a first approximation to the land use planning. However, a detailed integrated plan needs to be constructed taking into account details listed above. A first approximation can the basic analysis to enable one to decide priority areas depending upon available resources.

### 7.4.2 Data need for monitoring and evaluation

**Measurement of Soil Degradation:**

The main data required for measurement of soil degradation depends on method utilised. The first method which was developed in the early 30’s and later updated by in 1968 utilises data on rainfall erosivity, soil erodability factors, length and steepness of slope to measure average annual soil lost.
The second method is based on economic assessments of the impact of degradation. Degradation costs have been measured as

i. The value of defensive expenditure on soil conservation works, drainage and irrigation systems, etc. required to prevent land degradation;
ii. The value of lost yield;
iii. The replacement costs where the cost of additional inputs (e.g. fertiliser) needed to maintain the same level of yield is taken as a measure of the sort of soil degradation which can be equated to the quantity of lost soil nutrients;
iv. Taking an income approach whereby an estimate is made for reinvestment of a share of income from land to maintain the same level of income; and;
v. The cost of rehabilitating the plot to its former productive condition.

Applied to soils, it would mean that a proportion of the profits made from exploitative land use which results in degradation of land, were reinvested in some other way, say in reclaiming coastal marshland to maintain the same level of income originating from the same land use. Each of these methods measure soil degradation from a different angle. Some of these methods can be used only for a particular type of degradation whereas some can be used universally. For example the fourth approach is not suitable to measure the sort of soil degradation when the water table of some land area has gone down.

The third approach is the maintenance valuation approach which is more appropriate for the System of Economic and Environmental Accounting (SEEA). When the soil is restored to its former condition three components to estimate depletion and degradation of are:

- Cost of replacing nutrients through additional inputs to maintain level of productivity;
- Cost of replacing soil organic matter (and thereby restore structure which could be done, for example, by allotting part of the land to a green manure crop and foregoing production); and;
- Cost of replacing the eroded soil.

**Land quality indicators**

The Pressure-State-Response framework is a way used to group land quality indicators as follows:

**Group I: Pressure land quality indicators:** This group consists of primarily national production of agricultural commodities (crop, animal, area, yield), inputs (use of fertilisers, pesticides and other inputs) and cultivation practices (land use, are harvested, irrigation, soil conservation practices (to derive indicators such as)

- Ratio of cultivation: arable land;
- Production yield: arable land;
- Soil conserving: soil degrading crops; and;
- Nutrient inputs: nutrient outputs

**Group II: State land quality indicators:** This indicator compared the anticipated yield to the actual yield. Generally since there is no valid concept for anticipated yield (i.e. yield which is free form all constraints such as soil condition, water availability, salinity, agronomically and economically feasible yields are taken to develop land quality indicators such as
• actual yield: anticipated yield.

Such indicators can be aggregated by prominent types of soil degradation to monitor the policy impact. A large number of other indicators are available in this group which takes into account different agronomic attribute into consideration to measure the state of impact.

Group III: Response Land quality indicators: This group primarily involves adoption of soil conservation techniques, use of special inputs, crop rotation program, leaving field fallow for some time with reference to number of farmers adopting such techniques or extent of area covered.

7.5 COLLECTION OF STATISTICAL DATA

Four main methods of collecting data were highlighted as follows:

• Remote sensing technique;
• Cadastral mapping;
• Census of Agriculture; and;
• Sample surveys.
8. MANAGEMENT OF COMMUNICATION
by John King
Office for National Statistics
(April 9 - 11, 1997)

8.1 INTRODUCTION
Management of communication is a tool utilised in the collection, analysis and dissemination of data. It is even more important for environment data because it is multidimensional in nature and requires data from almost all fields to enable one to assess the extent to which the development process is sustainable. The main aims of introducing the course topic on management of communication were to familiarise participants with basic management concepts and their application in statistical units and to identify the different types environment data and environment data collection procedures for inclusion in an environment information network. To achieve the above mentioned objectives, the lecturer used experiences of participants in management of communication through group discussion, plenary presentations and lectures.

8.2 PROPOSAL FOR PRODUCTION OF STATISTICS ON ENVIRONMENT
The participants were divided into four groups. Each group was assigned to develop a proposal for the production of statistics on environment. The members of each group were treated as a syndicate group in charge of developing environment statistics and were required to report back to the director of statistics to discuss the plans.

When the participants first did this exercise the following observations were made; environmental statistics is an elephant, difficult to operationalise, therefore the presentations from each group are general in nature rather than specific and precise and wider context to environment issues with regard to their harmonisation at an international levels was a strong point of the group presentations.

8.3 MANAGEMENT
Management is defined as obtaining objectives/goals with specific resources in the most efficient way. Management is often seen as “getting the work done” or “meeting the targets” or “achieving results” or even “making decisions”. The key aspects of management are

- Accountability;
- Leadership;
- Defining aims and objectives;
- Organising and planning;
- Controlling and evaluating;
- Achieving results;
- Training and development of individuals; and
- Communication - written and spoken.

Most aspects of management may and should be delegate. Two aspects of management however should not be delegated. These are accountability and leadership.

8.4 PLANNING AND IMPLEMENTING A PROGRAMME OR STATISTICAL UNIT.
Planning is carried out so that appropriate resources in terms of money, people, time and equipment are found and efficiently and effectively managed. Planning advocates for proac-
tive approaches rather reactive approaches which are related to crisis management. Planning provides the knowledge on what has to be done, when, by whom and why. The steps involved in planning are:

- List the objectives (why are we doing the survey? Who are the users? What are their needs? When?) (it is very crucial to get this step right);
- List the tasks to achieve the objectives, timetable them;
- List the resources needed for the tasks, and when (people, equipment, money, etc. - all need to be timetabled);
- List the resources available, and compare this to the resources needed to see the resource gaps and when these occur - fill the gaps;
- Set up monitoring procedures; and
- Go - start the clock on the revised agreed programme; allocate tasks; monitor progress and use of resources, revise and improve.

Planning, managing and implementing are not static activities. There is therefore, the need to continuously review plans. This enables one to adapt to changes and succeed. The same considerations apply to implementing change and to improving quality. Figure 8.1 below describes the planning cycle.

**Figure 8-1 Planning Cycle**

![Planning Cycle Diagram](image)

and continue round the cycle....

### 8.4.1 Objectives

Objectives provide focus for work and should be set in all areas dealing with resources, activities, results. Productivity is equal to results/resources. Objectives are usually set by others such as one’s lines manager, or a client, particular user of data. They can also be set by the individual. Objectives should be S M A R T.

- **S** Specific
- **M** Measurable
- **A** Agreed
- **R** Realistic
- **T** Timebound.

Objectives are crucial for management information systems, for they provide the yardstick for measuring performance. The above mentioned principles also equally apply to objectives for
tasks and to those for people. The tasks of a senior manager may become the objectives for the next person in the hierarchy. The figure below shows the flow of tasks. It is worth noting that the kind of objectives set for people are behavioural (describe some form of behaviour). Objectives that are set for people are behavioural. In this respect they describe some form of behaviour.

**Figure 8.2 Flow of Tasks**

<table>
<thead>
<tr>
<th>Senior Statistician</th>
<th>Objectives</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistician</td>
<td>Objectives</td>
<td>Tasks</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Statistical Officer</td>
<td>Objectives</td>
<td>Tasks</td>
</tr>
</tbody>
</table>

### 8.4.2 Tasks:

A complete list of tasks are required. A timetable is a key tool utilised in listing tasks it specifies how the tasks will be done by whom, and when.

An exercise (2) was given to the participants to specify objectives for the Environment Statistics Unit and draw up a task plan and timetable to meet these objectives. The participants were told to build upon the ideas that were discussed in the first exercise.

### 8.4.3 Resources Needed

We can build on the task (or activity) list and timetable to develop a resource plan and timetable. This will indicate the skills and knowledge needed for each task, and will show how many people (or man-hours) are needed. We should show what equipment, transport, consumables, accommodation, money etc. will be needed for each task; when each of these will be needed, and for how long.

### 8.4.4 Resource Gaps

We also need to draw up a list of what resources are available. (We may have to make assumptions about the basis for this or the budgets to be agreed, but these assumptions will be clear and can be checked subsequently). A comparison of the resources needed and those available will show the resource gaps: which resources are missing, and when. The gaps may be in money, time, people/ skills, equipment, etc., or some combination of these. The gaps need filling in one way or another: modifying the plans or objectives; finding resources from elsewhere; not doing something else; otherwise we will not be able to do the survey as planned.

Training may be a very important way of filling some of the human resource gaps. Again, an inventory of a person’s skills will be compared with the skill requirements of the task or job. A training programme is designed to fill these gaps. Note that the training programme thus has clear objectives, which should be agreed by the trainee, the line manager, and the trainers.
8.4.5 Monitoring

We need monitoring procedures to track what is happening and what is not happening; to get some advance indications of potential trouble areas. Information from the monitoring systems allows us to be in control, and to plan for changes. Together with the action plan/timetable we can see consequences of developments and adjust plans accordingly. The information from these systems should be shared widely; all those involved in the task (the team) need to know what is happening, so they to can act.

8.4.6 Managing Change

We need to know how to manage change. We start with a vision of what we want the result to be - where we will be; what our unit will be, what our outputs will be, what our performance will be etc. We need a clear vision of the “destination”. There will be some details, and the more that is known the better, but the picture has to be one that can be communicated simply and easily. It will provide motivation and inspiration.

We have to take stock of where we are, and then plan the route. We should concentrate on the destination, not on the present problems and difficulties (these are what we are moving away from, changing). The emphasis is on how to get there, not on how to leave here. Don’t worry about present constraints and obstacles; these will be dealt with in the action plan if they are relevant.

How to get there? List the things working in our favour, and those that might hold up progress to the vision. How can these be used to our advantage? How can we step over the obstacles or remove them? There will be budgets and equipment to include under this analysis. A useful tool in achieving this analysis is the SWOT chart (Strengths, Weaknesses, Opportunities and Threats. The Table below shows the results of a discussion held on strengths and weakness in setting up an environment statistics unit.

### Table 8-1 SWOT Analysis for Setting up and Environment Statistics Unit

<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>National obligations</td>
<td>Lack of experience</td>
</tr>
<tr>
<td>International obligations</td>
<td>Clear specifications agreements</td>
</tr>
<tr>
<td>Legislation</td>
<td>No common objective</td>
</tr>
<tr>
<td>Desirable activity</td>
<td>Lack of transparency (unwillingness to declare existing problems)</td>
</tr>
<tr>
<td>Relevant</td>
<td>Bureaucracy</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deal with current problems</td>
<td>Treading on others toes</td>
</tr>
<tr>
<td>Influence current policy</td>
<td>Transparency (Fear of loss of political power in event of poor performance statistics)</td>
</tr>
<tr>
<td>Current interest world wide</td>
<td>Competition between agencies</td>
</tr>
<tr>
<td>Gain resources because it is topical</td>
<td>Hostile reactions</td>
</tr>
<tr>
<td>Better use of data at the CSO.</td>
<td>Proliferation/competition between agencies</td>
</tr>
<tr>
<td>Transparency (more awareness)</td>
<td></td>
</tr>
</tbody>
</table>

There will also be people to consider, and not just those who will be doing the changes. Other people will be affected: our users, other parts of the office, our suppliers (people and firms who provide data). The interested groups, people, organisations - both internal and external to the organisation. These are sometimes referred to as the stockholders. Stockholders are those who affect and who are affected by the unit’s or organisation’s activities and policies. We need to think
of their attitudes: will they be for, against or indifferent? Again, we need to plan how to handle them: to encourage them, enlist their support, persuade them, and neutralise them. The Figure 8.3 shows the diagram that was discussed during plenary indicating the stockholders in the area of environment statistics.

**Figure 8-3 Stockholders Analysis**

![Stockholders Analysis Diagram]

Draw up an action plan showing the route, the difficulties and traps, the side-roads, leading to the destination. Determine how to navigate through to the destination; the time scale, the timetable and the actions you will have to take at each point.

**8.5 USERS AND PRODUCERS OF STATISTICS**

In statistical work, the objectives are, almost always, set by the users of the statistics. They will specify what they want and when they want it. Producer-User relationships and communication are thus essential if the tasks (e.g. the survey) are to be well and clearly specified, and the users’ needs met.

The objectives should specify in some detail the output of the survey and a timetable for this. Then we know: why we are doing the survey, who the main users are, and what are their needs. The users know clearly what they will get and when, and it has been agreed. (One of the golden rules of questionnaire design is, “start with the tables, then see the questions to be asked”. So, this discussion will set some of the objectives).

Discussions between users and producers should start at the beginning of the survey and go on past the end. These communications and relationships don’t start with a dissemination workshop, or when something goes wrong with the survey (e.g. delays). Users are an integral part of the survey team. They may be helpful in many ways at different stages of the survey. In some instances, they may even provide some resources for the completion of the survey. Remember that they are the customers.
8.6 COMMUNICATION AND NETWORKING

Communications may be formal or informal (and are usually a mixture of both) and can be at different levels depending on the nature of the communications. There are occasional high level forms of communication, dealing with strategic aspects through a Steering or Management Committees. At a lower levels, there are more frequent formal meetings to monitor progress and to deal with more routine matters, through Liaison Committees. Informal communication (often called networking) is also very important. It allows people to be consulted and to influence decisions before reach decision making levels. On the other hand, they help contributors to form their own views before formal encounters. Many matters going to formal meeting will have been discussed, and possibly resolved, in this way beforehand, informal communication can help to defuse potential clashes and can help to encourage others to co-operate.

8.7 CONCLUSION

To conclude the course topic the participants were given the same exercise as the first one. It was clear from the presentations that the important aspects of management of communication had been grasped. It was also noted the time spent by each of the participants in the room amounted to 2 to 3 weeks emphasising the need for team building in order to achieve the stated goals.
9. INFORMATION SYSTEM ON SUPPLY AND USE OF ENERGY

by Helmut Mayer
Federal Statistics Office of Germany
Wiesbaden
(April 14 - 16, 1997)

9.1 INTRODUCTION
Information systems on supply and use of energy answer key questions such as: Do we have the energy we need? Are the sources adequate? What are the prices?. Energy information systems are also an input into environmental data bases especially in the estimation of air pollution. The aim of introducing this course topic was to enable participants to be familiar with information systems, to monitor and assess stocks and use of energy and materials. The construction and use of energy balance sheets as a tool for monitoring and assessing was also introduced. This topic was supplemented by a tutorial to enhance the understanding of balance sheets. In addition an exercise on construction of balance sheets was carried out using the spreadsheet package EXCEL.

9.2 THE NEED FOR AN ENERGY INFORMATION SYSTEM
The energy information system is essential for economic reasons. There is need to account for how much income has been earned from energy as a sector and also how much energy is used by the different sectors of the economy. The information system is also important for environmental assessment. Production and transformation of energy is regarded to be the main source of pollution. In this respect, the emission of carbon dioxide and formation of acid that is mainly connected to the combustion of fuels. Another example of an environmental impact related to use of energy is the danger of radiation connected with nuclear power plants. It is important to note that the impacts of production and transformation of energy are at the various levels, namely global, regional and local.

The impacts at a global level include issues such as the greenhouse gases which lead to the depletion of the ozone layers.. The local level issues include land use changes e.g. in setting up uranium mines the land used may change from forestry to the industry. The construction of roads is another land use change which is directly related to use of energy in transportation. The atmosphere is warmed up by transformation of energy from chemical to mechanical rather than consumption that is why we have global warming. Table 9.1 shows the various pollutants/emissions and the level at which the impact on environment is most evident. Table 9.2 shows the effect and source of pollutant.

<table>
<thead>
<tr>
<th>Table 9.1 Level of Environmental impact for Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pollutants/Emissions</strong></td>
</tr>
<tr>
<td><strong>Level</strong></td>
</tr>
<tr>
<td>Local</td>
</tr>
<tr>
<td>Regional</td>
</tr>
<tr>
<td>Global</td>
</tr>
</tbody>
</table>
Table 9.2 The Effects of Different Pollutants/Emissions and Their Sources

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Effect</th>
<th>Caused by</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO</td>
<td>Affects the health of the population</td>
<td>fossil fuels, gas and coal</td>
</tr>
<tr>
<td>CO₂</td>
<td>Leads to global warming</td>
<td>diesel oil</td>
</tr>
<tr>
<td>SO₂</td>
<td>Formation of acid rain</td>
<td>diesel oil</td>
</tr>
<tr>
<td>NOₓ</td>
<td>Global warming</td>
<td>diesel oil</td>
</tr>
<tr>
<td>Particulate</td>
<td>Toxic substances which affect human health</td>
<td>Diesel oil</td>
</tr>
<tr>
<td>VOC</td>
<td>Ozone layer depletion</td>
<td>Petroleum products</td>
</tr>
</tbody>
</table>

Some of the key questions which need to be answered in formulation of an energy information system are:

- What will be the land use changes in construction for hydroelectric plants?
- What are the energy demands for fuelwood and to what extent can these be met from the available forest resources?
- Can the environmental impacts be reduced by change in energy sources?

9.3 BALANCE SHEETS

Balance sheets are principally constructed for various uses. These include simulation which is utilised for forecasting. For instance what would happen to the energy sector if imports went up. The balance sheets are also utilised to determine which form of energy is most efficient. Each kind of energy produces some form of air pollution so balance sheets can utilise to estimate air pollution that is caused by the different sectors of the economy. Finally balance sheets are utilised in construction of input output tables which are utilised in the production of national accounts.

Table 9.3 shows an example of the balance sheet constructed for Germany in an aggregate form. Table 9.4 shows the actual distribution of each of sector by type of energy sources.

In order to formulate the balance sheet the following assumptions are made: Each type energy generated has an input however potential power is not calculated. Therefore, for hydroelectric power one assumption is that input is equal to output. Another assumption is that hydroelectric power has useful energy coefficients of 1:3. The assumption made for hydroelectric power are the same as those that can be made for nuclear energy.

A source of energy is either primary or is transformed. Hot steam water is not considered as a primary source but rather another source of energy. The outcome of nuclear energy is mostly electricity and hence not a primary resource. For hydroelectric power there is no transformation output because it is a primary source of electricity. This is also the case for natural gases. Oil has transformation figures both in the transformation output and primary production because of aggregation. Some types of oil are primary and others are transformed. In this regard raw petroleum is a primary source whereas diesel, gasoline, kerosene, heating oil are all transformed sources of energy.

9.3.1 Units Utilised in Presentation of Energy Statistics

In order in come up with table 9.1 and consequently table 9.2 there is need to convert the various sources of energy into one unit the terajoule which is the most commonly used unit. The relationships between the units is highlighted below:

1 joule/sec = 1 watt = Volt x ampere
1 joule = watt second
Kilo = 10³
Mega $= 10^6$
Giga $= 10^9$
Tera $= 10^{12}$
Peta $= 10^{15}$
Exa $= 10^{18}$
1 kwh $= 3,600,000$ watt seconds
1 kcal $= 4.1868$ kilojoules
1 kcal/h $= 0.27778$ cal/s $= 1.163$ watt
1 ws $= 1$ j $= 0.239$
1 kwh $= 3600$ kj $= 860$ kcal
1 w $= 1$ j/s $= 0.239$ cal/s $= 0.86$ kcal/h

The calorific values for the various sources of energy are as listed below:-

<table>
<thead>
<tr>
<th>Item per 1000 tonnes</th>
<th>Terajoules (TJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard coal</td>
<td>29.767</td>
</tr>
<tr>
<td>Lignite</td>
<td>8.74</td>
</tr>
<tr>
<td>Hard brown coal</td>
<td>14.95</td>
</tr>
<tr>
<td>Hard brown coal briquettes</td>
<td>19.46</td>
</tr>
<tr>
<td>Lignite coke</td>
<td>29.935</td>
</tr>
<tr>
<td>Fuel wood (in Germany)</td>
<td>14.654</td>
</tr>
<tr>
<td>Crude oil</td>
<td>42.75</td>
</tr>
<tr>
<td>Motor gasoline</td>
<td>42.733</td>
</tr>
<tr>
<td>Heavy fuel oil</td>
<td>40.614</td>
</tr>
<tr>
<td>LPG</td>
<td>45.987</td>
</tr>
</tbody>
</table>

9.3.2 Construction of Balance sheets

Having transformed all energy into one common unit then the balance sheets are calculated based on the theories in national accounts as represented in the following formula:

$$P = IC + Cpr + Cpu + Inv + Ex - Im$$

whereby

- IC Intermediate consumption
- P Production
- Cpr Private consumption
- Cpu Public consumption
- Inv Investment
- Ex, Im Exports and Imports respectively.

For example for steam hot air: Total transformation output of steam (199260) = Consumption of energy sector (13480) + distribution losses (15830) + industry (36,930) + transport (150) + households commerce and public authorities (125870).
Hence box 9.1 below highlights the formula that is utilised based on the principle of national accounts

**Box 9.1 Formular Utilised for Construction of Balance Sheets in Germany**

<table>
<thead>
<tr>
<th>Formula</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production (primary source)</td>
<td>1</td>
</tr>
<tr>
<td>+ Imports (Primary sources and derived energy)</td>
<td>2</td>
</tr>
<tr>
<td>+ Withdrawals form stocks (primary source and derived energy)</td>
<td>3</td>
</tr>
<tr>
<td>= Total domestic supply (primary sources and derived energy)</td>
<td>4</td>
</tr>
<tr>
<td>- Exports and ship’s bunkers (primary sources and derived)</td>
<td>5,6</td>
</tr>
<tr>
<td>+ Increase in stocks (primary sources and derived energy)</td>
<td>7</td>
</tr>
<tr>
<td>= Gross domestic use of primary sources (primary sources and derived energy)</td>
<td>8</td>
</tr>
<tr>
<td>- Transformation input (primary sources and derived energy)</td>
<td>22</td>
</tr>
<tr>
<td>+ Transformation output (derived energy)</td>
<td>36</td>
</tr>
<tr>
<td>- Energy consumption with energy branches</td>
<td>45</td>
</tr>
<tr>
<td>- Distribution losses, etc.</td>
<td>46</td>
</tr>
<tr>
<td>= Energy available for final consumption (primary sources and derived energy)</td>
<td>47</td>
</tr>
<tr>
<td>- Non-energy consumption (primary sources and derived energy)</td>
<td>48</td>
</tr>
<tr>
<td>+/- Statistical discrepancies (primary sources and derived energy)</td>
<td>49</td>
</tr>
<tr>
<td>= Final energy consumption (primary source and derived energy)</td>
<td>50</td>
</tr>
</tbody>
</table>
### Table 9.3 Energy Balance Sheet for Germany 1980 in Terajoules

<table>
<thead>
<tr>
<th>ENERGY BALANCE SHEET 1980 GERMANY TERAJOULE</th>
<th>R</th>
<th>Hard coal</th>
<th>Lignite</th>
<th>Other solid fuels</th>
<th>Oil</th>
<th>Petroleum</th>
<th>Prod. gas</th>
<th>Nat. gas</th>
<th>Electric energy</th>
<th>Hydro electric power</th>
<th>Nuclear energy</th>
<th>Steam hot water</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTION</td>
<td>1</td>
<td>2585982</td>
<td>1109671</td>
<td>59310</td>
<td>197383</td>
<td>0</td>
<td>613786</td>
<td>0</td>
<td>166622</td>
<td>0</td>
<td>4732754</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMPORTS</td>
<td>2</td>
<td>314523</td>
<td>55761</td>
<td>0</td>
<td>5829978</td>
<td>19471</td>
<td>1367568</td>
<td>184875</td>
<td>0</td>
<td>420200</td>
<td>0</td>
<td>8192196</td>
<td></td>
</tr>
<tr>
<td>WITHDRAWAL FROM STOCKS</td>
<td>3</td>
<td>29711</td>
<td>1091</td>
<td>0</td>
<td>36140</td>
<td>594</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>67448</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>TOTAL DOMESTIC SUPPLY</td>
<td>4</td>
<td>2990216</td>
<td>1166523</td>
<td>59310</td>
<td>6063501</td>
<td>19975</td>
<td>1981354</td>
<td>184875</td>
<td>0</td>
<td>420200</td>
<td>0</td>
<td>12929364</td>
<td></td>
</tr>
<tr>
<td>EXPORTS</td>
<td>5</td>
<td>610941</td>
<td>17981</td>
<td>2947</td>
<td>283381</td>
<td>19763</td>
<td>83678</td>
<td>129352</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1148243</td>
<td></td>
</tr>
<tr>
<td>SHIPS' BUNKERS</td>
<td>6</td>
<td>314</td>
<td>0</td>
<td>0</td>
<td>121184</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>122098</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>INCREASE IN STOCKS</td>
<td>7</td>
<td>59903</td>
<td>162</td>
<td>0</td>
<td>215109</td>
<td>774</td>
<td>10537</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>286485</td>
<td></td>
</tr>
<tr>
<td>GROSS DOM. USE OF PRIM. SOURCES</td>
<td>8</td>
<td>2259058</td>
<td>1148368</td>
<td>56363</td>
<td>5443227</td>
<td>-562</td>
<td>1886093</td>
<td>55323</td>
<td>0</td>
<td>420200</td>
<td>0</td>
<td>11435570</td>
<td></td>
</tr>
</tbody>
</table>

#### Consumption of the Energy Sector

| CONSUMPTION OF THE ENERGY SECTOR | 45 | 9752       | 1635      | 0           | 166163 | 275752    | 58067     | 138438   | 0 | 134880         | 0                 | 658737         |       |

#### Distribution Losses

| DISTRIBUTION LOSSES | 46 | 0         | 0         | 0           | 17152  | 19958     | 86871     | 0       | 0 | 15833          | 139871           |       |
### Table 9.4 Composition of Total Domestic Supply and Percent Distribution of Final Energy Distribution by Sector

<table>
<thead>
<tr>
<th>I. Composition of Total Domestic Supply</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTION</td>
<td>1 88.3 95.1 100.0 3.3 0.0 31.0 0.0 100.0 0.0 -/0! 36.4</td>
</tr>
<tr>
<td>IMPORTS</td>
<td>2 10.7 4.8 0.0 96.1 97.5 69.0 100.0 0.0 100.0 -/0! 63.1</td>
</tr>
<tr>
<td>WITHDRAWAL FROM STOCKS</td>
<td>3 1.0 0.1 0.0 0.6 2.5 0.0 0.0 0.0 0.0 -/0! 0.5</td>
</tr>
<tr>
<td>TOTAL DOMESTIC SUPPLY</td>
<td>4 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Composition of Final Energy Consumption</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>FINAL ENERGY CONSUMPTION</td>
<td>50 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0 100.0</td>
</tr>
<tr>
<td>INDUSTRY</td>
<td>73 75.2 44.2 8.3 16.5 75.5 10.4 47.9 -/0! -/0! 22.7 34.3</td>
</tr>
<tr>
<td>TRANSPORT</td>
<td>78 0.3 0.6 0.0 40.3 0.1 0.2 3.4 -/0! -/0! 0.1 22.1</td>
</tr>
<tr>
<td>HOUSEHOLDS, COMMERCE; PUB.AUTH...</td>
<td>79 19.0 55.0 91.7 31.6 24.4 49.4 48.7 -/0! -/0! 77.2 42.3</td>
</tr>
<tr>
<td>ARMED FORCES</td>
<td>80 5.4 0.3 0.0 1.6 0.0 0.0 0.0 -/0! -/0! 0.0 1.3</td>
</tr>
<tr>
<td>TOTAL ENERGY CONSUMPTION</td>
<td>50 8.6 1.8 0.2 53.4 4.0 15.0 14.8 0.0 0.0 2.2 100.0</td>
</tr>
<tr>
<td>INDUSTRY</td>
<td>73 18.9 2.3 0.0 25.8 8.9 22.0 20.7 0.0 0.0 1.4 100.0</td>
</tr>
<tr>
<td>TRANSPORT</td>
<td>78 0.1 0.0 0.0 97.3 0.0 0.2 2.3 0.0 0.0 0.0 100.0</td>
</tr>
<tr>
<td>HOUSEHOLDS, COMMERCE; PUB.AUTH...</td>
<td>79 3.9 2.3 0.4 52.5 2.3 17.5 17.1 0.0 0.0 4.0 100.0</td>
</tr>
<tr>
<td>ARMED FORCES</td>
<td>80 35.3 0.4 0.0 64.4 0.0 0.0 0.0 0.0 0.0 0.0 100.0</td>
</tr>
</tbody>
</table>

#### 9.4 IMPORTANT INDICATORS ON ENERGY CONSUMPTION

Some of the important indicators constructed from energy balance sheets are listed below as follows:

**Total domestic supply of energy**
- Level of total domestic supply of energy which can be presented as joules or coal units or oil units;
- Specific energy consumption which can be presented in monetary units and presented as a proportion of GDP; and;
- Specific energy consumption which can be presented as a per capita units; and;
- Total domestic supply of energy can further be disaggregated by domestic sources, different energy carriers (coal, gas, oil, hydro-power, nuclear power), renewable sources and by broad categories of use such as consumption within the energy branches, non-energetic use and final energy consumption.

**Final energy consumption**
- Level of final energy consumption in joules or coal units or oil units;
- Composition of different energy carriers (solid fuels, petroleum, gas, electricity, heat) by branches (industry, traffic, households and other commercial uses)
- Use categories of energy such as heat into industrial processes (electrolysis, furnaces, cracker), space heating, power, traffic, lighting.

**Energy content of goods and services**
- Total energy content presented in input output tables;
- Net energy content (primary sources); and;
- Breakdown of resources into sources (domestic generation, directly imported, energy content of imported commodities) breakdown of use categories (consumption, capital formation, exports) and breakdown into commodities (of final domestic use).
9.5 **SOURCE OF ENERGY STATISTICS**

The main sources of energy statistics in Germany include:

- Survey for establishment and enterprises of electricity gas, steam and water supply.
- Survey with in mining and manufacturing for establishments on consumption and stocks of fuels(quarterly) on purchases and use of electricity and on production (amounts and values) and survey for enterprises on costs of energy inputs on a yearly basis and on input of raw materials every 4 years.
- Other statistics, such as petroleum products and taxes on them, statistics on trade exports and imported and are collected from the specific government ministries responsible.
- Statistics on private consumption are derived from household surveys which are carried out at various intervals (quarterly, yearly and 5-yearly basis).

9.6 **PROPOSALS TO SAVE ENERGY**

The proposal to save energy were drawn from the participants using cards. The following were the recommended

**Developed countries:**

- Stop using nuclear power and start using solar energy;
- Start using solar driven cars;
- Change consumption patterns and promote public transport; and;
- Adopt decentralised energy systems.

**Developing countries:**

- Promote use of solar energy and hydro power;
- Change attitudes and perceptions about energy used;
- Changes in technology; and;
- Utilise economic techniques, such as taxes and pricing, to save energy.

9.7 **CONCLUSION**

A paper entitled “The Energy Sector in Swaziland” was presented. In this paper the balance sheet of Swaziland and the actions, projects and programmes that were currently being undertaken were presented. This example enhanced the understanding and applicability of energy statistics in developing countries.
10. ENVIRONMENT MODELLING

by Sui San Lim
ÖKO INSTITUTE OF ECOLOGY
DARMSTADT
(April 17 - 18, 1997)

10.1 INTRODUCTION
Environmental modelling is the estimation of environmental changes including forecast under different scenarios (with or without environmental measures). An example of a computer based environmental modelling package namely “Environmental Manual” was introduced. EM is package utilised for modelling energy options for power development. It has been developed by the ÖKO Institute for Applied ecology for the German Government with sponsorship through GTZ and co-ordinated by World Bank. Other donors include DFID (ODA) and Bank of German (KFW).

10.2 THE ENVIRONMENTAL MANUAL
The environmental manual is a new tool for energy and environmental planning and cost analysis in developing countries. It is a database system which contains information on costs and quantitative environmental impacts of energy system. The EM is also an analysis system which determines life-cycle costs and emissions whereby a cycle is the process from extraction, transportation conversion of energy, combustion and end use. The EM is an evaluation tool used to decide the trade-offs between impacts, and helps to address uncertainty. It utilises a self explaining windows interface.

Countries which do not have adequate data can utilise the generic data offered by the EM to make preliminary estimates for power development. EM also provides the possibility to utilise own data. In this regard therefore a pragmatic approach can be adopted in developing a system for finding the most appropriate energy sources. Hence building a data base system using a step by step procedure.

EM enables one to carry out consistency checks of data by comparing with generic data bases and computation of fuel dependent emissions. It offers various analytical options e.g. the breakdown to local/global impacts, contributions of individual powerplants to results of larger system.

10.3 QUESTIONS THAT CAN BE ANSWERED BY EM
There are different kinds of questions that can be answered by EM and these are as stated below:

Utility
- Alternative to cover demand for power?
- What are the least cost options?
- What options comply with emission standards?

Ministry of energy
- What are the economic, environmental and social effects of the alternatives?
- What long term environmental effects of the supply options?
- Which power sources fits into national strategy?
- What are the emission standards required by lending agencies?

Lending agencies
Chapter 10 Environmental Modelling

- What are the long term environmental effects of strategies/options?
- What alternatives comply with own standards?
- What are internal/external costs of alternatives?
- What are the financing options for global warming benefits?

**Local Authorities, NGOs**
- What are the direct/indirect local environment effects of alternatives?

### 10.4 DATA CONTAINED IN EM

The EM data base contains data on the different types of energy and materials. For each energy source EM contains data on: processes of extraction by technology type, different means of transportation used for energy extraction, conversion technologies, end uses and cost data. It also contains data on the types of emissions, land use effects and material use. The EM data contains generic data which can be changed with country and technology specific information for the country or region in question. Figure 10.1 below shows the areas and type of results expected from EM

**Figure 10.1 Results of EM**

<table>
<thead>
<tr>
<th>Qualitative Data</th>
<th>Environmental Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(Biodiversity, ecosystems, socio-culture, Human Health)</em></td>
<td></td>
</tr>
</tbody>
</table>

**Quantitative Data**

- Cost impacts
- Internal
- External
- Net Present Value

**Other Data**

- Compliance with environmental standards
- Airborne emissions 
  \( \text{(} O_2, \text{ NO}_x, \text{ Particulates HCl, HF)} \)
- Greenhouse gases 
  \( \text{(} CO_2, CO, CH, \text{ NMOVOC, N}_2\text{O CFC)} \)
- Heavy Metals 
  \( \text{(such as Cd, Hg, Pb)} \)
- Solid wastes 
  \( \text{(bottom/fly ash, FGD residuals)} \)
- Liquid effluents 
  \( \text{(user defined)} \)
- Land use

### 10.5 SCENARIOS

The EM is a demand driven bottom-up approach. In other words EM scenarios start with the demand, then the supply options are defined which deliver electricity and or heat. The supply side includes different forms of power including steam turbine power plants (coal), steam
turbine (oil), wind turbine, cogenerator, boiler, stove, hydro plant and combined cycle power
station.

10.6 CURRENT ACTIVITIES OF EM
The current activities of EM are as outlined below:-

- An ongoing case study for Morocco on the effects on environmental standards;
- EM applications in World Bank District Heating Study on project evaluations in
  Central/Eastern Europe; and;
- EM user Network in the internet.

The activities that are planned include:

- Support for EM applications in (China, Southern Africa);
- Database extensions (industry, transport); and;
- Model and data base extensions/updates.

10.7 EXERCISES
To have an understanding of the functioning of EM the participants were given a step by step
procedure for using EM. This entailed working with a generic database in order to learn how
one can adjust fuel and process records, and how to create scenarios to compare energy
options. The participants also worked through an exercise to answer the question “Is it more
economical and more effective to buy a low sulphur coal and burn it in a power plants with no
emission control device for sulphur dioxide or burn high sulphur coal in a more expensive
power plant equipped with emission control technologies to reduce sulphur dioxide?”

Three types of sulphur were identified these were models burning high sulphur coal in a
power plants equipped with emission control technologies, a second option which burned low
sulphur coal which is not equipped with any pollution control devices and an option base case
which represents original generic data.

The results of the exercise were that while an environmental friendly power plant is certainly
more expensive because of additional investments in pollution control devices, it may be the
least cost solution for internal and external cost. Interest rates for additional investment are
low and there is a discount for the high sulphur fuel.

The example did not recommend to burn high sulphur coals at any price. However, it clearly
showed that in case only a high sulphur coal is available and low-sulphur coals carry a high
premium (or supply is unreliable) it is certainly more cost effective and more environmentally
friendly to burn the high sulphur coal in an expensive power plant equipped with a wet scrub-
ber for flue gas de-sulphurisation than trying to burn a low-sulphur or standard sulphur fuel in
a normal power plant.
11. QUANTIFICATION OF ENVIRONMENT RELEVANT ACTIVITIES OF INDUSTRIES (MINING AND MANUFACTURING)

by Gilles Tremblay
Genivar-Quebec, Canada
(April 21 - 23, 1997)

11.1 INTRODUCTION
The two days session was an introduction to use of statistics, and statistical methods, for environmental impacts assessment of mining and production of pulp and paper industries. Examples from Canada were utilised as case studies. In Canada both industries are of great economic importance and are subject to the same kind of monitoring processes. The important role played by partnership between government and industries in achieving successful environmental monitoring programmes in Canada was stressed.

11.2 MINING
There are two primary step in the mining process. These are extraction and beneficiation. Extraction is the removal of ore from deposits in the ground. Once the ore is removed, additional processing is required to isolate the valuable minerals from the remaining wastes. These supplementary processing steps are known as beneficiation. In some cases, the ore is not crushed, but the valuable metal is extracted by leaching. This implies the use of chemicals (sulphuric acid most of the time) to dissolve the metal. Based upon the location and type of mineral, the mining practices may differ, but they all lead to large amount of waste materials.

The mining operations produce large amount of waste minerals and tailings. Once these wastes and tailings get into contact with air and water they become major sources of three kinds of environmental impacts namely acid mining drainage, air pollution and land use.

The acid mining drainage is caused by the presence of sulphurs in waste materials. When the sulphur gets into contact with air and water it produces acid which lowers the PH and results in metals dissolving. The solution produced may in some instances be transported to the rivers, lakes and underground water. The acid mining drainage is by far the worst problem of mining. Pollution caused by transportation of particles by the wind is less important. However, in some cases, the pollution may have severe consequence for particular cases. For example pollution caused by asbestos is dangerous for human health. In these situations, a cover can be made with special textiles or other kind of rocks or minerals in order to stop the air pollution. Finally, the changes in land use due to drilling, blasting, and change in topography are considered to be environmental issues because of the hazardous nature of the mined region.

11.3 STEPS IN ENVIRONMENTAL PROJECT
In development of an environmental monitoring programme it was noted that the first crucial step is to get all background information on the project impacts assessments report. The following steps were recommended for the report.

1. Project rationale.
   - Cost/market analysis;
   - Socio-economic benefits;
   - Environmental ecology and economics; and;
• Description.

2. Project name

3. Technical description of project
   • Location, layout, land requirement and time table for development;
   • Construction supply requirement;
   • Mining operation;
   • Process and product;
   • Waste management;
   • Water management;
   • Infrastructure requirement;
   • Transportation system requirement;
   • Employment work force; and;
   • Health and risky safety risk.

4. Scope of environmental assessment
   • Temporal and spatial boundaries;
   • Potential for cumulative environment effect (difficult to asses);
   • Committee of specialists who set out the assessment criteria; and;
   • Value ecosystem components namely human beings, forests and animals.

5. Project Setting
   • Regional context;
   • Biophysical environment;
   • Socio-economic environment;
   • Land ownership; and;
   • Land use present.

6. Conservation with affected parties
   • Who to approach;
   • Nature of information; and;
   • Conservation technique.

8. Prediction and interpretation of environmental impact direct and indirect
   • Direct forecast response;
   • Criteria for assessing significance- ANOVA could be used;
   • Determination of impact significance; and;
   • Cumulative environmental impact.

9. Mitigation and compensation
   • How to reduce impact; and;
   • Residual impacts.

10. Monitoring programme
   • Objectives;
   • Parameters;
   • Sampling;
   • Methods;
   • Location;
   • Description of sampling site; and;
   • Sampling and reporting frequency.

11. Net profits and costs of the project.
11.4 STATISTICAL METHODS USED IN ANALYSIS OF ENVIRONMENTAL EFFECTS OF MINING AND MANUFACTURING

Analysis of Variance (ANOVA)
Analysis of variance (ANOVA) is a statistical method that is used to determine whether there is a significant difference between the means of variables such as height of plants, herbicides, etc., for the different habitat’s or groups. The assumptions made are; the different groups or habitat’s should be independent, the variables should be normally distributed with equality of variance and additivity of effects.

Principal Components analysis
Principal components are uncorrelated linear function of the multi-dimensional variables under consideration. This statistical method is used to reduce large amounts of multi-dimensional data (such as yields of beans, peas, potatoes, sorghum for different land types) to a manageable two or three factorial variables, which are a linear combination of the original variables. The principal component technique is an exploratory technique utilised to determine (the patterns of) relationships among variables, groups of samples, or simply explore data. The key question that arises having identified the principal component is that any meaning can be attributed to the resulting linear relationship. If there is an elaborate meaning attached to the components then the statistical method can be utilised to rank the variables under study.

Correspondences analysis.
The correspondences analysis is utilised to analyse categorical data. Such data does not need to have any ranking. They are simply identifiers of the different habitats, species or any other categories. In correspondences analysis the first step is to construct a contingency table which is centred and reduced. The sum of each line and column is then weighted (once for the lines and once for the columns). Diagonalisation of the resulting matrix is done in order to determine the factorials axis as in a principal components analysis. The first diagonalised matrix gives plots of columns identifiers of lines in the multidimensional space by columns variables and the other diagonalised matrix to give plots of the identifiers of lines in the multidimensional space of the same contingency table, the factorials axis are the same, so both projects can be done on the same graph. The correspondences analysis technique is useful as an exploration technique to find out what is happening in the different habitats.

Polynomial Regression
Polynomial regression is a statistical method that it utilised to study curvilinear relationships. In particular this technique was developed in Canada to study the relationships between fish (L) and mercury concentration (HG). Until very recently interpretation was based on linear regression, covariance analysis (ANCOVA) and Student newmann keuls (SNK) multiple comparisons of means mercury levels. These procedures were not always satisfactory.

For comparison between years, polynomial regression model relates mercury level to length (L), square length (L²), binary (dummy) indicator variables (Bᵢ), and the products of each of these explanatory variables (Lx Bᵢ, L²x Bᵢ, etc.) for each sample year as shown in equation below.

\[ HG = - L \times B₁ + L² \times B₁ + L \times B₂ + L² \times B₂ + \ldots \]

Polynomial regression with indicator variables allows to perform rigorous statistical comparison of mercury to length relationships in different years, even when the shape of the relationships differ. It is simple to obtain accurate estimations of mercury levels at standardised
length, and multiple comparisons of these estimations are simple to perform. The method can also be applied to spatial analysis (comparison of sampling stations), or to the comparison of different biological forms of the same species.

11.5 OVERVIEW OF THE STUDY ON GOLD MINING

The case study is based on gold mining in Val D'Or, in Québec. The study forms a part of the Aquatic Effects Technology Evaluation program which was created by the co-operation between industries and government. It’s purpose is to review and evaluate environmental monitoring technologies for the assessment of mining related impacts on the environment. The study considered the comparison of surficial mapping of sediment techniques, water quality, sediment toxicity and invertebrate and fish communities.

The pilot study was implemented in three main phases. The first phase was an assessment of the adequacy of the site selected by the technical committee by undertaking a field reconnaissance survey and preparing a field study design. The second phase was the implementation of the study design and the third phase was the preparation of a final report assessing and comparing the methods and recommending modifications to the design that allow the technical committee to reliably compare methods in subsequent years.

One of the methods utilised in analysing the case of gold mining is Canada was the Principle Components Analysis. It demonstrated that station groupings based on full and partial extraction were similar. Several other methods were utilised and a fish survey was carried out to evaluate various methods for measuring mining related fish community impacts. The major conclusions were that metal may be readily measured at detectable level in all tissue types samples. There is probably some inherent redundancy in the analysis of tissue types in adult fish. It was indicated that they are some possible differences in fish tissues among sites, suggesting that such measurements may be of some value as measures of biological response, young fish are easier to collect and maintain in viable condition than adult fish. It was also noted that field costs can be substantially reduced if small invertebrates could be monitored rather than organs of large fish.

11.6 A CASE STUDY FOR PULP AND PAPER INDUSTRY

The goal of regulations on effluents of pulp and papers is to measure and follow the consequences of industrial effluents on environment in order to evaluate if the regulations are adequate for fish and habitat protection. To do that, the program involves a series of cycles which allows to gather the scientific information needed to evaluate and improve the program. Each report produced at the end of a cycle is used to elaborate the next cycle. The environmental effects monitoring (EEM) programme was developed to guide the monitoring process of Canadian pulp and paper mills.

The EEM is carrying out an invertebrate survey which is a partial fulfilment of reporting requirements. In most cases, the invertebrate survey should involve collection of the macroinvertebrate community. The survey can be of two types that is intensive or extensive. The objective of an intensive survey is to test specific effluents related to hypothesis set. In general four sampling areas within each major habitat class will be sampled. Generally if historical information on the invertebrate communities within a system has been described in enough detail to determine where zones effects and recovery are located, then an intensive study should be designed. The objective of an extensive survey on the other hand is to describe variations in the invertebrate community relative to the effluent discharge. Extensive surveys are also needed to describe the zones of effect and recovery of the invertebrate community. Effect zones are those sections (areas) of the system where specific measures of invertebrate community structure are significantly different from sections of the system which receive no
effluent discharges. Zones of recovery are those sections of the system where measures of invertebrate community structure are more similar to measure from unexposed areas. Generally, recovery zones are found at increasing distances from the effluent discharge. An extensive survey is designed when there are no biological data on the system and when changes in effluent quality are expected to result in changes in the location(s) of the effect and recovery zones of the receiving environment.

The EEM is also carrying out a fish survey. A large number of biotic and abiotic factors determine the suitability of habitat for fish. Data on water and sediment quality cannot be used to define environmental acceptability, or monitor ecosystem level changes over time. It is necessary to monitor the resident biological of aquatic systems to ensure that no adverse changes in the ecosystem. Historically, fish have been useful organisms for evaluating environmental impacts on aquatic systems. Some of the advantages of using fish include:

- Some species are long-lived and therefore are good indicators of long-term effects
- The health of the local fish populations is of central importance due to their recognised socio-economic and recreational value;
- There is an abundance of literature on the life history, distribution and environmental requirement of fish, as well as on the responses of fish to a variety of chemical and physical stressors; and;
- Different species of fish are relative easy to identify and collect.

11.7 COMPUTER EXERCISES
The participants were given exercises to find out the relevance of applicability and repercussions of using some of the statistical methods in carrying out environment impact assessments. The windows based software entitled for statistical analysis was utilised to analyse hypothetical data.
12. QUANTIFICATION OF ENVIRONMENT RELEVANT ACTIVITIES OF INDUSTRIES (TOURISM)
by Andrea Möller
German Institute for Tourism Research - Munich
(April 23, 1997)

12.1 INTRODUCTION
The course topic on tourism was introduced so that the participants have an understanding of the impact of a service sector (such as tourism) on the environment. The course topic was treated under five main headings and these were:

- The life cycle analysis of tourism products;
- Tourism development world-wide and the transport problem;
- The domain of tourism definitions;
- Approaches to measuring tourism on the environment; and;
- Building up an information system on “Tourism and Environment”.

12.2 LIFE CYCLE ANALYSIS OF TOURISM PRODUCTS
The life cycle analysis of an inclusive tour is a conceptual framework utilised to analyse the impact of the tourism sector on the environment. In the life cycle analysis several materials are utilised. There different stages of the life cycle have different implications on the environment. The stages of an inclusive tour are as shown in Figure 12.1 below

Figure 12.1 Life Cycle Analysis of an inclusive Tour
For each stage of the life cycle there is an impact which could be environmental in nature, economic or social and these could be analysed by the various inputs into the various levels of the life cycle shown in Figure 12.1.

The greatest impact of tourism on environment is high air emissions as a result of air transportation. The scheme for calculation of primary energy consumption by different means of transport is given in the following Table 12.1. To get an impression of the magnitude of the problem the participants were requested to calculate the amount of energy that has been utilised in coming to the Munich Centre from their respective countries.

**Table 12.1 Scheme for Calculation of Primary Energy Consumption by Different Means of Transport.**

<table>
<thead>
<tr>
<th>Primary Energy Consumption per person and trip</th>
<th>Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>By Car</td>
<td>No of Kilometres x 2.88 mega-joule/Km per person in the car</td>
</tr>
<tr>
<td>By Bus</td>
<td>No. of kilometres x 0.35 mega joule/km (85% use of capacity)</td>
</tr>
<tr>
<td>By Train</td>
<td>No. of kilometres x 0.17 mega-joule/km</td>
</tr>
<tr>
<td>By Ship</td>
<td>No. of kilometres x 1.49 mega-joule/km</td>
</tr>
<tr>
<td>By Aeroplane</td>
<td>No. of kilometres x 1.49 mega-joule/km + (No. Of take-off/landings x 343 MJ)</td>
</tr>
</tbody>
</table>

Source: Mezzasalma, R., Eco-Management for Tour Operators, Research Institute for leisure and Tourism.

**12.3 CLASSIFICATION OF INTERNATIONAL VISITORS**

The flow diagram Figure 12.2 shows the classification of international visitors according to the World Tourism Organisation.
Figure 12.2 Classification of International Travellers

<table>
<thead>
<tr>
<th>Classification</th>
<th>Travellers</th>
<th>Not included in tourism statistics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leisure, recreation and holidays</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Visiting friends and relatives</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business and professional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religion and pilgrimages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main purpose of visit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non residents (foreigners)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crew members (non-residents)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nationals residing abroad</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cruise passengers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crews</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Key to Figure 12.2
1. Visitors who spend at least one night in the country visited, but less than one year.
2. Visitors who arrive and leave the same day for leisure, recreation and holiday; visiting friends and relative; business and professional; health treatment; religious pilgrimages and other tourism purposes, including transit day visitors en route to or from their destination countries.
3. Persons who arrive in a country aboard ship even when disembarking for one or more day visits.
4. Foreign air or ship crews docked or inlay over and who use the accommodation establishments of the country visited.
5. Crews who are not residents of the country visited and who stay in the country for the day.
6. As defined by the United Nations in the “Recommendations on the International Migration statistics, 1980.”
7. Who do not leave the transit areas of the airport or the port, including transfer between airports or ports.
9. When they travel from their country of origin to the duty station and vice-versa (including household servants and dependants accompanying or joining them).

12.4 CARRYING CAPACITY
The concept of carrying capacity was outlined as follows:

“How many tourists can I put there before I threaten the long term viability of the system?”

This concept of carrying capacity is founded on the experience of pastoral agriculture which is based on the principles that a pasture can support only a particular number of cattle in perpetuity. If this threshold is exceeded, the supporting system is damaged often to point where it can support no more grazing at all.

This concept only deals with one product (in this case cattle), the tourism product includes a variety of products and services. Tourism depends on many attributes of an environment - the aesthetics, wildlife, access to shoreline, ability to support active uses (e.g. Sports); each attribute has its own response to different levels of use. Different types of uses have different impacts. Different cultures have different levels of sensitivity towards change. Human activity’s impact can be gradual, affect different parts of the systems at different rates. Tourism environments are mostly multipurpose environments. Other uses have to be considered when determining the correct level of development.

Hence the concept of carrying capacity is not an ideal concept for evaluating impact of tourism on the environment. The simplistic concept of carrying capacity involving identification of a single threshold value is inadequate for tourism management. An approach should rather reflect the sensitivity of the different attributes of the environment to various types and levels of use. At each level of use certain trade-offs have to be made.
The dimensions of carrying capacity for sustainable tourism are highlighted in Box 12.1 below:

**Box 12.1 Dimensions of Carrying Capacity for Sustainable Tourism**

| Environment carrying capacity: The degree to which an ecosystem, habitat or landscape can accommodate the various impacts of tourism and its associated infrastructure without damage being caused or without losing its “sense of place”. |
| Cultural and social carrying capacity: The level beyond which tourism development and visitors numbers adversely affect local communities and their ways of life. |
| Psychological carrying capacity: The level beyond which the essential qualities that people seek in the protected area (such as peace and quiet, few other people, few signs of human development) would be damaged by tourism developments. |

*Source Federation of National Parks in Europe, 1993*

Carrying capacity is a concept beyond ecological matters. A policy for sustainable tourism development avoids serious environmental problems such as congestion, pollution of air and water, noise or degradation, degradation of ecosystems, overload of infrastructure. It also avoids loss of culture identity of the host society or serious social problems (e.g. Crime). It avoids serious economic distortions, while still bringing economic benefit. A sustainable policy for tourism development maintains tourists satisfaction levels so that the desired tourist markets continue visiting the area.

**12.5 APPROACH BY WORLD TOURISM ORGANISATION**

The aim of the approach proposed by World Tourism Organisation are

- To develop an international system of indicators for sustainable tourism;
- Measure sensitivity of environment rather than carrying capacity;
- To develop warning systems for areas of concern in order to improve decision making with regard to sustainable tourism development; and;
- Reduce number of crucial indicators.

The characteristics of indicators developed are grouped into two dimensions the core indicators for general application and destination specific indicators applicable to particular ecosystems or types of tourism. This disaggregation enables the understanding of tourism and environment as a two way relationship including socio-economic indicators. The areas of concern covered in this approach are environmental sensitivity, stress on the environment, results of tourist use and human, biological consequences of tourism use.
### Table 12.2 Ecosystem Indicators.

<table>
<thead>
<tr>
<th>Ecosystem</th>
<th>Sample Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal zones</td>
<td>Degradation (% of beach degraded, eroded) Use intensity (persons per metre of accessible beach) Shore/marine fauna (number of key species sightings) Water quality (faecal coliform and heavy metal counts)</td>
</tr>
<tr>
<td>Mountain regions</td>
<td>Erosion (% of surface areas eroded) Biodiversity (key species counts) Access to key sites (hours wait)</td>
</tr>
<tr>
<td>Cultural sites</td>
<td>Potential social stress (ratio average income of tourists/local) In seasonal sites (% of vendors open year round) antagonism (reported incidents between locals/tourists)</td>
</tr>
<tr>
<td>Small islands</td>
<td>Currency leakage (% loss from total tourism revenues) Ownership (% foreign/non-local ownership of tourism establishments) Water availability (costs, remaining supply) Use intensity measure (scale of entire island as well as for impacted sites)</td>
</tr>
</tbody>
</table>

### Table 12.3 Core Indicators of Sustainable Tourism

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>SPECIFIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site protection</td>
<td>Category of site protection according to IUCN index</td>
</tr>
<tr>
<td>Stress</td>
<td>Tourism numbers visiting site (per annum/peak month)</td>
</tr>
<tr>
<td>Use intensity</td>
<td>Intensity of use peak period (persons/hectares)</td>
</tr>
<tr>
<td>Social impact</td>
<td>Ratio of tourists to locals (peak period)</td>
</tr>
<tr>
<td>Developing control</td>
<td>Existence of environmental review procedure or formal controls over development of site and use densities.</td>
</tr>
<tr>
<td>Waste management</td>
<td>Percentage of sewage from sites receiving treatment (additional indicators may include structural limits of other infrastructure capacity on site e.g. water supply, garbage.)</td>
</tr>
<tr>
<td>Planning process</td>
<td>Existence of organised regional planned for tourist destination region (including tourism component)</td>
</tr>
<tr>
<td>Critical ecosystems</td>
<td>Number of rare/endangered species</td>
</tr>
<tr>
<td>Consumer satisfaction</td>
<td>Level of satisfaction by locals (questionnaire based)</td>
</tr>
</tbody>
</table>

The IUCN Protected Area Categories are as listed below

I.   Scientific reserve/strict nature reserve
II.  National park
III. Natural monument
IV.  Managed nature reserve or wildlife sanctuary
V. Protected landscape
VI. Resource reserve
VII. Natural biotic areas of anthropological reserve
VIII. Multiple use management areas/managed resource
IX. Biosphere reserve
X. World Heritage Site

12.6 EUROPEAN COMMUNITY MODEL OF SUSTAINABLE TOURISM

This approach of sustainable tourism has been developed in conjunction with the IFTO/EU and the DWIF. The aims of the approach are: to provide a model for analysing the basic objects and requirements for the long term maintenance of a tourist destination; to develop a reduced number of indicators, comparatively easy collection of relevant data, significance, quantification, if possible; determining points/threshold at which critical values or situations are reached in order to know that action is required (identifying standards/limiting factors/carrying capacities).

The characteristics of this approach is that it is management oriented. Tourism is understood as an equilibrium between three major objectives/aims which are protection of population’s prosperity/socio cultural identity; preservation of the destination’s attractiveness for tourists and preservation of destination’s ecological functions. This approach has been applied to destinations such as Malloca, Rhodas, Ibiza whereby stress on socio-economic indicators/welfare in these destinations measured. Figure 9.2 below show the pyramid of sustainable tourism

Figure 12.3 Pyramid for Sustainable Tourism

For each of the major aims special targets/variables can be attributed. For example the major aim of securing population’s prosperity in the socio-cultural identity is represented by security of the population’s prosperity, security of the economic efficiency and preservation of the population’s socio-cultural identity. Table 12.4 below shows the targets, indicators and critical values or situations.
Table 12.4 Target variable indicators and critical value/situation

<table>
<thead>
<tr>
<th>Target/variables</th>
<th>Indicator</th>
<th>Critical Value/Situation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observance of carrying capacity</td>
<td>Airport</td>
<td>If maximum capacity of airport is exceeded</td>
</tr>
<tr>
<td></td>
<td>Tourists attractions</td>
<td>If communication ways and parking lots are continuously overcrowded</td>
</tr>
<tr>
<td></td>
<td>Potable water supply</td>
<td>If there is water shortage in peak season, long term danger of overselling, floods, forest fire and other subsequent ecological damages</td>
</tr>
<tr>
<td></td>
<td>Sewage disposal</td>
<td>If EU standards for sewage disposal are mostly neglected (standard per inhabitant not complied with)</td>
</tr>
<tr>
<td></td>
<td>Protection of species and biotopes, protected areas</td>
<td>If due to (direct or indirect) exploitation by tourists, species are in danger or becoming extinct and/or biotopes are imperilled or being destroyed.</td>
</tr>
<tr>
<td></td>
<td>Pollution, emissions</td>
<td>If due to (direct or indirect) tourist utilisation Water, soil air are continuously being threatened by pollution and or noise.</td>
</tr>
<tr>
<td>Population</td>
<td>Preservation of intensity</td>
<td>If at local level the ration of beds of Tourists to locals is greater than 3:1</td>
</tr>
<tr>
<td></td>
<td>Second residence per household</td>
<td>If number of second residences is extensive and if financial burdens on the municipality are measurable.</td>
</tr>
<tr>
<td>Foreign infiltration’s</td>
<td></td>
<td>If local inhabitants feel disturbed by tourists</td>
</tr>
<tr>
<td></td>
<td>observance of quality of tourists supply and evaluation of ecological situation</td>
<td>Persistent and/or important criticism of destination’s condition with special reference to quality of accommodation, restaurants, service, leisure, infrastructure overcrowding (communications, network, beaches, sights) Ecological condition nature (landscape, waste) Aesthetic (settlement pattern, landscape, cultural assets)</td>
</tr>
<tr>
<td>Behaviour</td>
<td></td>
<td>Fewer people trading up to higher quality supply</td>
</tr>
</tbody>
</table>

12.7 APPROACH BY EUROSTAT

The aim of the approach that has been developed by EUROSTAT is to build up a European community system of integrated environmental and economical indicators for monitoring. Tourism is one of the priority economic sectors identified for assessing impact of the economy on the environment. The approach also aims to integrate environmental aspects by calculating physical indicators/indices related to the pressure of human and economic activities on the environment.

This approach is on the UN framework for interrelationship between tourism and environment. Social/economic activities describe human activities impact on the environment. Environmental impacts of tourism can be described as changes in the quality of the environment. Stock, inventories, background conditions are needed to describe the qualities of environment which include tourism demand. Responses to environment impact as actions/measures taken for environmental and nature protection.

Hunting and fishing are environment topics which lead to increased tourism activity in certain areas. The major environmental problem caused loss of biodiversity. Increasing tourists leads to increased use of various means of transport and the consequence is the green house effect, destruction of the ozone layer, air pollution. With regard to water used for human consumption, with increasing number of tourists leads to increased consumption of water and in small
islands this may lead to water scarcity. The construction of hotels and roads, ski lifts and other infrastructure leads to land use and environmental restructuring, this leads to loss of biological diversity and soil erosion. Increase in the number of persons in tourism areas implies an increase in the amounts of waste. The table 12.5 shows the variables or indicators and the impact of tourism on the environment.

**Table 12.5 Variables related to the impact of Tourism on the Environment and vice versa.**

<table>
<thead>
<tr>
<th>Variable related to the impact of tourism on the environment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy Use</td>
<td>Total amount of energy used for passenger transport (visitors only) by mode of transport. Total amount of energy used for the transportation of goods for consumption by visitors (by mode of transport) Energy use for tourism purposes other than transport, e.g. energy used in tourist accommodation</td>
</tr>
<tr>
<td>Water use for human consumption</td>
<td>Water supply to the tourism sector</td>
</tr>
<tr>
<td>Land use and environment restructuring</td>
<td>Areas changed for tourism purposes. Ratio of area occupied by tourism establishment to total residential area Areas with vegetation changes caused by trampling, skiing or other tourism activities.</td>
</tr>
<tr>
<td>Hunting</td>
<td>Number of animals killed by visitors Percentage of game killed by visitors</td>
</tr>
<tr>
<td>Fishing</td>
<td>Percentage of fish catches taken by visitors Introduction of artificial species for angling</td>
</tr>
</tbody>
</table>

**Variables related to the influence of the environment on Tourism demand**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use and soil quality</td>
<td>Changes in land use Soil erosion risk Protected areas</td>
</tr>
<tr>
<td>Biological resources</td>
<td>Population numbers of wild species Forest damage</td>
</tr>
<tr>
<td>Water quality</td>
<td>Water quality of lakes, rives, seas Bathing water quality</td>
</tr>
<tr>
<td>Climate and Air pollution</td>
<td>Mean monthly temperature average monthly precipitation Air pollution</td>
</tr>
</tbody>
</table>

**12.8 TRILATERAL MONITORING AND ASSESSMENT PROGRAMME/TRILATERAL MONITORING EXPERT GROUP (TMAP/TMEG)**

The TMAP and TMEG approach has been used to assess the state of the Wadden Sea a famous ecosystem in Northern Germany. The target was to monitor the development in space and time.

The characteristics of this approach is that it is applied to a specific ecosystem the Wadden sea of the Netherlands, Germany and Denmark. It only measures the impact of human activity on the ecosystem (one-way relationship between tourism and environment!) and is based on selection of issues of concern and corresponding hypothesis.

The approach is being utilised to test a particular hypothesis that recreational activities can affect the occurrence and abundance of species. This includes the population size, growth and reproduction of species. The main impact of recreational activities may be related to the presence of visitors inside the Wadden Sea and their activities. National fluctuations have to be taken into account.
In this approach the impacts of land based pollutant inputs, dumping, military use, fisheries, recreation, shipping/harbour, oil/gas extraction and sand gravel grading, coastal change on the ecosystem is studied. Only a few of the variables are studied in detail.

12.9 CONCLUSION

To enhance the understanding of the participants an exercise on building an information system on tourism was given. This exercise entailed studying hypothetical data from an island and name the main environmental issues, the indicators that would be required to monitor the environment and the questions that can be asked and methodology required to collect information.
13. STATISTICS ON WATER AND AIR
By Léon Tromp
Central Bureau of Statistics Netherlands
(April 24 - 25, 1997)

13.1 INTRODUCTION
The topic on water and air statistics was introduced to enable participants to manage information on the status and the trends in water supply and demand and water quality, as a basis for short and long term forecasts of shortages and countermeasures. The course topic was also aimed at presenting information on the quality of air with respect to most important pollution factors.

To achieve this aim the course was arranged under the following main headings

- Generalities of environment statistics;
- Air pollution;
- Water pollution; and;
- Environmental Policy Plan.

13.2 GENERALITIES ON ENVIRONMENT STATISTICS.
The organisation of environmental statistics is by and large done using the Pressure State Response framework. Environmental statistics cannot be viewed in isolation for the main interactions played between the social, economic and environment. In this regard therefore environmental statistics includes aspects of social and economic statistics which can be built upon. Figure 13.1 below shows the domain of environmental statistics.

Figure 13.1 Environment Statistics Interrelationships

The three fields of statistics are very interdependent; for instance in environmental accounting most of the data utilised and definitions are an expansion of the existing economic concepts. From the social statistics surveys, such as household surveys basic statistics can be provided, that can be utilised for estimation of some environmental parameters.

On the whole, environmental statistics exist, however, they are fragmented in nature, hence co-ordination becomes a crucial issue. The other impediments for collection of data are gen-
erally the lack of expertise, manpower and co-operation. However it should be noted that a
first compendium is relatively easy to assemble but sustained efforts to produce regular addi-
tions to meaningful time-series data is a much harder task.

13.3 AIR POLLUTION

13.3.1 Sources of air pollution
The main sources of air pollution are industry, power plants, transport and in-house pollution
from the households. The main pollutants are subdivided into two pollutants the macro pollut-
ant which are found in large quantities and are from many sources include, sulphur dioxide
(SO$_2$), suspended particulate matter (SPM), nitrogen oxides (NO$_x$), carbon monoxide (CO),
Volatile organic compounds (VOC) such as ozone O$_3$ and an example of a micro pollutant
which occurs in small quantities is Lead (Pb).

Sulphur dioxide and nitrogen oxide are the main source of acid rain. Sulphur dioxide is also
responsible for respiratory diseases. Suspended particulate matter are finely divided solid pol-
lutants that may be dispersed through the air from combustion processes, industrial activities
or natural sources. Increased mortality, morbidity and impaired pulmonary and permeability
responses have been attributed to SO$_2$ and SPM. Nitrogen dioxide and ozone also affect respi-
ratory system; acute exposure can cause inflammatory and permeability responses, lung func-
tion decrements and increases in airway reactivity. Ozone is known to irritate the eyes, nose
and throat and to cause headaches. Carbon monoxide is dangerous to human health because it
combines with the red blood cells and then reduces their oxygen carrying capacity. Volatile
organic compounds evaporate readily and contribute to air pollution mainly through the pro-
duction of photochemical oxidants. Lead is a pollutant which is dangerous to human health; in
severe cases it may lead to retardation of mental health among children. It inhibits haemoglo-in synthesis of red blood cell in the bone marrow, impairs liver and kidney function and
causes neurological damage.

13.3.2 Responses to air pollution
Responses to air pollution are of three types. These include reducing consumption of re-
sources which is a difficult alternative in the cases where the options are limited. The second
is a change in the production process by reducing some inputs and the third alternative are the
end of pipe measures e.g. catalytic converters in vehicles. The measures which relate to the
production process or the product are called end of pipe protection measures. End of pipe
protection in other words implies adding on technical installations for environmental control
of emissions. These operate independently from the production process or are on an identifi-
able part added on to production facilities. The end of pipe measures are more or less short
term measures compared to the resource based measures which are longer term in nature.
These policies may be achieved by enacting laws, fixing certain norms or taxes subsidies and
other measures.

13.3.3 Air pollution Statistics
Air pollution statistics are categorised into two main groups; these are air quality and emis-
sions. Most of the air pollution statistics are localised and there have various methods of
measurement. There is also no uniform way of aggregating the statistics. Some of the methods
that have been utilised to aggregate statistics include mean, highest levels and distance to de-
sired levels. In some cases one is confronted with different kinds of data for different time pe-
riods hence in these cases it is difficult to measure the trends. For air quality you need to
cluster the samples. Air pollution statistics have a signal value.
For emissions data the major sources include point sources such as industry, area sources such as traffic (although sometimes it is referred to as line sources) micro sources such as households and diffuse sources such as agriculture. Emission data just like air quality data have signal values. Emission data is a neglected information source yet is politically relevant. The method of collection of data entails building up an emission inventory. In the Netherlands there are 700 industries which are monitored individually. In these cases inspectors from the statistical offices actually visit the factories. It is estimated that 80% of all emission is taken care of. For the small polluters indirect methods are used. It should however be noted that the indirect approaches are less reliable. The data required to make the indirect approach is the amount of people working in the households, small shops of 5 to 10 people and emission factors.

13.3.4 Exercise on construction of an emission inventory.
The participants were required to came up with an emission inventory for a hypothetical case study on air pollution in Pascalo, capital of sampling. The WHO rapid assessment method was used to calculate the emissions. In this exercise activities itemised by production process were outlined according to the ISIC codes. A short description of the activities enabled one to select the process and hence the relevant emission factors for the calculation of an emission inventory.

13.4 WATER POLLUTION

13.4.1 Water supply (See Chapter 14 for more details)
The amount of water on the earth is constant and cannot be increased or decreased. Of a global total of 1360 million cubic kilometres of water, which cover about 70% of the earth’s surface, only three percent is fresh, and of that, less than one percent is available for human use in the form of surface waters such as rivers and lakes. Although there is ample fresh water on the earth to meet present and future demand, it is often not where it is needed. Uneven distribution of ground water, surface water and rainfall means that many arid and semi arid parts of the world are without reliable sources of fresh water.

13.4.2 Water uses
Different levels of water purity are required for different types of water use. There are five basic categories of water use: public water supply, mainly destined for human consumption; water used in agriculture; in industry; for recreation; and for fisheries and wildlife. Each category of use has its own quality criteria and method for assessing suitability. The highest standard of purity is required for drinking water, while, on the other hand, it is acceptable for water used for industrial cooling to be relatively highly polluted.

13.4.3 Sources of water pollution.
The main sources of water pollution are agricultural sources which include pesticides, manure, fertilisers and irrigation; industrial sources which include heavy metals and warming up of water and households which include faeces, bathing and washing water. A description of pollutants is given below. It is based on the lecture notes and a UNEP publication entitled “fresh water pollution”.

Pathogens
Pathogens such as viruses and bacteria and other biological organisms cause water borne diseases. Organic material from domestic sewage, municipal water and agro-industrial effluent are the most common water pollutants and are the main sources of pathogens. Because water borne diseases are difficult to detect in the laboratory, indicators which easily measure organ-
isms are used. The presence of organisms indicates that water is contaminated with faecal matter. The most commonly used indicators is of faecal coliforms, so faecal contamination is often expressed as the number of faecal coliforms per 100 ml of water. According to WHO, total coliforms in drinking water should not exceed 10 per 100 ml, and faecal caliform concentrations should be zero per 100 ml.

**Organic matter**

More organic matter is discharged into water courses than any other pollutant. This organic matter contains a wide range of carbon compounds, the primary source of which is domestic sewage, but industrial effluents, such as those from tanneries, paper mills and textile factories, are also significant sources. Organic matter is broken down by aerobic microbes. The oxygen required for this process is taken from the surrounding water, thus diminishing its total oxygen content. Large amounts of organic matter cause severe oxygen depletion in water, which is then unable to support both the decomposition of organic compounds and many forms of aquatic life. The amount of oxygen required for microbial decomposition can be measured as biochemical oxygen demand. Two other most common variables used to estimate amounts of organic matter present in water are chemical oxygen demand (COD) which is the oxygen required to oxidise the organic compounds using a powerful chemical oxidant; and the oxygen saturation expressed as a percentage of water’s oxygen carrying capacity.

**Nutrients**

Small doses of nutrients are essential to the metabolism and growth of aquatic organism. But man made sources of nutrients - such as the organic matter in municipal waste and waste water and run off from fields fertilised with chemical manure can upset the natural balance of organism living in water. In many cases, nitrogen and phosphorous the two most important nutrients are far above levels monitored by Global environmental monitoring water background stations. The nutrient overloading in water bodies, primarily with nitrogen and phosphorous, causes eutrophication of lakes and reservoirs by promoting abnormal plant growth (seen as algae blooms) and then deplete oxygen as they decompose. More worrying are high nitrate level of drinking water, which have potentially serious consequences for human health.

**Heavy Metals**

Heavy metals include cadmium, chromium, copper, lead, nickel and zinc. Heavy metal pollution of water has a number of man-made causes including processing of ores and metals; the industrial use of metal compounds (chromium tanneries, for example); and, particularly, leaching from domestic and industrial water dumps, mine tailings, contaminated bottom sediment and lead pipes. This kind of leaching has potentially acute consequences. Acidified or saline water enhances metal mobility so drawing more lead from pipes, or other metals from mine tailings; it also transforms the metal into a more readily absorbed and stored in living tissues, thus amplifying the toxic effects of leaching. Safe levels of metal concentration are hard to establish and vary according to type and degree of exposure and state and toxicity of metal in question. Acute human intoxication from heavy metal pollution is not yet common.

**Organic micro pollutants**

Organic micro pollutants (chemical substances such as DDT, PCBs and industrial solvents) originate primarily in industries such as coal mining and petrol refining, and in textile, wood pulp and pesticide factories. They are released into the environment through urban and agricultural run-off, atmospheric fall-out, and urban and industrial wastewater. Organic compounds are also found in substances for domestic use, such as household solvents and aerosol containers. Because these compounds are commonly used, their rate of dispersal into the envi-
ronment is correspondingly high. More synthetic organic compounds are introduced every year, often without a full understanding of the risk they pose to the environment in general and human health in particular. They can have two effects on humans: immediate short term toxicity and reactions from long term exposure, both of which can result in chronic symptoms and death. There is now evidence that disinfecting public water supplies with chlorine (to eliminate pathogens) might actually lead to the formation of volatile halogenated derivatives, some of which are known carcinogens. It is impossible to generalise about the potential toxicity of organic micro-pollutants because there are so many of them, all with different derivatives and not all laboratories are equipped to detect low (but possibly still harmful) concentrations.

**Suspended Matter**

Suspended particulate matter (SPM) consists of material that float in suspension in water. They have three main sources; natural soil erosion, matter formed organically within a water body, and material produced as a by-product of human activity. SPM particle can make water unsuitable and unpleasant to drink and are also major carriers for many organic and inorganic pollutants, including most toxic metals, pathogens and nutrients. Suspended matter is one of the simples variables to measure.

**Salinity**

Increasing salinity is a significant and widespread from of freshwater pollution, particulate in arid, semi-arid and some coastal regions. Salinity is caused primarily by a combination of poor drainage and high evaporation rates that concentrate salts on irrigated land and occurs mainly in regions that rely on irrigation for crop production. Another cause of salinity’s is the over pumping of coastal aquifers, which leads to the intrusion of saline water. Local increases in salinity have also been caused by the use of salt to prevent icing on roads, as a side effect of mining and a result of disposal of the saline water that is produced during oil production. None of there issues compares in importance with the problem of salinity introduces as a result of irrigation.

13.4.4 Responses

Several steps have been taken to control the pollution of freshwater. Some of these are as listed below:

- Regulating sewage disposal;
- Constructing city sewerage schemes;
- Installing waster treatment plants;
- Treating and recycling industrial effluents;
- Substitution harmful consumer products (such as phosphates in washing powder);
- Banning dangerous pesticides (DDT for example) and industrial chemicals.

According to UNEP these steps, although by no means comprehensive, have begun to reduce levels of pollutants in many industrialised countries. In the developing countries, far fewer regulations and controls exist, and pollution from domestic wastes is still the cause of widespread death and disease.

The rapidly developing countries of South American and Asia also pose a higher threat to water quality because of the different types of pollution that evolved slowly over a century in Europe are affecting those nations within a decade. Only 10 of the 60 countries of this category have laws in place to deal with their environmentally damaging problems.
Action need to be taken in three main areas: Water resource management, waste water treatment, and providing safe public water supplies.

13.5 **ENVIRONMENT POLICY PLAN**

To have an understanding of the end uses of data on environmental statistics the participants were divided into four groups to discuss the environmental plan. This entailed drawing up a 10 point plan outlining the essential elements of a policy.

13.6 **REFERENCES**

UNEP, *Fresh Water Pollution*, 1991
14. STUDY TOUR
CDG MUNICH CENTRE
(April 29 - May 2, 1997)

14.1 WELCOME REMARKS (BERNARD LANGEVIN)
Welcome remarks were made by the head of the unit on technical cooperation with non member countries. He noted that training for the ACP countries has been the main priority of technical co-operation for the European Union (EU) for a period of more than 30 years. He observed that the trend now was to train statisticians within their region of origin. The courses being held at the Munich Centre, which entailed travel by the students to Germany, were a survival of the older strategy that had been utilised by the EU. The reasons for survival were itemised as the need to update the knowledge of statisticians and foster south to south network. The second priority areas for technical co-operation was observed to be specific projects which in most instances focused on strengthening of institution rather than concentrating on a specific issue which was a strategy carried out in the past. He also noted that the institution strengthening was being focused at regional levels. He ended his remarks by welcoming participants to the EUROSTAT.

14.2 INTRODUCTION TO EUROSTAT (DAVID BOND)
EUROSTAT’S mission statement is to provide the European Union with a high quality statistical information service. It is one of the 34 directorate generals of the European Union. The objectives of the EUROSTAT are:

- To supply the European institutions with data;
- To construct the European Statistical System;
- To offer as wide an audience as possible access to data; and;
- To co-operate with non-member countries for the development of statistical systems

The aims of supplying European Institutions with data is to ensure that the data which is relevant, scientifically produced, objective and independent is assessed and utilised in conceiving and achieving policies within the member states. The critical points that are considered in setting up a European Statistical System are to harmonise concepts and definitions, classifications and methodology. Statistical data is equated to a public service which becomes useful if dissemination of results is efficient. It was noted that the four main ways of disseminating information were publications, databases, electronic products and information services. In addition it was noted that EUROSTAT co-operates with other countries in the development of statistics. These were categorised into those who are trading partners, such USA and Canada, and those countries which need assistance for example, ACP countries, Latin America and Central and Eastern European countries.

14.2.1 Strategies
The various ways of achieving objectives were pointed out as legal procedures, committees, working groups and statistical programmes.

The decision making process is categorised into two, that is, the legal acts and votes. The legal acts are decisions binding upon those it is addresses, directives obliging member states to achieve objectives and regulations binding in all parts objectives and means. The votes one the other hand were simple, unanimous and based on qualified majority (62 out of 87 votes).

Member states have weights for votes based on their population. These are as follows: France
Chapter 14 Study Tour

10, Germany 10, Italy 10, Spain 8, Belgium 5, Greece 5, Netherlands 5, Portugal 5, Austria 4, Sweden 4, Denmark 3, Finland 3, Ireland 3 and Luxembourg 2.

Working groups are of paramount importance in building teamwork among the member states. It was noted that EUROSTAT has 10 sector committees, 80 specialised working groups and task forces. The members of these groups are National Statistical Institutes, EUROSTAT (chair) and observers from other countries and international organisations.

The Statistical Programme Committee is the overall decision making committee and has delegated powers from the council. The Committee is composed of National Statistical Institutes Directors General, with EUROSTAT as the chair. The role of the committee is to provide assistance in the co-ordination of the programmes and consultation on measures to achieve the programme methodology.

14.2.2 Organisation and Resources.
EUROSTAT employs 600 permanent staff and 200 temporary staff. These staff work very closely with other institutions such as Eurocost, CESD, TES, private firms and experts.

The amount of financial resources that have been availed to EUROSTAT in the previous years are as follows: 47 Million ECU in 1996, 54 million ECU in 1995 and 56 Million ECU in 1994. Twenty two (22%) of budget availed to EUROSTAT is returned to member states through European Statistical Service projects.

14.2.3 EUROSTAT Publications
The major themes of EUROSTAT’S publications are general statistics, economy and finance, population and social conditions, energy and industry, agriculture, forestry and fisheries, foreign trade and balance of payments, services, transport and tourism and research and development. The series of publications include yearbooks, annual statistics, short term statistics, accounts and surveys, studies and research, methods and statistics in focus.

14.2.4 Channels Of Dissemination
The channels of dissemination are representation offices, EUROSTAT’S data shops and press office, 50 commercial hosts and brokers, 45 sales offices, national and regional statistical institutes, 750 European documentation centres and depository libraries, 300 Euro-Info-Centres, 140 delegations of the EU and representation offices of the EU. The factors considered in dissemination include: selection of information, required data carrier, frequency of delivery, price, presentation, target group and dissemination channel. At the conclusion of the presentation participants were given the following addresses for further information:

Central Information Office
JMO B3/88
L-2920 Luxembourg
Tel (352) 4301-34841
Fax (352) 4301-32649

Internet access through Europa site http//europa.eu.int/Eurostat.html.

14.3 EUROSTAT AND THE ACP COUNTRIES (ROGER EDMUNDS)
The main objective of EUROSTAT related the ACP countries is to enter into technical co-operation with non-member states. This technical co-operation includes partners across the world (EFTA, USA/Canada and others) and other countries which request for co-operation
As it relates to the ACP countries, there are 70 signatories of the Lomé Convention. This convention is the legal basis for the Community Co-operation System. Under the Lomé Convention, grants from the European Development Fund (EDF) accounts for 52% of the funds for development programmes (the National Indicative Programme - NIP and the Regional Indicative Programme - RIP) in the ACP. Other sources of funds for ACP countries are from the following programmes: EIB credit; Structural Adjustment; STABEX; SYSMIN; Emergency aid; Venture capital, and Interest-rate subsidies. Figure 14.1 shows the stages of an EDF project.

**Figure 14.1 The Stages of an EDF project**

14.3.1 EUROSTAT and Development Aid:
Development aid to ACP (and other developing countries) falls under Division C-3 which falls under Directorate C. EUROSTAT C-3 intervenes in projects at the following points in the project cycle:

- Identification;
- Supervision of feasibility studies;
- Preparation and compilation of the financing proposal;
- Supervision of implementation;
- Evaluation; and;
- Co-ordination of technical assistance with EU and EFTA.

The other parts of the Commission responsible for statistical co-operation are DG I (external relations), and DG VIII (development). These intervene in projects at the financing stage. DG VIII is responsible for projects in the ACP countries.
14.3.2 **EUROSTAT: Priorities for Statistical Co-operation:**
The following were the main programmes of technical cooperation.

**Training Projects:** COMSTAT: Community support programme for statistical training for the benefit of ACP countries. PALOP: Portuguese speaking African countries benefit from this project which is statistical training for middle managers. EASTC: (Eastern Africa Statistical Training Centre in Tanzania) provides intermediate level training for English-speaking Africa. SADC: Training projects for the “Southern African Development Community”.

**External Trade:** EUROTRACE: The maintenance and development of the software for managing external trade at the regional level.

**Food Security:** DIAPER: (Ongoing Diagnosis of Food Policy and Rural Development). The objective of this project is to improve statistical information in the food sector, paving the way to national self-sufficiency and food security.

**National Accounts:** ERE-TES: The development of a software for the preparation of input/output tables by products and branches.

**Prices:** ICP: (International Comparison of Prices Programme). The assessment of GDP in real term and purchasing power parities (in 22 African Countries).
CPI: Project for a consumer price index for the countries of the UEMOA (Economic and Monetary Union of West Africa).

**Social Statistics:** 123 Survey: This was developed by DIAL (Development of Instruments for the Long Term Adjustment) for the informal sector of the economy. It can however be adapted to other social sectors (like poverty, education and health).

Migration: An analysis of the causes of migration flows between the European Union and the countries of the south.

14.4 **INDICATORS OF SUSTAINABLE DEVELOPMENT (EVA GUINOMET)**
An overview of the approach that was undertaken by EUROSTAT in developing indicators for sustainable development was given to the participants. It was noted that the United Nations Commission of Sustainable Development developed the framework for sustainable development indicators which had been utilised by the EUROSTAT. Therefore, the mandate of EUROSTAT was to compile existing data and present the facts without analysis. It was observed that out the recommended list EUROSTAT had produced 46 of the recommended 132 indicators. Four categories of indicators had been developed and these were the economic, social, environmental and institutional. These four categories of indicators are differentiated: by driving force indicators, which represent human activities, processes and patterns having an impact on the environment; state indicators, providing a snap-shot of an existing situation; response indicators, which outline measures; and institutional indicators which highlighted the extent to which institutions take account of sustainable development issues. The purpose of developing indicators on sustainable development were outlined as creation of an information base rather than a definitive list of sustainable development indicators. The break down for the economic, social and environmental indicators that have been collected is as follows:

**Economic Indicators**
1. Per capita GDP
2. Investment share in GDP
3. Share of manufacturing value added in GDP
4. Annual consumption of energy per capita
5. Consumption of renewable energy
6. Lifetime of proven energy reserves
7. Environmental protection expenditure as a percentage of GDP
8. Foreign direct investment
9. Total ODA given or received as a percentage of GDP

**Social Indicators**
10. Population growth rate
11. Net migration rate
12. Total fertility rate
13. Infant mortality rate
14. Life expectancy at birth
15. Total national health expenditure as a proportion of GDP
16. Unemployment rate
17. Women per 100 men in the labour force
18. Ratio of average female wage to male wage
19. Population density
20. Percent of population in urban areas
21. Rate of growth of urban areas
22. Rate of growth of urban population
23. Floor area per person
24. Per capita consumption of fossil fuel by motor vehicle transport

**Environmental indicators**
25. Emissions of sulphur oxides
26. Emission of nitrogen oxides
27. Expenditure of air pollution abatement
28. Consumption of water per capita
29. Waste water treatment
30. Annual withdrawals of ground and surface water
31. Arable land per capita
32. Land use changes
33. Energy use in agriculture
34. Use of fertilisers in agriculture
35. Use of agricultural pesticides
36. Generation of industrial and municipal solid waste
37. Expenditure on waste management
38. Rate of waste recycling and reuse
39. Forest area change
40. Wood harvesting intensity
41. Managed forest area ratio
42. Threatened species as a percentage of total native species

**14.5 PROTECTED AREA AS A PERCENTAGE OF TOTAL AREA. EFFECTS OF TRANSPORT ON THE ECOSYSTEM (GRAHAM LOCK - EUROSTAT)**

The aim of introducing the topic on “Effects of Transport on the Ecosystem” was to provide the participants with an overview on the methods and efforts undertaken by EUROSTAT in aggregating and presenting statistics on environment and its effect on the ecosystem. It was pointed out that the major environmental issues in the area of Transport were energy use and its implications for emissions and land use. It was, however, noted that in the Union, data on
impacts on land uses was less available. Transport in comparison to industry was noted to have an increasing trend and it contributed almost half of emissions with respect to volatile organic compounds, carbon monoxide and nitrogen oxide in comparison to other sectors of industry electric generation and space heating.

14.5.1 Policy Areas
The overview of the major policy fields of the Union were highlighted as:-

- Climate change.
- Ozone depletion
- Loss of biodiversity
- Resource depletion
- Waste
- Air pollution
- Dispersion of toxics
- Water pollution and water resources
- Marine environment and coastal zone.
- Urban problems of noise and odours.

In developing data systems and answering policy questions it was noted that the Pressure-State-Response approach was used in the Union. The advantages of using the Pressure-State-Response were observed to be:

- Not everything needs to be covered;
- The framework helps to build a picture of the situation;
- Enables one to assess very easily whether a certain policy is absolutely necessary; and;
- Focuses on a particular question.

14.5.2 Air Emissions
Example of questions on air emission were given as follows:

**Attribution of responsibility:**
- Who produces?
- Where are the emissions produced?
- How are they dispersed and where are they deposited?

**What is responsibility based on:**
- Fuel sales
- Fuel consumption
- Flag or nationality of vehicle or vessel
- Ownership of transport and the transport activity itself

**Attribution of country:**
- National
- Domestic (both origin and destination within the country)
- Transit (neither origin nor destination in country)

**Option of attribution:**
- 100% to country of origin
Having introduced the questions, it was noted the data available does not necessarily answer the questions which are required, however, available data was utilised to give a picture on transport trends an effects on the environment.

The following trends in the transport sector were noted:

**Infrastructure:** Length of motor ways in the European union has more than doubled in the last twenty years. However, railway lines have decreased by 4% from 1970 to 1980 and a further 4% from 1980 to 1990. Although the trend on railway has decreased, it still contributes about 27% of expenditure, which is assumed to be maintenance of the railway lines.

**Vehicle fleets:** The numbers of virtually all types of road motor vehicles and passenger cars are, however, increasing at a far higher rate than vehicles used for public transport. The factors which affect emissions are aggregate of turnover of vehicle fleets, engine type and size. Based on data from a few countries, it is generally noted that diesel cars are increasing in some countries, apart from Germany, where the trend seems to have levelled off.

**Energy Consumption** The major fuel used by road motor vehicles is petrol, although usage of diesel has been increasing at a rate higher due to the pricing policies.

**Carbon dioxide emissions:** Increasing man-made emissions of the so-called greenhouse gases (carbon dioxide, methane, nitrous oxide, chloroflorocarbons) that contribute to the threat of global warming. The major part of these emissions, both in terms of quantity and potential greenhouse effect, results from combustion of fossil fuels. Emissions of carbon dioxide from transport are continuing to rise since no technology exists to remove carbon dioxide from exhaust gases, and it will therefore be necessary to reduce consumption of fossil fuels by developing more fuel efficient cars or by modifying driving habits.

**Noxious emissions:** Control engines vehicles are responsible for the greater part of emissions of volatile organic compounds and oxides of sulphur, and both engine types contribute approximate equal emissions of nitrogen. Passenger vehicles are the major source of volatile organic compounds, due to their large numbers on the roads.

**Lead:** In recent years the motor car has been a major contributor to atmospheric lead pollution, especially in urban areas. Leaded petrol now contains on average only 1/3 of the lead it contained 20 years ago. The major reduction in lead emissions has been achieved by reducing the lead content of leaded petrol before introduction of unleaded petrol.

**Volatile organic compounds:** The major organic volatile compound emitted by road motor vehicle is benzene, which is present in petrol. Estimates indicate that road traffic emissions of volatile organic compounds are starting to fall in Germany, France, Netherlands and the United Kingdom since the introduction of catalytic converters. As the vehicle stock in all the member states is replaced with catalytic converters, this trend will continue throughout the European Union.

**Carbon monoxide:** The most dangerous traffic emissions for human health is carbon monoxide, due to its ability to combine with haemoglobin and thereby interfere with the transport oxygen through the body. It also contributes to the greenhouse effect. Since introduction of
catalytic converters and improvements in engine efficiently, emissions have started to decrease in some member states.

**Particulate Matter:** There are a variety of sources including coal combustion and industrial activity; but the major sources of the smaller particles (less than 10 micrometers in diameter), which have been linked with cardiovascular and pulmonary diseases, is diesel exhaust.

### 14.5.3 Responses

The responses to environmental issues were presented in form of the major taxes that have been taken by the European Union in the area of transport. Some of these included taxes on energy consumption, road transport taxes and eco-taxes, which were defined as taxes which are introduced with particular environmental policy objectives.

It was noted that ecological taxes may have an influence on consumer behaviour, although, in the absence of real alternatives to petroleum products there is little product switching, except between fuels. An example of this was noted to be the tax differential between leaded and unleaded petrol which had increased the consumption of unleaded petrol although the fall in lead emissions has been for the most part caused by regulatory standards which have reduced the lead content of leaded petrol.

### 14.6 GEOGRAPHICAL INFORMATION SYSTEMS (KOSTAS GLANNAKOURIS)

Geographical information system was defined as a computer based set of tools for capturing collecting, editing, integrating, analysing and displaying data in association with their geophysical location. It was noted that the primary data collection was done through field measurements and satellites and secondary data collection using vector digitising and raster scanning.

It was noted that economic, social and natural actions and phenomena all have a spatial component. By coupling statistical information with geographical territories we enhance the effectiveness with which they are presented or analysed.

Some of the questions which GIS could answer were noted as:

- What is found at a specific location?
- Does a regional distribution of earthquakes show any pattern or predictability?
- Does the distribution of cases of a disease form a pattern in space? Is it associated with environmental pollution? Can we estimate the extent of mineral deposits over a particular region?

#### 14.6.1 GISCO Project

The work of the GISCO project of EUROSTAT was outlined. The origin of GISCO was noted to have arisen from the EUROSTAT’S task force on spatial statistics. It was later established in 1992. The user community of GISCO includes EUROSTAT Sectoral Units, other commissions Directorate General and commission external users. The objectives of GISCO were given as follows; Information assessment, policy definition support, implementation of decisions, monitoring and follow up and public information.

The GISCO activities are:

- Geographic information policy;
- GISCO reference data base management;
- Map production and servicing;
• Dissemination and external relations;
• Desktop mapping tools; and;
• GIS analytical applications.

The work plan for the GISCO project is to:

• Refine spatial detail and consolidate date base contents for selected themes;
• Integrate statistical nomenclatures;
• Link with EUROSTAT statistical data bases;
• Link with policy instruments; and;
• Integrate to multimodal concept.

14.6.2 Technical Environment
The hardware used by GISCO consists of: Sun-Sparc 10 workstations, UNIX, NCD X - Terminals Disk space 10 GB. Calcomp electrostatic plotter, AO format Calcomp digitiser, AO format, TEKTRONIX A4 format. The software utilised are Arc/Info V7.0.4 GI system, ARC/View Atlas/GIS, MapInfo, and ARC/view for PC.

14.6.3 Spatial Analysis
Two spatial analysis examples were given. These are
i. To design the least cost paths connecting a selected Transport European Network (TEN) lines with other links of the same TEN; and;
ii. Delimitation of urban agglomerations with the help of remote sensing of the four cities of Bordeaux, Limbourg Sud, Main Taunus Kreis and Swanley.

The reference data that was utilised in the first example was soil type, land cover, digital elevation model and the Trans European Network of roads. The final result was a map showing the minimum cost paths. It was noted that GIS calculated the minimum cost paths by utilising only two reference points at a time rather than using multiple points.

The data utilised for the second example was satellite images, 37 photos from the air at a scale of 1:2000 and 11 maps of National Geographical Institute of France 1:25000. The steps that were involved in the pilot exercise were highlighted as follows:

• Correction of satellite images
• Automated classification for delimiting urban and agricultural areas
• Analysis -synthesis coding and interpretation of the results
• Application of two methods for the identification of urban agglomerations
• Differences of the urban morphological zones.

The major results of the remote sensing pilot exercise was that overall precision of automating land use recognition and classification was 86.7%. It was also observed that there was no difference in using raster analysis and vector analysis.

14.7 ENVIRONMENT STATISTICS AT EUROSTAT (THEO VAN CRUCHTEN)
Organisation of environment statistics in EUROSTAT is based on the Pressure-State-Response model. EUROSTAT’S concentrates on the driving force/pressures of environment, which means attempting to make an inventory of human activities that influence the environment well as making inventories of pollutants that are discharged. The framework shown in Figure 14.2 is used for the collection of inventories.

**Figure 14.2 Framework for Environmental Statistics**

![Framework for Environmental Statistics](image)

**Figure 14.3 Organisation of the Environmental Statistics**

<table>
<thead>
<tr>
<th>Driving Force Statistics</th>
<th>Environment Statistics</th>
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<tbody>
<tr>
<td></td>
<td>Agriculture</td>
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<td>Transport and Tourism</td>
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<td>Energy</td>
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<td>Pressure Statistics</td>
<td>Land Use</td>
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<td>Waste</td>
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<td>Noise</td>
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<td>Material flows</td>
</tr>
<tr>
<td>State Statistics</td>
<td>Economic Satellite data</td>
</tr>
</tbody>
</table>

Statistics for Environmental Policy, 1997
14.8 **THE DEVELOPMENT OF EUROSTAT’S WORK PROGRAMME ON WATER STATISTICS.**

The overall objective of water statistics was noted as to collect and publish data in a broad sense on the use of water for human activities (abstraction, supply, disposal). It is anticipated that over time the results will illustrate the following: changes due to the EU policy on water, effects of the legal tools to reduce water pollution and the effects of the general policy on waste as included in the 5th Environment Action Program. When the full programme is developed it is envisaged that a balance sheet for water in the European Union and each of its member states will be prepared. The balance sheet is aimed at showing the water needs as well as the water use and in particular the discrepancies both in water quantities and water quality and the availability and need.

14.8.1 **Water Statistics**

The main areas of focus and items for data collection were highlighted as follows

**Resources:** Precipitation, evaporation, inflow and outflow of rivers and lakes.

**Water abstraction:** Ground water, surface water, spring water and other water for human consumption and how much is used.

**Water use and water consumption:** Public supply, self supply, type of application and cooling.

**Waste water collection:** Population served by waste water collection and treatment facilities.

**Waste water treatment facilities:** Number, capacity, influent and effluent road of treatment plans by type.

**Sewage sludge production:** Production and disposal of sewage sludge.

**Waste water production:** Quantities of water and their pollution load by type and activity by pollutant.

**Flow of water in economy/society:** Flow balance: where water is used, polluted and discharged into sewer system and its treatment.

With regard to the areas mentioned above it was noted that data in the member countries was not necessarily available and the following observations were made.

With regard to water resources, estimates in the member countries are available, however, the precision of the estimates is difficult to judge and the imbalances therefore warrant standardisation of estimation methods. Large differences in measuring frequencies and the work load of the member states differs according to the number of rivers entering or leaving the country.

The data on water abstraction and consumption however needs to be collected from industry and water supply companies. Household estimates for self supply need to be made. In addition, data used for irrigation and for animals is difficult to estimate and it is recommended to add questions in the farm structure surveys of each of the member states. Furthermore, all water that is abstracted and not immediately returned to its source should be considered to be consumed, however, opinions may differ in the member states.

Waste water originating from households of biodegradable material is dealt with by the bacterial flora in the water. However, due to population growth and concentration of population in the cities, the pollution has become more concentrated and the natural capacity of self purification is now insufficient to treat all wastes. Next to the population emissions an important load in the water comes from industry and the variety of pollutants is large, ranging from compounds comparable to those in household waste water, over highly concentrated organically polluted water waters from the food processing industry. Industry produces a wide vari-
ety of pollutants ranging from metal surface treatments, pesticides and derivatives of oil. The effects of some of these pollutants is so high that they destroy self purification capacity.

Data on surface water quality has been reported since 1977 and it concentrates more or less on bacteriological pollution. Only two heavy metals, cadmium and mercury, are included on the list. A presentation of data showing degradation of water quality from the source of the river to the mouth would require that enough sample points are available along the streams.

14.8.2 Policy measures
Some of the policy areas in the area of water were highlighted as follows:-

- Measures relating to detergents;
- Quantity of water required for abstraction for drinking water;
- Bathing water quality;
- Pollution caused by dangerous substances;
- Quality of water intended for human consumption; and;

14.9 FEDERAL STATISTICAL OFFICE OF BERLIN (J. KAISER)
The Director of the Federal Statistics Office in Berlin welcomed the participants to the statistics office of Germany. He noted that that main statistical office was in Wiesbaden and the Berlin office was only one of the three offices of the Federal Statistics Office. He also pointed out that centralised expertise existed in the area of agriculture, forestry and fisheries, construction and dwellings, family budget, foreign trade and environmental protection and trading and special studies.

14.9.1 Work of the Federal Statistical Office:
The main task of the Federal Statistical Office is to prepare statistics on:

- Population;
- Employment;
- Housing and building activities;
- Education, culture and justice;
- Public health and social security systems;
- Prices, wages and salaries;
- Foreign trade;
- Food and agriculture;
- Commerce and transportation;
- Production and industries;
- Environment; and;
- Enterprises accounts and family budget.

The major sources of information are censuses, sample surveys and administrative records.

The demand for statistics produced by the Federal Statistics Office is from various users and these include international organisations, Federal Government, State Government and Local authorities, enterprises, associations and trade unions, universities, research institutes, opinion and market researchers. The general public as well such as political parties, media, other organisations and private citizens are all part of the users of statistics collected at federal level.
14.9.2 Principles of Statistics

The three principles that guide the statistical office are objectivity, neutrality and legality. Objectivity is required of all statistical offices. The statistical office is financed by and is dependent on the government. Other sources of income include revenues from special projects required by the government and other organisations. However, the statistical office is its own entity and not part of another ministry. This means that it has its own budget and laws on statistics. This allows for the neutrality of the statistics. The framework of the statistical system is given by 4 categories of laws:

- Basic law for the Federal Republic of Germany (human rights, etc.).
- Law on statistics for federal purposes (statistical law).
- Specific legal provisions for individual statistics - i.e. all statistics produced by the office have a legal basis.
- Relevant provisions of the EC. This means that the EC can recommend that some statistics be produced and the statistical office must comply.

No statistical data can be collected without a legal foundation. The legal foundation prescribes the:

- topics to be recorded;
- types of surveys to be conducted;
- reporting period;
- periodicity;
- groups of respondents;
- obligation to provide information and
- protection of data.

The advantages of this system is that the legal situation is clear and it ensures optimum protection of respondents. The disadvantage is that it makes the quick adaptation to a situation impossible because of the necessary legislative procedure.

14.9.3 Division of Labour: Federal Statistical Office and “Länder” Statistical Offices:

It was indicated that there was one main statistical office (Federal) and 16 statistical offices (one for each Länder) in Germany.

The relationship between these is that the Federal Office:

(i) deals with the method and material preparations, and
(ii) plans for the data collection and processing.

The Länder Offices:

(i) deal with the actual data collection,
(ii) select the respondents to be included in the surveys,
(ii) conduct the surveys,
(iv) process the surveys, and
(v) compile the results for the Länder.

The advantages of this decentralisation are:

- it allows for the distribution of the work among several different offices, and
- service to the public is facilitated.
The disadvantages of this decentralisation are:

- due to the different capacities of the Länders, the supply of statistics to the Federal Office is inconsistent, and
- the publication of statistics is only possible when all Länders are ready.

14.10 GERMAN ENVIRONMENT STATISTICS (JOSEPH STEINFELDER)

Environment Statistics is an indispensable base for environmental policy. The great demand for environment information emphasised the need for a constant and systematic collection of environmental data. The aim of collecting environment statistics is to reflect material cycles and impact of man on the environment spending. The legal basis for environmental statistics is the German Environment Statistics law which was first established in 1974, and amended in 1980 and 1984. In 1994 a new environment statistics law was adapted and entered into force on 1 January 1997. It was observed that the latest changes were responsible for the increased demand for environment data.

German Environment Statistics consists of four areas, namely waste management, wastewater management, air pollution and environment economy. The Federal Statistical Office is in a phase of methodological, organisational and technical preparation of new surveys, with most of them being conducted for the first time in 1997 and later years.

The main statistical tasks which the Federal Statistics Office are a result of the increasing demand of environment statistics. These include identification and establishment of new groups of respondents, conducting preliminary or test surveys, inventing new classifications for instance for air emissions or substances damaging the ozone layer.

14.10.1 Waste Management Statistics.

The three principles based on the Waste Disposal Act of Germany were identified as avoidance of waste, recovery of waste and disposal of waste. The three surveys in the area of waste management statistics are; waste collection, waste treatment and recovery and waste disposal. The characteristics of these surveys were outlined as follows;

- Type, quantity, origin and destination of treated waste (sorted, crushed, recycled waste) and discarded waste (e.g. dumped waste);
- Use of energy and recycled material obtained by waste-treating processes; and;
- Technical data on waste treatment and waste disposal facilities (like capacity, equipment e.g. incineration plants).

Special surveys will be designed and these will include those producers that contribute most to the total waste e.g. construction and demolition waste and those of special interest like used oils, plastic waste, glass waste, paper and paperboard waste, packing material. The survey will include questions on collection, treatment and disposal of these types of waste and the owners of the respective facilities.

The other special types of surveys include hazardous wastes, which is yearly and the, secondary statistical survey on waste which utilises administrative records of transport’s of waste.

14.10.2 Water and waste-water management statistics

The surveys for water and waste-water management statistics were highlighted as follows; survey on water and waste-water management, surveys on water and waste-water
management in industry, agriculture, public thermal plants, survey on accidents with water-
harmful substances, survey on facilities/plants handling water harmful substances and survey
on the facilities/plants handling water-harmful substances.

The respondents for such surveys include owners of public and private water and waste-water
facilities. In the case of agriculture the survey is proposed to cover farms which use water for
irrigation and introduce discharge waste-water into lakes, rivers or canals. Water statistics
comprise of a survey on accidents with water harmful substances investigates such as
accidents through storing, handling and transporting these substances.

14.10.3 Air pollution statistics
Two surveys for air pollution statistics are the survey on air pollution (by industrial facilities)
and the survey on substances damaging the ozone layer which is based on administrative
records and conducted every four years. The source of information was environment
authorities or licensing and monitoring authorities of the facilities.

The characteristics covered in these surveys are: The type and quantity of emitted substances,
the type and capacity of facilities and the type of substances handled.

14.10.4 Environment Economy/Environment industry statistics.
Three surveys for environment economy and industry statistics are; the survey on investment
of industry for environmental protection, survey on the current expenditure of industry on the
protection of the environment and survey on goods and services for the protection of the
environment.

The characteristics of the survey on environmental investment industries include waste
management, waste-water management, air pollution control, noise control, nature
conservation and soil conservation.

The survey on current expenditures for protection of environment include production related
measures that help to reduce, avoid or remove harmful emissions on the environment. These
measures are in the areas of waste management, waste-water management, air pollution
control, noise control, nature conservation and soil conservation.

The survey on goods and services for the protection of the environment is an annual
representative sample which provides information on size, structure and the development of
the environment industry market. The environment industry is defined as the industries
producing goods and services to avoid or eliminate harmful influences of production or
consumption. An example of such an industry is installation for water treatment plants. The
data collected is usually referred to as end of pipe environmental protection technology.
15. EFFECTS OF AGRICULTURAL ACTIVITIES ON THE ECOSYSTEM

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15.1 INTRODUCTION
The aim of introducing the course topic on effects of agricultural activities on the ecosystem was to sensitise the participants on the qualitative and quantitative effects on the ecosystem and to discuss the measurement of these effects. To achieve this target the course was treated under the following main headings

- The policy context and objective for developing agri-environmental indicators;
- The conceptual framework for developing agri-environmental indicators;
- Indicators to address agri-environmental indicators;
- Plenary discussion on national experiences; and;
- Developing work on building a set of agri-environmental indicators.

15.2 THE POLICY CONTEXT AND OBJECTIVES FOR DEVELOPING AGRI-ENVIRONMENTAL INDICATORS
What is agriculture doing to the environment? And what impact do different policy measures have? These questions underlie work on developing agri-environmental indicators (AEIs). The demand for information on agri-environmental linkages largely reflects the high priority given by governments to environmental improvement. The supply of quantitative information of this sort, however, is currently inadequate. But without governments and others cannot identify the environmental risks and benefits associated with agriculture, which makes it difficult to improve the monitoring, assessment and targeting of agricultural and environmental programmes. Agri-environmental indicators are intended to:

- Provide information to government policy makers and the public on the current state of the environment in agriculture, and changes to it;
- Help policy-makers understand links between causes and effects and the impact of agricultural policies on the environment, and guide their responses to changes in environmental conditions;
- Contribute to monitoring and evaluating policy effectiveness in promoting sustainable agriculture.

15.3 THE CONCEPTUAL FRAMEWORK FOR DEVELOPING AGRI-ENVIRONMENTAL INDICATORS
A major challenge is to provide a solid conceptual and methodological basis to support the empirical analysis of agri-environmental linkages, especially in terms of quantifying the impact of agricultural policies and policy changes on the environment in agriculture. In order to better understand agri-environmental linkages, and to identify and develop policy relevant indicators, particular consideration has been given to:

- recognising specific characteristics of the linkages between agriculture and the environment;
- situating agriculture in the broader context of sustainable development, especially in terms of the relationships between the economic, social and environmental dimensions;
ensuring the framework to structure agri-environmental analysis is largely consistent with
that commonly being used in other related work in national administrations and else-
where.

The specific characteristics of agriculture in relation to the environment that are of particular
importance are as follow:

First, agricultural activities produce a diverse range of harmful and beneficial impacts on en-
vironmental quality. Farming can lead to a deterioration in soil, water and air quality and the
loss of habitats and biodiversity. But agricultural activity can contribute to environmental
benefits such as acting as a sink for greenhouse gases, conserving and also enhancing biodi-
versity and landscape, and preventing flooding and landslides.

Second, the relationship between agricultural activities and the environment is frequently
complex, site specific and non-linear. Agricultural activities can have impacts on the envi-
ronment which are determined by different agro-ecological systems and physical attributes of
the land, the prevailing economic conditions and production technology, and farmers' man-
agement practices in relation to natural conditions.

Third, the agricultural sectors in most OECD countries, and many other non-OECD countries,
are characterised by policies delivering high levels of support and government intervention.
Farmers behaviour can be significantly affected by these policies, in that they influence the
level of agricultural production, its location, and the farming practices and management sys-
tems employed. Also changes in environmental quality can trigger market and societal rea-
cions which may in turn influence agricultural and environmental policy decisions.

The situation of agriculture needs to be considered in the broader context of sustainable devel-
opment.

Human activities, such as agriculture and economic developments, and modifications to them
in the form of plans, programmes, and policies are linked to the,
capacity of natural systems, including agro-ecosystems, to absorb the effects of human ac-
tivities on the environment, and determine,
environmental impacts, both harmful and beneficial, and the long term sustainability of the
ecosystem.

The Driving Force-State-Response Framework (DSR) is utilised to improve the understanding
and help in organising what needs to be measured and develop relevant indicator. The frame-
work is most useful in developing the linkages.

Driving forces are those elements which cause changes in the state of the environment. These
include:

Natural environmental processes and factors, including the agro-ecological system, the
physical attributes of the land, meteorological conditions, and random events such as earth-
quakes;
Biophysical inputs and outputs at the farm level, covering the use of chemical inputs, energy
and water resources; farm management practices; and decisions taken in terms of the level
and mix of agricultural commodities produced;
Economic and societal driving forces, encompassing reactions to economic and policy signals
received from markets and governments; variations in the level and composition of farm
financial resources; changes in technology; cultural attitudes and public pressure; social structures; and population growth.

The concept of “driving forces” recognises that agricultural activities can both produce beneficial impacts to enhance environmental quality, for example by increasing the water storage capacity of certain agricultural systems which may ameliorate problems of soil erosion, landslides and flooding, and also have harmful impacts on the environment, such as the excessive use of fertilisers and pesticides and inappropriate management practices. Driving forces also accommodate a broader coverage of the influences affecting the environment in agriculture and sustainable agriculture, including farmer behaviour, government policies, economic, social, and cultural factors.

The state or condition of the environment in agriculture, refers to changes in environmental conditions that may arise from various driving forces. The impact of agriculture on the environment can occur both on-farm and off-farm, for example the effects on biodiversity and climate change, and operate at various temporal and spatial scales from the field through to the global scale. While the state of the environment in agriculture encompasses a wide range of different elements, it can be broadly categorised into the following sub-categories of the:

State of the natural resources, used in agricultural production — soil, water and air — covering their physical, chemical and biological condition;

Composition, structure and functioning of the ecosystem, affected by agricultural activities, including biodiversity and natural habitats, for many countries the inclusion of the man-made environment, such as agricultural landscapes, is also an integral part of this sub-category;

State of human health and environmentally related welfare, including for example the risk to human health from pesticide spraying and the public nuisance caused by odours from intensive livestock production. The range of issues in this sub-category may vary greatly from country to country depending on where the boundaries of agri-environmental issues are drawn, and the importance society attaches to these issues.

An important consideration when examining the “state” component in the DSR framework is to identify the share of agriculture in the environmental media or issue concerned, and to assess its importance for policy purposes. Typically, agriculture is only one amongst other activities in the economy which has an impact on the state of the environment. For example, river and groundwater water quality may be the combined result of agricultural and industrial activities and the disposal of urban waste. A further aspect in this context is that while agriculture can affect the state of the environment, changes in environmental conditions can also impact on agricultural production activities, such as through acid air emissions or ozone depletion.

Responses refer to the reaction by groups in society and policy makers to the actual and perceived changes in the state of the environment in agriculture, the sustainability of agriculture and to market signals. The responses include:

Farmer behaviour, by changes in input use, farm management practices, such as integrated pest management, and co-operative approaches between farmers and farmers and other stockholders;

Consumer reactions, through altering food consumption patterns, including preferences for “organically” produced foods;

Responses by the agro-food chain, with changes in technology to produce less toxic pesticides and the voluntary adoption of better safety and quality standards by the food industry;
Government actions, through changes in policy measures, including regulatory approaches, the use of economic instruments such as subsidies and taxes, training and information programmes, research and development, and agricultural policies.

15.3.1 Linkages between driving-force, state and response

Analysis of the linkages between driving forces, state and response is a key element in shedding light on the relationship between the causes and effects of agriculture’s impact on the environment to better guide policy makers in their responses to changes in environmental conditions in agriculture. At this stage of the OECD work and in analysis elsewhere, however, these linkages are not yet fully developed. Significant further work needs to be undertaken on the linkages between indicators in the DSR framework, before causal relationships and feedback can be better understood and easily expressed for use by policy-makers and other stakeholders.

Analysing agri-environmental linkages in the DSR framework highlights the need to develop knowledge not only of the physical, chemical and biological factors that relate variations in agricultural practices, input use and production to changes in environmental quality, but also to improve knowledge of the economic, socio-cultural and policy factors that determine and influence the effects of agricultural activities on the environment.

The driving forces are not always sufficient to explain changes in the state of the environment, because the environment in agriculture has the capacity to absorb some stress. Moreover, a particular change in the state of the environment may not easily be quantified and interpreted as either beneficial or harmful in all cases, especially where judgements on environmental quality are affected by evolving societal and cultural attitudes. This emphasises the importance of understanding the linkages between policies, agricultural production and environmental quality, to help to guide responses by policy makers to changes in environmental conditions in agriculture.

The DSR framework outlined here is essentially a working tool with the possibility of its components being modified as understanding of agri-environmental linkages improves and as agricultural and environmental policy goals evolve. This process is being complemented by other policy related analysis undertaken by OECD, which could help towards the development of a policy relevant set of AEIs.

Structuring work on indicators in the context of the DSR framework should ensure that indicators are not developed in isolation but can provide insights for policy makers as to the economic, social and environmental linkages and components of sustainable agriculture. In this respect it is worth noting that the interpretation of any one indicator may need to be complemented with other indicators, and be seen within the overall context of the set or appropriate sub-set of indicators.

15.3.2 Selection Criteria for Indicators

There are potentially a large number of indicators that could be developed to help quantify the various components and linkages in the DSR framework. To assist in the choice of an operational set of indicators within this framework each indicator is examined against four general criteria:

Policy relevance;
Analytical soundness;
Measurability; and;
Level of aggregation.

Policy relevance relates to those agri-environmental issues identified in the DSR framework as being of importance to policy makers.
The criterion of analytical soundness concerns, in particular, the extent to which the indicator can establish links between agriculture activities and environmental conditions, and thus refers more specifically to the attributes which provide the basis to measure the indicator. It should also be possible for the indicator to explain a link between agriculture and an environmental issue which is easy to interpret and applicable to a wide set of farming systems. The indicator should also be able to show trends and ranges of values over time, which might be complemented by nationally defined targets and thresholds where these exist.
The criterion of measurability, relates to the appropriate data available to measure the indicator. The indicator should be developed from established national or sub-national data, preferably using a long time series where this is available given the lengthy time period for many environmental effects to become apparent. While a considerable database exists in many countries from which to calculate indicators, problems of data definitions, quality, the regularity of data collection and methods of indicator measurement remain obstacles to progressing the work on certain indicators.
The criterion of the level of aggregation seeks to determine at which level (i.e. farm, sectoral, regional, national), the indicator can be meaningfully applied for policy purposes and not to conceal more than it reveals. This criterion highlights the issue of encapsulating the spatial and temporal diversity of the environment and the geographical scale of different environmental issues ranging from the farm through to the global scale. Moreover, the extent to which different agro-ecological zones have varying physical resource characteristics and property rights associated with those resources can change the impact of environmental outcomes that may arise from farming in those zones.

15.4 INDICATORS TO ADDRESS AGRI-ENVIRONMENTAL ISSUES

Indicators are being developed for the measurement of thirteen agri-environmental issues identified by OECD countries, which can be grouped under three headings relating to primary agriculture (indicators might be developed at a later stage on upstream/downstream activities related to agriculture):

1. The use by primary agriculture of:

Nutrients – mainly chemical fertilisers and livestock manure;
Pesticides – herbicides, insecticides, fungicides and other pesticides;
Water – particularly water for irrigation;
Land – this covers both changing farmland use and agricultural land conservation.

2. The impact of primary agriculture on:

Soil quality – the impact on soil quality, in particular to reveal the risk of erosion;
Water quality – the impact on surface and groundwater quality;
Greenhouse gases – both the release and accumulation of such gases;
Biodiversity – of domesticated species used by agriculture, as well as on wild species;
Wildlife habitats – changes and fragmentation of habitat in agricultural areas;
Landscape – changes in agricultural landscapes;

3. The environmental impacts from primary agriculture related to:

Farm management practices – on nutrients, pests, soil, irrigation and the farm as a whole;
Farm financial resources – the varying and different sources of financial resources for farms;
Socio-cultural aspects – the impact of the socio-cultural structure of rural communities.

15.4.1 Agricultural Nutrient Use

To capture how well nutrients are used in the agro-ecosystem the OECD is developing a nutrient balance approach, which can provide an indicator of the extent to which agricultural production leads to a net surplus (or deficit) of nutrients into (or from) the soil, water or air. However, a deficit or surplus of the nutrient balance, at least over the short term, does not unambiguously indicate a beneficial or harmful environmental impact. Two main approaches are being considered to measure nutrient balances, limited at this stage of the work to nitrogen and phosphorous balances, including the:

- **Soil surface balance**, which measures the difference between the input or application of nutrients entering the soil and the output or withdrawal of nutrients from the soil. Using nitrogen as an example, the inputs include chiefly the application of chemical fertilisers and livestock manure, but the use of other inputs can also be taken into account including, sewage sludge, the atmospheric deposition of nutrients in the soil (which mainly includes ammonia), the nitrogen content of crop residues remaining in fields (e.g. potatoes), and the biological fixation of nitrogen by leguminous crops. The output consists of the withdrawal of nitrogen from harvested and fodder crops.

- **Farm gate balance**, which measures the difference between the nutrient content of farm inputs and the nutrient content of the outputs from the farm. Again using nitrogen as an example, the inputs consist of purchased materials such as chemical fertilisers, manure, fodder and livestock, but natural phenomenon, such as the atmospheric deposition of nitrogen in the soil and biological fixation by leguminous crops, can also be included. Outputs include the nitrogen content of milk, meat, manure, fodder and cereals, sold of-farm.

**Preliminary OECD work on national nitrogen balance calculations**, using the soil surface method for the period 1985 to 1995, suggests a number of key trends in terms of the nitrogen surplus/deficit expressed as kilograms of nitrogen per hectare of total agricultural land:

- Overall the trend in nitrogen balance surpluses over the last decade is downwards or constant, especially for those OECD member countries with a nitrogen surplus in excess of 100 kg/ha;

- Generally those countries with high livestock densities and intensive production systems have the highest nitrogen surpluses. Regional data, however, suggests that in areas of some countries where the national nitrogen surplus is below 100 kg/ha, they may be experiencing both the effects of nitrate pollution and soil nutrient depletion from crop production;

- Further analysis is required to explain the causes of the changing levels and trends in nitrogen surpluses/deficits between countries, and the potential environmental impacts.

15.4.2 Agricultural pesticide use

The approach being considered by OECD to measure the agricultural pesticide use issue involves classifying pesticide use data into different environmental risk categories. This approach combines information on pesticide use with that on pesticide chemistry which influences environmental risk, that is mobility, persistence, and toxicity. Until OECD evolves a suitable pesticide risk classification system, initially work would begin on collecting pesticide use data, expressed in terms of the quantity of active ingredients per crop and/or per hectare, taking into account the proportion of agricultural land on which pesticides are applied, and the distinction between pesticide use on arable crops and pastures.
From a preliminary examination of trends in pesticide use data in OECD countries, between 1985 to 1995, several key points emerge:

- Overall the trend in pesticide use over the last decade has remained constant or declined in most OECD countries, although pesticide use increased in a few countries;
- Variability of weather conditions may alter pesticide use, warmer conditions generally require higher uses of pesticides than colder conditions to maintain agricultural productivity;
- Cereals, industrial crops, fruit and vegetables account for the major share of agricultural pesticide use in most countries, while pasture and rangeland account for the major part of agricultural land use, pesticides on forage account for below 5% of total pesticide usage;
- There is considerable variation in the quantities of pesticides used per hectare both between various crops and between different countries;
- Changes in cropping systems, rotations and tillage systems can affect pesticide use, for example, agricultural land changing from arable and permanent crop use to pasture where little if any pesticides are used;
- Technological developments, can lead to smaller quantity of active ingredients required per hectare, although the toxicity of the new products may still be high;
- The effects of organic agricultural production systems and the use of biotechnology in plant engineering in some countries on overall trends in pesticide use is at present uncertain; and;
- Further analysis is required to explain the causes of the changing levels and trends in pesticide use between different crops and countries and the potential environmental and health impacts.

The interpretation of pesticide use data will be improved by linking it to an environmental and health risk ranking system and also other indicators, in particular those covering soil and water quality and farm pest management. For example, there is some evidence that moving from more “traditional” intensive farm practices to organic farming systems may achieve a considerable reduction in pesticide use while maintaining the economic viability of the system. On the other hand, maintaining winter green cover to limit nutrient losses from agricultural land, for example, can require the additional use of pesticides.

15.4.3 Agricultural water use

Measurement of agricultural water use is being considered by developing water balances, both for the use of surface and groundwater resources by agriculture, together with exploring possible linkages with indicators related to farm management, especially irrigation management.

Indicators for measuring a water balance include consideration of various water use efficiency equations, monitoring stream and river flows (surface water) and also groundwater levels. Monitoring of water flows and levels might be in terms of measuring the relationship over time between surface water flows and groundwater levels in relation to rainfall within a catchment area. To monitor “excess” water, possible indicators could include measuring groundwater levels and the incidence of flooding. Other additional indicators being examined include calculation of water costs per tonne of crop/livestock output, and estimating the quantity of water recharged into groundwater reservoirs through certain agricultural practices.

It will be necessary to develop the water balance approach in terms of the sustainable use of water by agriculture, and also explore the linkages with indicators related to irrigation management. As regards the latter, it is necessary to identify different irrigation techniques and to classify them according to their water use efficiency in relation to a given unit of agricultural
output. Work is also needed to examine the spatial aspects of agricultural water use and also consider the related issue of water resource pricing.

15.4.4 Agricultural land use and conservation

The indicators under consideration to monitor changes in **agricultural land use** include:

- Land retired from production and maintained for conservation purposes;
- Total agricultural land area in relation to the total land area;
- Agricultural land per capita;
- Agricultural land shifted to non-agricultural uses, including abandoned farmland;
- Shifts in land use from wetlands to farmland.

Indicators under consideration to address **agricultural land conservation**, cover the role of agriculture in ameliorating soil erosion, landslides and flooding, measured by the volume of:

- Water stored by agricultural soils and ridges and banks (flood prevention);
- Water penetrating into groundwater reservoirs relative to the outflow of water from agricultural lands into surface flows (sustainable agricultural water use); and;
- Soil eroded from sloping land that is abandoned (prevention of soil erosion and landslides).

In further developing the indicators of agricultural land use and conservation it will be necessary to define more precisely the linkage between a particular change in land use and land conservation and environmental quality, and thus the establishment of the relevant indicators. It should be noted that understanding these linkages is also of concern to a number of other agri-environmental issues discussed in this paper. However, this issue, and related indicators, can provide policy relevant information on the ability of agriculture to provide environmental benefits not captured by other indicators discussed here. It will also be important to identify more clearly the links between land use and conservation and other agri-environmental issues.

15.4.5 Agricultural soil quality

Measurement of agriculture’s impact on soil quality is being considered through the development of a soil risk methodology which combines indicators on the vulnerability of soil to various degradation processes; extent of soil degradation; and soil management practices.

The emphasis with this methodology is on measuring “risk” rather than the “state” of soil quality in view of the difficulty and cost of measuring the latter and also of separating out natural impacts from water and wind erosion from the influence of farm practices on soil quality. At present the risk method is most suited to soil erosion and salinity degradation processes, rather than to aspects of soil quality such as waterlogging and toxic contamination. Estimated risk of soil degradation can be expressed in absolute terms (tonnes per hectare), classes of severity (low to excessive) or as a trend (% change), taking into account specific ecosystems. This provides an integration of information on the natural susceptibility of soil to change with land management practices. Although the soil risk approach does not reveal the extent of environmental damage, it can suggest the degree of soil fragility in some regions.

While the focus is on biophysical processes of soil degradation risk, the economic consequences of degradation are also relevant. Thus, the economic effects of soil degradation could be measured through, for example, the loss of production foregone, using data for trends in yields, and the cost of the rehabilitation of soil degradation.
Further analysis is required to examine the potential of integrating indicators that address the issue of soil quality with other indicators, particularly farm management. However, some farm management practices are already incorporated into the soil risk methodology outlined above, including the soil cover factor (a function of crops grown and the tillage practices being used). Moreover, the inclusion of some indicators that address the agricultural land use and conservation issue, such as the contribution of agriculture to the environment through its water holding capacity, might be considered in the soil risk methodology.

15.4.6 Agriculture and water quality

The method under consideration to establish agriculture’s impact on water quality involves the integration of the "state" and "risk" approaches to measure surface water (rivers and lakes) and groundwater quality in agriculture:

- The “state” approach, measures observed data on the concentrations in weight/litre of water of nitrogen, phosphorous, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, toxic pesticide residues, bacteria, viruses, ammonium, salinity and suspended matter resulting from agricultural activities.
- The “risk” approach, measures the ratio of potential contaminant concentration to the tolerable or allowable concentration, based on a partial budgeting method for nutrients and pesticides.

More work will be required to improve the basic data and methodologies for both the “state” and “risk” approaches to measure agriculture’s impact on water quality. The links between this and other issues is being explored, especially nutrient and pesticide use, land use and conservation, soil quality, and farm management. The need to develop methods of expressing the regional diversity concerning this issue is also necessary, including comparison against national water quality standards, and work might also examine the impact of agriculture on marine water quality drawing on other efforts in this area.

15.4.7 Agricultural greenhouse gases

To measure the release and accumulation of agricultural greenhouse gases the OECD is developing a net balance of the release and accumulation of carbon dioxide, methane and nitrous oxide by agriculture expressed in CO$_2$ equivalents. The net balance method of measurement can provide a better reflection of agriculture’s contribution to climate change than just measuring gross emissions, by taking into account the role of agricultural greenhouse gases (GHG) sinks. The need to ensure consistency with other international methodologies to calculate GHG in this area is important.

The net balance GHG measurement will require refinement in terms of including the use of fossil fuel on farm, and clarification of the distinction between farm-forestry and forestry. It will also be necessary to provide information that can reveal the range of uncertainty in estimates of agriculture as a sink and source for GHG, which some studies show can be substantial. Consideration also needs to be given to examining links with the farm management indicator to measure the options to reduce GHG emissions and/or develop sinks in agriculture.

15.4.8 Agriculture and biodiversity

The development of indicators to address biodiversity in agriculture is complex because of differing levels at which it operates in agriculture. Since it is possible to preserve biodiversity ex situ and in situ the indicators that could address biodiversity in agriculture will need to reflect both approaches, including the measurement of the biodiversity of “domesticated” species in agriculture; and the impact of agriculture on the biodiversity of “wild” species.
It will be necessary to define more clearly the link between agriculture and biodiversity, in particular drawing a sharper distinction between biodiversity of “domesticated” species and the biodiversity of “wild” species. Work will also need to focus on the significance of site-specificity, as the scale of many biodiversity issues is at the sub-national level. Methods also need to be evolved that can interpret the environmental impact of agriculture on biodiversity, such as whether a farm structure with smaller field plots and a denser and more comprehensive network of border elements such as hedges and boundary strips provides more favourable conditions to enhance biodiversity. Work will also explore links between this issue and those covering agriculture in relation to wildlife habitats and landscape.

15.4.9 Agriculture and wildlife habitats

Indicators to measure agriculture and wildlife habitat are not yet established but the following are under consideration: changes in the area of selected “large-scale” habitats in agriculture such as wetlands and pasture; fragmentation of habitats both in the agro-ecosystem and “natural” habitats; length of “contact zone” between agricultural and non-agricultural lands.

None of these indicators provide a direct causal link between agricultural activities and impacts on habitats, although if used in conjunction with other indicators, such as those that address nutrient and pesticide use and farm management, they may contribute information to establish these linkages. The indicators outlined here provide little information on the relationship between changes in the quality of habitats and agriculture, although the measurement of changes in “key indicator” wildlife species and habitat fragmentation could be of value in this context.

In developing indicators to address the link between agriculture and wildlife habitats work is required to define more precisely the scope of wildlife habitats in agriculture and establish the linkages between natural habitats and agriculture, especially in relation to key indicator species and landscape. National legislation and international agreements may be of help in establishing these definitions and linkages. More work has to be undertaken to understand the direction of agriculture’s impact on biodiversity. The difficulty of encapsulating the spatial diversity of wildlife habitats into national wildlife habitat indicators also needs to be addressed.

15.4.10 Farm management

A number of indicators to assess the environmental impacts of farm management practices are under consideration, including the measurement of:

- **Nutrient management** - the share of land which is analysed regularly for soil phosphorus; the share of farms using a nutrient management plan; the area of land which require less than normally recommended nutrient inputs and also receiving excessive (i.e. Above recommended levels) of nutrient inputs; the timing of slurry application and months of available slurry storage on farm; and the use of low ammonia emission slurry application machinery;
- **Pest management** - the share of land on which integrated pest management practices are adopted; the use of pest forecasting systems; the area of cropping land on which pesticides are not applied; and the efficiency of pesticide spraying equipment in applying pesticides;
- **Soil management** - the share of land on which soil conservation practices are adopted including the use of winter cover crops, and appropriate tillage practices;
- **Irrigation management** - the efficiency of water use on irrigated land in terms of the quantity of water used to produce a unit of agricultural output; and the pricing of water to agriculture; and;
• Whole farm management - the rate of adoption of farm plans or property management plans —which, when fully developed, may contain information relating to economic, farm production and biophysical or environmental factors — either approved by governments or voluntarily.

Further analysis of farm management practices will be required in terms of defining measurable indicators that can separate out environmentally appropriate from inappropriate practices. Additional work could also explore the relationship with other agri-environmental issues and related indicators. As some countries have already defined certain practices in national legislation, for example “organic farming”, while FAO has developed internationally accepted definitions for certain farm management practices, such as integrated pest management, this information could provide an input to develop indicators that address the farm management issue.

15.4.11 Farm financial resources
The indicators under consideration to address the issue of farm financial resources and the environment include measurement of: net farm and off-farm income; policy transfers; average rate of return on capital employed; and the average debt/equity ratio, on a per farm basis and adjusted for inflation in real terms.

More work has to be completed on defining the direction of environmental impact, associated with changes in the level of farm financial resources. Further investigation is also required of the links between farm financial resources, farm management practices employed, and the effect on the environment, taking into account other factors, such as longer term climatic changes and population growth, which may indirectly influence farmer behaviour and environmental outcomes.

15.4.12 Socio-cultural issues in relation to agriculture
Although the importance of socio-cultural issues in the analysis of agriculture and the environment, including sustainable agriculture, is generally accepted, no precise definition of the policy issues nor relevant indicators have yet been established. However, some indicators are under consideration, including the measurement of:

• Land use changes, especially the transfer of agricultural land to use for urban development;
• Changes in population growth and composition, in particular rural-urban changes;
• Education and training of farmers, in relation to the adoption of environmental plans and sustainable farming practices; and;
• Farmer health and safety, related to the use of agricultural pesticides and machinery.

The key aspect to further work to address the socio-cultural issue in relation to agriculture and the environment, relates to establishing a clear definition of the relevant policy issues and developing indicators that can quantify these issues. Work underway both on other agri-environmental issues, for example land use and farm management, and in other OECD activities, such as on rural development and structural adjustment in agriculture, could be drawn on to help develop the definition of issues and identification of indicators. However, further conceptual work is also required to examine the linkages between the socio-cultural, economic and environmental components in the DSR framework, and also consider the spatial aspects of these links in developing appropriate indicators.
15.5 CONCLUSION

The participants were given the opportunity to have a question and answer session with particular reference to the work they would need to perform in their offices which is related to agriculture.

To conclude the course topic the future of OECD agri-environmental indicator work was also highlighted as follows:

- **Improve the conceptual and analytical understanding of the links between agriculture and the environment** in specific areas to help identify which policy relevant indicators might be developed and how they should be measured, in particular for example biodiversity, habitats, landscape, farm financial resources and socio-cultural aspects of agri-environmental linkages. In these areas the links between agriculture and environmental impacts need further refinement and relevant indicators identified.

- **Identify policy relevant indicators and methods of measurement** for those agri-environmental issue areas, where the conceptual basis is advanced but for which indicators and methods of measurement are not yet established, such as pesticide use, soil and water quality.

- **Collect, systematically, basic agri-environmental data and begin the calculation of indicators** where methods of measurement are established. In this regard, work is already underway on calculating indicators and collecting basic data related to, for example, nutrient use and greenhouse gases.

- **Examine how the driving force-state-response (DSR) framework** and related indicators can be used as analytical tools to better understand agri-environmental relationships in policy analysis and to evaluate the impact of policies on the environment in agriculture.
16. INFORMATION SYSTEM ON FORESTRY

By Howard Wright
Oxford Institute of Forestry
(7th - 9th May 1997)

16.1 INTRODUCTION.

The aim of introducing information system on forestry was to provide background knowledge required to for accurate, up-to-date information on forestry. To achieve this target the following sub-topics were treated:

- Definition of a forest;
- Roles of a forests;
- Criteria for selection of indicators;
- Forest resource accounting;
- Current issues in forestry management; and;
- Forest inventories.

16.2 WHAT IS A FOREST?

The term forest encompasses an enormous range of habitats, ranging from elfin cloud forests a few metres tall to 50 metre-high stands of redwoods or eucalyptus and from single species coniferous plantations to topical moist forests of extraordinary complexity.

The major problem in mapping forests is in deciding at what point tree cover becomes dense enough to be called a forest rather than, say, an open woodland. There is no straightforward answer. FAO classifies a forest as any area more than 10 per cent canopy cover. But this very wide definition includes many areas which few would regard as forests. A more satisfactory definition is one covering closed canopy forest (any area with over 40 per cent crown cover). This works well with broadleaf or mixed coniferous and broadleaf forests but less well with purely coniferous forests, where canopy cover is often less than 40 per cent.

16.2.1 Status of the World Forest Resources

Ninety percent of the world’s forests are unprotected. Surprisingly, tropical moist forests and mangroves appear to be the two best protected forest types - but this protection is in theory rather than practice. It is therefore important that we improve the quality of existing protected areas, as well as increase the territory they cover. Table 15.1 shows the percentage of protected forest by area and type.

<table>
<thead>
<tr>
<th>Forest type</th>
<th>Global area (sq km)</th>
<th>Percentage protected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical moist</td>
<td>11.2 million</td>
<td>8 percent</td>
</tr>
<tr>
<td>Tropical dry</td>
<td>0.8 million</td>
<td>5 percent</td>
</tr>
<tr>
<td>Temperate broad-leaf/mixed</td>
<td>7.2 million</td>
<td>6 percent</td>
</tr>
<tr>
<td>Temperate needle leaf</td>
<td>13.9 million</td>
<td>5 percent</td>
</tr>
<tr>
<td>Mangrove</td>
<td>0.2 million</td>
<td>9 percent</td>
</tr>
</tbody>
</table>

Source: The WWF world Forest map 1996.
16.3 ROLE OF FORESTS
The forests have economic, environmental and social uses. The economic uses of forests include timber production, pharmaceutical products, provision of energy, fodder and food. The environmental roles of forests include conserving the soil, controlling floods and flow of water, rehabilitation of degraded land and genetic conservation. The social roles of forests include employment creation, provision of areas that can generate income e.g. tourism and forests contributions to human and animal health.

16.4 CHARACTERISTICS OF TROPICAL FORESTS
There is increasing human population pressure on the forestry. It is estimated that 450 sq. km are lost every day. This has been due to low government commitment to conservation of forestry resources, slow pace of industrial development and frequent exploitation of natural forests usually aimed for export. The physical causes of tropical deforestation are shifting agriculture, secondary agriculture, fuel production, logging and overgrazing, fires, urban and industrial expansion and war damage. There has also been loss of genetic variation due to over-exploitation, climatic change, pollution, introduction of exotics and artificial breeding. Many plantations species have been started. These are usually exotic, fast growing species which have short commercial cycles. There has been a growing phenomena of nationalism with regard to forests hence the advocacy for growing indigenous species.

16.5 CONSERVATION AND SUSTAINABLE MANAGEMENT OF FORESTS
There is need to conserve biodiversity for ethical and ecological reasons. Many species live together and maintain an ecological balance. The objective of conservation to maintain ecological processes and life support systems to preserve genetic diversity and promote sustainable use of forest resources.

Sustainable management of forest is defined as

“The stewardship and use of forests in a way, at a rate, that maintains their biodiversity, productivity regeneration capacity, vitality; and their potential to fulfil now, and in the future, relevant ecological, economic and social functions at local, national, and global levels; that does not cause damage to other ecosystems” (Interministerial Conference on European Forest Helsinki 1993)

16.6 CRITERIA FOR SELECTION OF INDICATORS
The process of identifying indicators entails identifying critical components to operationalise sustainability. Some of the factors that can be considered in selection of forestry indicators are as highlighted below:

- Primary tools of evaluation;
- Site specific (or generic);
- Ranked according to importance;
- Possibility of cross linkage; and;
- Possibilities of information sharing.

16.7 FOREST RESOURCE ACCOUNTING APPROACH
Forest resource accounting focuses on three key areas of information. These include the demand for forest goods and services, the supply, the use and management of forest assets. The supply aspect includes information of the extent, composition, ownership and capability of

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5 There is need to have several types of trees as mono type forests may be destroyed by a disease single disease.
forest assets. The demand aspects includes information on market demands, international obligations, investment opportunities and threats to forests. The use aspect includes information on flows of forest goods and services, management practices and industry capabilities. (For more information see Chapter 19)

16.8 CURRENT ISSUE IN FORESTRY MANAGEMENT

The participants were divided into four groups and given an article from UNASYLVA to read and to summarise the main salient features. The four papers that were:

- “Policy and Legal Aspects of Sustainable Forest Management” by R. M. de Montalember and F. Schmithüsen
- “Common Property Regimes in the Forest: Just a Relic from the Past?” By M. McKean and E. Ostrom
- “The Conservation of Genetic Resources in Managed Tropical Forests” R. H. Kemp.
- “Present and Potential Roles of Forest in the Global Climate Change Debate” by S. Brown.

16.8.1 “Policy and Legal aspects of Sustainable Forest Management” by R. M. de Montalember and F. Schmithüsen

This paper identifies the policy shift from traditional yield concept to sustainable forest management. The policy shift to sustainable forest management is a result of increasing complex challenges of reconciling the demands of various users. This shift consists of a significant change from production techniques designed to ensure sustained commodity flow over time to a broadened focus that encompasses socio-economic impact, the participation of rural people, environmental benefits and ecological stability while maintaining the potential to respond to evolving demands. The sustainable forest management policy framework now embraces more systematically the economic, social and ecological roles of forests development. For the policy framework to be achieved the aspects which are particularly important are the

- Land use policies and planning aspects;
- Macro-economic policies and structural adjustment measures;
- Policy interactions between forestry and related sectors;
- The conservation and wise utilisation of forests;
- Forest dwellers and neighbouring communities;
- Fiscal policies for forestry activities; and;
- Price polices for all marketed forest goods and services.

The implementation of polices and laws and their impact as an effective incentive and regulatory framework ultimately depends on the attitudes and capacities at national and local levels. This is why any progress in policy regulations requires a critical examination of the institutional arrangement and skills of people involved in developing, disseminating, supporting and implementing more widely sustainable forest management practices. Forest management can only be undertaken and pursued through interdisciplinary approaches with effectively coordinated rural development policies and regulations. No sustainable forest management is feasible unless it benefits from sound and sustainable context of consistent developments and converging strategies occurring in related sectors.
16.8.2 “Common Property Regimes in the Forest: Just a Relic from the Past?” By M. McKean and E. Ostrom

The objective of this paper is to examine current and future potential of common property rights (CPRs) in the conservation and sustainable use of forest resources. The basic argument is that CPRs were once used globally for management of forest resources for long term benefits. With the natural decay of CPR communities opted for other system under the influence of new technologies in the economic development process. CPRs were legislated out of existence. In this case CPRs were left out in the formal property rights codification process and where such rights existed land reform transferred such rights to individuals.

Common pool resources refers to an arrangement of property rights in which a group of resource users share rights and duties towards a resource. CPR refers to an arrangement of property rights in which a group of resource users share rights and duties towards a resource.

Common property has been oddly used to refer to a resources system of non-property or rather to open access resources for which rights and duties are undefined. In CPR, there is property rather than non-property, their are rights rather than absence of rights. These rights are not common to all but are common to a specific group of users. Hence, common property is not access open to all but access limited to a specific group of users who hold their rights in common.

The advantages of CPR is that it is a way of privatising the rights to a resource without dividing it into pieces, a system desirable when the resource system is productivity managed as an intact whole rather than fragmented and uncoordinated smaller pieces.

CPR is a favoured policy because it promotes keeping resources intact as whole rather than division into smaller pieces, it provides the possibility to share risk, collective management is less costly.

The policy recommendations for CPR are:

- User groups need the right to organise their activities, or at least a guarantee of no interference;
- The boundaries of the resource must be clear;
- The criteria for membership in the group of eligible users of the resource must be clear;
- Users must have the right to modify their use rules over time;
- Use rules need to be clear and enforceable;
- Inexpensive and rapid methods of resolving minor conflicts need to be devised;
- Institutions for managing very large systems need to be layered, with considerable authority devolved to small components.

Therefore the CPR can be applicable and it should not be considered as relics of the past since this approach could be effectively applied to reduce deforestation rates in some parts of the world.


This paper highlights the importance of genetic diversity of tropical forestry. The biological diversity of tropical forests constitutes a unique national and international asset. As human populations continue to increase, setting aside large areas purely to preserve biodiversity becomes more and more difficult. At the same time, however, the conservation of genetic re-
sources is fundamental to the sustainable management of the forest ecosystem in which they occur. The conservation of a wide diversity of species and variation in natural forests is dependent on maintaining essential functional components of the ecosystem. These often involve a range of complex interactions. The key elements that need to be considered in order to achieve sustainable management are selective logging, improved forestry inventories, national data centres, and national strategies.

Selective logging in mixed forests can be managed to allow for maximum genetic diversity of both pioneer and climax species. In this regard logging should leave large seed bearing trees which can help to ensure regeneration and maintenance of genetic equality.

The paper emphasises the need for a forest inventory in conservation of diversity. Traditional forest inventories need to be improved to include information on the composition and condition of forests. Inadequate information on species composition of the forest is one of the main problems confronting natural forest management.

National data centres are critical in achieving conservation of genetic diversity. This is because a variety of information sources is required to contribute to the construction of a tropical forest inventory. Information that is required ranges from forest composition, species composition and the science of flowering and fruiting.

Existing laws and regulations may need to be revised and a coherent system of incentives for sustainable forest management to be met. Management of forests particularly genetic diversity, must be undertaken at local levels. However, in the context of national plans, there is ample scope for international conventions on biological diversity, currently being negotiated.

16.8.4 “Present and Potential Roles of Forest in The Global Climate Change Debate” by S. Brown.

The article describes how forests contribute to climate change through their influence on the global carbon cycle. The Carbon cycle consists of the following processes:

- Storage of carbon in vegetation and soil;
- Exchange of carbon with the atmosphere through photosynthesis (plants take up carbon dioxide and store it in their leaves, stems, roots, fruits) and respiration;
- Release of atmospheric carbon when disturbed by either human or natural causes such as wild fires, logging, over harvesting and degradation, clearing and burning for conversion to non forest uses e.g. agriculture and pastures.
- Absorption and becoming sinks during re-growth after disturbance.

There is a distinction between the forests in temperate (18%), boreal zone (30%) and tropical zone (52%). Tropical forests are undergoing high rates of loss, but with sound management they can be regenerated and hence can accumulate carbon.

Carbon storage in vegetation and soil can be achieved by:

- Increasing the area and or density of forest;
- Establish plantations on non forested lands;
- Promote vegetation and protection; and;
- Increase carbon stored in durable wood products (expand demand for wood products at a faster rate than decay of wood).
Although forest contribute to climate change through their influence on carbon cycles, the research has shown that their current contribution to global warming is minimal. However, this could change as forests are annually and increasingly being cleared and degraded. In addition as forest, mature, die and decay they cease to absorb carbon.

**16.9 FOREST INVENTORIES**

Inventories are crucial for the sound management of forests. They are various sampling methods utilised for constructing forest inventories. These include systematic, stratified and multi-stage sampling.

In a typical forest plantation the size of tree and age follow a normal distribution. On the other hand the age and size of tree in a natural forest follow a negative exponential. Figure 16.4 shows the distribution of trees by size and frequency. In this figure the shaded area shows the trees that can be harvested in order to have sustainable management. This technique enables one to achieve low impact logging. In practice, there are computer software that can enable one to select the right age of tree for logging. Data sources for the computer data bases include, remote sensing, surveys and administrative records.

**Figure 16.1 Potential Harvest**

![Potential Harvest Diagram](image)

**16.9.1 The case of Australia forests inventories**

The participants were shown a video presentation from Australia’s national forestry inventory. Australia has a multi-resource inventory which includes environment, economic and social attributes of a forest. Some of the key issues portrayed in the video presentation were:

- Inventories are looking more at aggregating information collected from various sources;
- Non timber products are becoming more important as the policy shifts to community management of forests is attained; and;
- A participatory approach to making inventories is being promoted.

**16.10 OUTLOOK**

The participants were encouraged to carry out more reading on the topic. There were hence shown some of the important web pages on the internet which included:
• FAO Forest Home Page (Http://www.fao.org/waicent/faoinfo/forestry/forestry.htm);
• International Unit of Forestry Research Organisation (Http://iufro.boku.ac.at/);
• Oxford Forestry Institute (Http://ifs.plants.ox.ac.uk/ofif/cki/ofi.htm);
• World Forest Frontiers Initiatives (Http://www.wri.org/wri/ffi);
• World Conservation Monitoring Centre (Http://www.wcmc.org.uk/); and;
• World Wildlife Fund (www.wwf-UK.org/home.shtml)

16.11 REFERENCES
17. HUMAN SETTLEMENTS AND ENVIRONMENT
by Makandey Rai
UNCHS
(May 12 - 16, 1997)

17.1 INTRODUCTION
Human settlements interrelationship with environment was introduced to enable the participants to gain an understanding of demographic pressure on environment patterns and to analyse the effects of the household sector on environment.

To achieve the aims the aims of the course the topic was arranged as follows:

- Human settlements concept;
- Agenda 21;
- Methodology;
- Human settlements statistics;
- Data collection instrument at the national and city level and UNCHS habitat’s experience in the collection of human settlements statistics and are there any suggestion on how to improve it?;
- Publications, databases, world-wide web as an alternative media of data dissemination.

17.2 HUMAN SETTLEMENTS CONCEPT
In order to have adequate human settlements the natural environment is encroached upon to create the man made environment. The key question are what limits should we have in encroaching natural resources.

Human settlements is not synonymous with housing but rather it is the physical articulation of the social, economic, political activities of the people. Human settlements includes housing, shelter, services and infrastructure. The main objective for human settlements is to improve quality of life. The definition of human settlement is as given below:

“The fabric of human settlements consists of physical elements and services to which these elements provide the material support. The physical components comprise shelter, i.e. the superstructures of different shape, size, type and materials erected by mankind for security, privacy, and protection from the elements and for his singularity within a community; infrastructure, i.e. the complex networks designed to deliver or remove from the shelter people, goods, energy of information. Services cover those required by a community for the fulfilment of its functions as a social body, such as education, health, culture, welfare, recreation and nutrition.”

17.3 AGENDA 21.
The major issues raised with regard to human settlements in the Agenda 21 is the problems of overconsumption which leads to wastage of natural resources. The need to provide the basic needs of shelter, food, water and clothing is also highlighted.
There are five approaches recommended for achieving improved quality of life in development of human settlements and these are:

- Enabling approach;
- Capacity building;
- Partnership;
- Monitoring approach; and;
- Dissemination of information.

The Agenda 21 recommends the following:

- To make urban life more sustainable, governments should see that the homeless, poor and unemployed get access to land, credit and low-cost building materials. People also need security of tenure and legal protection against unfair eviction. Informal settlements and urban slums should be upgraded to ease the deficit in urban shelter. All urban areas need such services as clean water, sanitation and waste collection, and higher income neighbourhoods should pay the full cost of providing such services.
- Construction programmes should emphasise use of local materials, energy-efficient designs, material that do not harm health and the environment, and labour intensive technologies that employ more people.
- National action programmes are needed to promote energy saving and renewable energy technologies, such as solar, hydro, wind and biomass. Transportation strategies should reduce the need for motor vehicles by favouring high occupancy public transport, and providing safe bicycle and foot paths. Municipalities need to be developed in way that reduce the need for long distance commuting.
- Countries need to reduce urban poverty by supporting the informal economic sector, which operates many small businesses. Governments need to develop urban renewal projects in partnership with non-governmental organisations.
- To reduce migration to big cities governments should improve rural living conditions and encourage the development of medium-sized cities that create employment and housing. Sound management is needed to prevent urban sprawl onto agricultural land and environmentally fragile regions.
- It is also important to see that settlements are built in locations using designs and materials that reduce the risk of damage from such natural disasters such as storms, flooding, earthquakes and landslides.
- Developing countries need financial and technical assistance to help train experts in field such as urban planning, waste reduction, water quality, sanitation, energy efficiency and clean, efficient transportation.

17.4 METHODOLOGY FOR COLLECTION OF HUMAN SETTLEMENTS DATA

The FDES as described in chapter 20 is utilised for organising human settlements data. Table 17.1 shows the indicators recommended for human settlements statistics development that have been arranged by utilising the FDES. The recommendations for data acquisition are:

- Assess the existing data and data needs;
- Study the forms in which the data exists;
- Collect the data; and;
- Develop a method to store as a data base.
The main concerns that need to be addressed in the development of human settlements statistics are:

- Population growth and natural growth;
- Urbanisation;
- Inadequate shelter and basic amenities especially in marginal settlements;
- Overcrowding and urban decay;
- Environmental degradation;
- Lack of services and related infrastructure in rural as well as urban areas especially water supply and sanitation;
- Improvement of cultural heritage by the 2000; and;
- Health effects and living conditions.

17.4.1 Problems of Concepts
The definitions of urban and rural differ from country to country hence comparability of countries is difficult. With regard to the trends it is anticipated that one half of the population will be living in urban areas. Secondly another limitation with regard, to the concept of urbanisation is that the city boundaries change with time.
### Table 17.1 Framework for the Development of Environment Statistics: Human Settlements

<table>
<thead>
<tr>
<th>Social and economic activities and natural events</th>
<th>Environmental impacts of activities and events</th>
<th>Responses to environmental impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Settlements growth and change</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1 Population growth and change</td>
<td>1. Conditions of shelter, infrastructure and services</td>
<td>1. Human settlements policies and programmes</td>
</tr>
<tr>
<td>1.2 Construction of shelter and infrastructure</td>
<td>1.2 Access to infrastructure and services</td>
<td>2. Pollution monitoring and control</td>
</tr>
<tr>
<td>1.3 Utilities (energy and infrastructure)</td>
<td>1.3 Human settlements sprawl and dispersion</td>
<td>2.1 Environmental standards</td>
</tr>
<tr>
<td>1.4 Transport</td>
<td></td>
<td>2.2 Monitoring</td>
</tr>
<tr>
<td>1.5 Land use in human settlements</td>
<td></td>
<td>2.3 Treatment, disposal and reuse of discharges</td>
</tr>
<tr>
<td>2. Other activities</td>
<td></td>
<td>2.4 Expenditure for pollution control</td>
</tr>
<tr>
<td>2.1 Emission and waste discharge</td>
<td>2. Conditions of life-supporting resources</td>
<td></td>
</tr>
<tr>
<td>2.2 Hazardous activities at workplace [not developed]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Natural events</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Health and welfare conditions in human settlements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1 Exposure and health effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.2 Ambient concentrations of pollutants and wastes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3 Biological and ecological impacts [not developed]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.4 Micro climates [not developed]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5 Prevention and hazard mitigation of natural disaster</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The housing unit is defined in terms of conventional housing and marginal housing. The problem is that the definition of marginal housing is not agreed. In addition, they are not adequately covered in the statistics available. Marginal housing units are sometimes referred to as slums or squatter settlements. In the housing census marginal housing units are further subdivided into i) improvised housing ii) housing units in permanent buildings and iii) other premises not intended for human habitation.

Homeless population is a concept very much talked about in the political dimensions however the methodologies to establish the homeless population are not yet well developed. Therefore, routine figures on homeless population by country are difficult to find. What is always quoted i.e. (1 out of every 5 persons is without adequate shelter) is only an estimate. A related concept to homeless population is the street children.

17.4.2 Questionnaires utilised by UNCHS

The UNCHS has so far developed two questionnaires namely the human settlements statistics questionnaire and the city data programme questionnaire that has been developed for cities with a population of over 100,000.

The participants were divided into four groups so that they can discuss these questionnaires. The following were some of the observations made:

- Rural environment aspects are being neglected yet most of the developing countries have large rural population;
- Information in rural area is a big problem as additional data requirements are on fishing, deforestation and afforestation, agricultural land, soil erosion and recreation facilitates such as national parks; and;
- It is difficult to collect crime data.

17.5 DATA COLLECTION

The Kenya pilot programme (KPP) was given as an example of how human settlements information can be collected. The KPP programme concentrated on getting information from 8 cities in Kenya. The steps that were taken are as stated below:

- Sensitisation of local authorities;
- Team sent to fact finding missions to find out what data are available, to sensitise and generate capacity to collect data;
- Team to all cities to explain the difficulties of how to get records, followed by training in computer skills; and;
- Review of programme meeting.

17.6 DATA DISSEMINATION

Data dissemination has been done using various available options ranging from pocket booklets to statistical compendia in the print media and electronic media utilising diskettes for data bases and the internet.

The human settlements statistical database version 4 (1997) is one of the dissemination tools utilised by human settlements. The flowing data is included in this data base

**Demography:** Population, sex age structure, urbanisation, fertility/life expectancy, household and migration.
Economy: National accounts, labour, income distribution, poverty, household expenditure, public expenditure.

Land/natural resources: Land use, deforestation.

Housing: Housing stock, occupancy, tenure of households, housing construction, Housing facilities, building material.

Infrastructure and services Safe water, sanitation services, health, education, transport and communication and energy.

The list of human settlements indicators that are given in this data base are as listed below:

1. Total population in 000s
2. Urbanisation level
3. Total population growth rate
4. Urban population growth rate
5. Gross national product per capita
6. Income share of highest 20% to lowest 20%
7. Population below poverty line: urban %
8. Population below poverty line rural (%)
9. Government expenditure on housing and community amenities (% of total)
10. Land area per capita (ha/person)
11. Annual deforestation (sq. km)
12. Conventional dwelling per 1,000 inhabitant (/1000)
13. Average number of persons per room (person/room)
14. Owner occupancy ratio (%)
15. Housing unit with piped water (%)
16. Housing unit with toilet (%)
17. Population with access to safe water urban (%)
18. Population with access to safe water: rural (%)
19. Population with access to sanitation services: urban (%)
20. Population with access to sanitation service: rural (%)

To conclude the topic the participants were exposed to the web pages (Http://www.UNCHS.org/habrrd/info.htm) of UNCHS which highlighted activities being carried out and raw data which can be downloaded.

17.7 REFERENCES
18. ENVIRONMENT AND ECONOMIC ACCOUNTING

By Richard Allen

London

(May 20 - 23, 1997)

18.1 INTRODUCTION

Environment and economic accounting was a course topic introduced to enable Participants to be familiar with the principles of national accounts and the current role of environment in the SNA. The other aims of the course were: to enable participants to understand the concept of GDP and its limitation, to know the forms of presentation of national accounts and to be informed on satellite accounts.

18.2 THE SYSTEM OF NATIONAL ACCOUNTS

The system of National Accounts (SNA) consists of a coherent, consistent and integrated set of macroeconomics accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. It provides a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision taking and policy making. The accounts themselves present in a condensed way a great mass of detailed information, organised according to economic principles and perceptions, about the working of an economy. They provide a comprehensive and detailed record of the complex economic activities taking place within an economy and of the interactions between the different economic agents, and groups of agents, that takes place on markets or elsewhere. In practice the accounts are compiled for a succession of time period, thus provide a continuous flow of information that is indispensable for the monitoring, analysis and evaluation of the performance of an economy over time. The SNA provides information not only about economic activities, but also about the levels of an economy’s productive assets and the wealth of its inhabitants at particular points of time. Finally, the SNA includes an external account that displays the links between an economy and the rest of the world.

International interest in the comparability of national economic statistics dates from 1928 when the International Conference Relating to Economic Statistics and the League of Nations was held. The great depression of the 1930’s was an impetus to the study of national income. In 1939 the League of Nations published national income estimates for 26 countries, half of these were official estimated but still half were based on academic or other private studies.

The second world war led to further official interest in national accounts- particularly in the optimal allocation of resources to further the war effort. After the war the UN continued the work of the League of Nations and first “SNA” was published in 1953. Two slightly modified versions were published in 1960 and 1964. In 1968 the Statistical Commission published a revised version, the one which most of us are familiar, which has been used for 25 years. The most current version is the 1993 version (SNA 1993) which is not a UN publication but one jointly issued by the commission of European Communities, IMF, OECD, UN and the World Bank.

The uses of national accounts include, monitoring, analysing and evaluating the performance of the economy. National accounts enable informed rational policy-making and decision-taking. They also serve as a co-ordinating statistical framework. National accounts are not a completely satisfactory means of assessing welfare although GDP is often used as one. Valuations are based on market or quasi-market prices without any adjustment for utility (or welfare judgement) or on the effect on those not a party to the transaction.
In principal there is only limited change in the 1993 SNA from that of 1968. The aim is to preserve maximum continuity, however, with regard to the presentation and detail there are many changes and the conversion to the new SNA is not a trivial process.

18.2.1 Concepts and definitions

The phenomena of an economy are production, income, consumption, accumulation and wealth. Production of goods and services generates income and it is distributed (and redistributed) and used to finance final consumption, accumulation of capital, goods and wealth. The SNA provides an accounting framework based on internationally agreed concepts, definitions, classifications of rules. The SNA is not the only way of presenting national accounts.

Production is understood to be a physical process, carried out under the responsibility, control and management of an institutional unit, in which labour and assets are used to transfer inputs of goods and services into outputs of other goods and services. All goods and services produced as outputs must be such that they can be sold on markets or at least be capable of being provided by one unit to another, with or without charge. The system includes within the production boundary all production actually destined for the market whether for sale or for barter. It also includes all goods and services provided free to individual household or collectively to the community by government units or non profit institutional serving households (NPISH).

Consumption boundary: Consumption is equivalent to production. Services produced for own consumption are however not part of the consumption boundary. An example of such services are commonly known as “do it yourself services”. However, the expenditures used for “do it yourself” purposes are included in the household final expenditures.

Assets as defined by the system are entities that must be owned by some unit, or units, and from which economic benefits must be derived by their owner(s) by holdings or using them over a period of time. Financial assets and fixed assets, such as machinery, equipment and structures which have themselves been produced as outputs in the past, are clearly covered by this definition. However, the ownership criterion is important for determining which natural occurring i.e. non produced - assets are included in the system. Naturally occurring assets such as land, mineral deposits, fuel reserves, uncultivated forests or other vegetation and wild animals are included in the balance sheets provided that institutional units are exercising effective ownership rights over them - that is there are actual in position to be able to benefit from them. Assets need not be privately owned and could be owned by government units exercising ownership rights on behalf of entire communities. Thus, many environmental assets are included within the system. Assets that are not included are those such as the atmosphere or open sea, over which no ownership rights can be exercised, or mineral or fuel deposits that have not been discovered or that are unworkable - i.e. incapable of bringing any benefits to their owners, given the technology and relative prices existing at the time.

Changes in the values of naturally occurring assets owned by institutional units between one balance sheet and the next are recorded in the accumulation accounts of the system. For example, the depletion of a natural asset as a result of its use in production is recorded in the other changes in volume of assets account, together with losses of fixed assets due to their destruction by natural disaster (floods, earthquakes, etc.). Conversely, when deposits or reserves of minerals fuels are discovered or previously unworkable deposits become workable, their appearance is recorded in this account and they enter the balance sheets in this way.
Transactions can take place only between 2 resident institutions or between resident institutions and the rest of the world. Each transaction needs transactors, a buyer and seller, giver and receiver. A transaction is the transfer and must be in units of the economy.

Institutional units and institutional sectors: These are units capable of owning goods and assets, incurring liabilities and engaging in economic activities and transactions with others in their own right. The two main kinds that are distinguished in the SNA are households and legal entities. The institutional units are aggregated into five sectors and these include:

- Non financial corporations;
- Financial corporations;
- Government;
- Non-profit making institutions serving household; and;
- Households.

Non financial corporations include all resident non-financial corporations, irrespective of residence of their shareholders, all resident non financial-quasi corporations, including branches or agencies of foreign-owned non-financial enterprises (provided they have significant production are on a long-term basis) and all resident Non profit institution that are market producers of goods non-financial series (e.g. hospitals, schools). The sub-sectors include

- Public non-financial corporations;
- National private non-financial corporations; and;
- Foreign controlled non-financial corporations.

Financial corporations include resident corporations or quasi-corporations (and NPIs, if any) principally engaged in financial intermediation or in auxiliary financial intermediation or in auxiliary financial activities which are closely related to financial intermediation. The sub-sectors include

- The central bank;
- Other depository corporations;
- Other (financial intermediaries), except insurance corporation and pension funds (e.g. Investment corporations, financial leasing, hire-purchase companies etc.);
- Financial auxiliaries (e.g. broker etc.); and;
- Insurance corporations and pension funds.

Each of the above mentioned sectors is further sub-divided into public financial corporations, national private financial corporations and foreign controlled financial corporations.
**Government** is subdivided into the following sub-sectors:

Central Government;
State Government;
Local Government; and;
Social security funds.

Alternatively the social security funds may be associated with the level of government which operates them. Government enterprises which produce goods and services should be included in non-financial corporations as quasi-corporations if they have separate accounts and “act independently”.

**Households** are defined as a small groups of persons who share the same living accommodation, who pool some, or all, of their income and wealth and who consume certain goods and services collectively, mainly housing and food. Persons living permanently or may be expected to live indefinitely or for a very long time, in an institution e.g. prison, hospital etc. are treated as belonging to that “institutional household”.

Unincorporated enterprises may produce for the market or for own final use. Those activities included within the boundaries of the systems are all those for the production of goods, whether for the market or for own final use; the production of services for the market but only the production of the services of owner occupied dwellings and domestics services produced by employing paid staff.

Households may be sub-classified in various ways to satisfy particular needs and analyses. The system suggested in the SNA is based on the nature of the largest source of income of the household. This system is as highlighted below:

- Employers-mixed incomes accruing to owners of unincorporated enterprise with paid employees;
- Own-account workers-mixed incomes accruing to the owners incorporated enterprises without paid employees;
- Employees; and;
- Recipients of property and transfer of incomes-preferably further divided property incomes; pension; other transfer incomes.

**Non profit institutions serving household:** Non profit institutions (NPIs) are legal entities created for the purpose of producing goods and services. They are not a source of income or profit to those who establish, control or finance them. The NPIs may serve corporate and quasi-corporate enterprises, known as market NPIs, and unless financed and controlled by government are included in the appropriate corporate sector. All NPIs financed and controlled by government are included in the government sector. All other NPIs, that is those that are not market producers or government controlled are non profit institutions serving household.

**Rest of World:** To complete the institutional sectors used in the SNA there is the Rest of world which may or may not be subdivided to meet analytical needs. It comprises all non-resident units that enter into transactions with resident units. It may include certain institutional units physically located within the geographic boundary of the country such as foreign embassies, military bases or international organisations.
**Enterprises, Establishment and Industries:** Enterprises are the institutional unit of the production sector they may be a corporations, a quasi-corporations, unincorporated enterprises or a non profit institutions.

- Enterprises may have several secondary activities and to group them as “industries”: results in very heterogeneous groupings.
- Establishments are the result of partitioning enterprises on the basis of kind of activity. It may also be advantageous to partition by geographic locality.
- Industries are groupings of establishments according to the ISIC.

### 18.3 THE ACCOUNTS OF THE SNA

The accounts of the SNA are many and detailed as they may be prepared for sectors, subsectors, industries and products. the general sequence as follows:

- Production account;
- Generation of income account;
- Allocation of primary income account;
- Secondary distribution of income account;
- Redistribution of income in kind account;
- Use of disposable income account;
- Capital account;
- Financial account;
- Other changes in assets accounts, re-evaluation and other changes; and;
- Balance sheets.

Rest of the world accounts

- Goods and services;
- Primary income and current transfers;
- Capital transfers;
- Assets and liabilities;
- Other changes in volume of assets;
- Revaluation; and
- Balance sheets.

#### 18.3.1 Production account

The production account is the first in the sequence of the accounts and is compiled for institutional units, sectors, establishments, industries and the total economy. It is production which generates the income for the economy which is carried forward into the other accounts. The accounts are also of importance as they themselves show “who” produces “what”.

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate consumption</td>
<td>1883</td>
</tr>
<tr>
<td></td>
<td>Output</td>
</tr>
<tr>
<td></td>
<td>Market Output</td>
</tr>
<tr>
<td></td>
<td>Output for own final use</td>
</tr>
<tr>
<td></td>
<td>Other non market use</td>
</tr>
<tr>
<td></td>
<td>Taxes less subsidies</td>
</tr>
</tbody>
</table>

**Gross domestic product** 1854

- Consumption of fixed capital 222
- Net domestic product 1,632

**Total uses** 3,737

**Total Resources** 3737

In the above production account...
Gross domestic product = Total resources - Intermediate Consumption
Net domestic product = Gross domestic product - consumption of fixed capital.

Output is measure in this presentation in basic prices, that is producer prices less taxes on production plus subsidises on production.

18.3.2 Income account
The generation of income account is compiled to the economy as a whole, for institutional units and sectors, for establishments and industries in their capacity as producers. It is an elaboration of the production account. It shows the sectors, sub-sectors or industries in which different types of primary incomes originate. An example of an income account for a non-financial corporation for which value added was 717 is highlighted below.

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compensation of employees</td>
<td>545</td>
</tr>
<tr>
<td>Wages and salaries</td>
<td>421</td>
</tr>
<tr>
<td>Employers social contribution</td>
<td>124</td>
</tr>
<tr>
<td>Taxes on production</td>
<td>86</td>
</tr>
<tr>
<td>Subsidies on production</td>
<td>-35</td>
</tr>
<tr>
<td>Operating surplus</td>
<td></td>
</tr>
<tr>
<td>Total uses</td>
<td>717</td>
</tr>
<tr>
<td>Total resources</td>
<td>717</td>
</tr>
</tbody>
</table>

In the above generation of income account

Operating surplus = Total resources - Compensation of employees- taxes on production - subsidies on production.

18.3.3 Allocation of primary income account
The allocation of primary income account focuses on resident institutional units or sectors as recipients of primary incomes rather than as producers whose activities generate incomes. Below is a presentation of two allocation of primary income accounts one for households and the other for the total economy.

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property income</td>
<td>41</td>
</tr>
<tr>
<td>Interest</td>
<td>14</td>
</tr>
<tr>
<td>Rent</td>
<td>27</td>
</tr>
<tr>
<td>Balance of primary incomes</td>
<td>1367</td>
</tr>
<tr>
<td>Total uses</td>
<td>1408</td>
</tr>
<tr>
<td>Total resources</td>
<td>1408</td>
</tr>
</tbody>
</table>

Allocation of primary income account (Households)

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating surplus</td>
<td>60</td>
</tr>
<tr>
<td>Mixed income</td>
<td>432</td>
</tr>
<tr>
<td>Compensation of employees</td>
<td>766</td>
</tr>
<tr>
<td>Property income</td>
<td>150</td>
</tr>
<tr>
<td>Interest</td>
<td>49</td>
</tr>
<tr>
<td>Distributed income of corporations</td>
<td>57</td>
</tr>
<tr>
<td>Dividends</td>
<td>13</td>
</tr>
<tr>
<td>Withdrawals</td>
<td>44</td>
</tr>
<tr>
<td>Re-invested foreign inv. Earnings</td>
<td>3</td>
</tr>
<tr>
<td>Property income to insurance policy holders</td>
<td>20</td>
</tr>
<tr>
<td>Rent</td>
<td>21</td>
</tr>
<tr>
<td>Balance of primary incomes</td>
<td>1367</td>
</tr>
<tr>
<td>Total uses</td>
<td>1408</td>
</tr>
<tr>
<td>Total resources</td>
<td>1408</td>
</tr>
</tbody>
</table>
## Allocation of primary income account (total economy)

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Property income</td>
<td>Operating surplus</td>
</tr>
<tr>
<td>391</td>
<td>247</td>
</tr>
<tr>
<td>Interest</td>
<td>Mixed income</td>
</tr>
<tr>
<td>217</td>
<td>432</td>
</tr>
<tr>
<td>Distributed income of corporations</td>
<td>Compensation of employees</td>
</tr>
<tr>
<td>84</td>
<td>766</td>
</tr>
<tr>
<td>National Income</td>
<td>Taxes on production and imports</td>
</tr>
<tr>
<td>1661</td>
<td>235</td>
</tr>
<tr>
<td>Operating surplus</td>
<td>Subsidies on products and</td>
</tr>
<tr>
<td></td>
<td>production</td>
</tr>
<tr>
<td></td>
<td>-44</td>
</tr>
<tr>
<td>Mixed income</td>
<td>Property income</td>
</tr>
<tr>
<td>432</td>
<td>416</td>
</tr>
<tr>
<td>Compensation of employees</td>
<td>Interest</td>
</tr>
<tr>
<td>766</td>
<td>209</td>
</tr>
<tr>
<td>Taxes on production and imports</td>
<td>Distributed income from</td>
</tr>
<tr>
<td>235</td>
<td>corporations</td>
</tr>
<tr>
<td>Subsidies on products and production</td>
<td>Dividends</td>
</tr>
<tr>
<td></td>
<td>46</td>
</tr>
<tr>
<td>Property income</td>
<td>Withdrawals</td>
</tr>
<tr>
<td>416</td>
<td>57</td>
</tr>
<tr>
<td>Interest</td>
<td>Re-invested earnings on dir for</td>
</tr>
<tr>
<td>209</td>
<td>investment</td>
</tr>
<tr>
<td>Distributed income from corporations</td>
<td>Attributions to insurance</td>
</tr>
<tr>
<td></td>
<td>policyholders</td>
</tr>
<tr>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Rent</td>
<td></td>
</tr>
<tr>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>

### Total uses 2052  Total resources 2052

### 18.3.4 Secondary Distribution of Income

The secondary distribution of income account shows how primary incomes of an institutional unit or sector is transformed into disposable income by the receipt and payment of current transfers excluding social transfers in kind.

They are three types of current transfers. These are:
- Current taxes on income and wealth;
- Social contribution and benefits; and;
- Other current transfers.

Redistribution of income is a major purpose of government. An example of secondary distribution of income for households is given below.

## Secondary distribution of income account (households)

<table>
<thead>
<tr>
<th>Uses</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current taxes</td>
<td>Balance of primary incomes</td>
</tr>
<tr>
<td>178</td>
<td>1367</td>
</tr>
<tr>
<td>Taxes on income</td>
<td>Social Benefits, except transfers</td>
</tr>
<tr>
<td>176</td>
<td>in kind</td>
</tr>
<tr>
<td>Other current taxes</td>
<td>Social security benefits in cash</td>
</tr>
<tr>
<td>2</td>
<td>232</td>
</tr>
<tr>
<td>Social contributions</td>
<td>Private funded social benefits</td>
</tr>
<tr>
<td>322</td>
<td>29</td>
</tr>
<tr>
<td>Actual</td>
<td>Unfunded employee social benefits</td>
</tr>
<tr>
<td>363</td>
<td>19</td>
</tr>
<tr>
<td>Employers</td>
<td>Social assistance benefits, cash</td>
</tr>
<tr>
<td>174</td>
<td>52</td>
</tr>
<tr>
<td>Compulsory</td>
<td>Non-life insurance claims</td>
</tr>
<tr>
<td>160</td>
<td>35</td>
</tr>
<tr>
<td>Voluntary</td>
<td>Miscellaneous</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>Employees</td>
<td></td>
</tr>
<tr>
<td>97</td>
<td></td>
</tr>
<tr>
<td>Compulsory</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td></td>
</tr>
<tr>
<td>Voluntary</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Self and non employed persons</td>
<td>Other current transfers</td>
</tr>
<tr>
<td>32</td>
<td>36</td>
</tr>
<tr>
<td>Compulsory</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td></td>
</tr>
<tr>
<td>Voluntary</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Imputed</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td></td>
</tr>
<tr>
<td>Other Current transfers</td>
<td></td>
</tr>
<tr>
<td>71</td>
<td></td>
</tr>
<tr>
<td>Non-life insurance premiums</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Disposable income</td>
<td></td>
</tr>
<tr>
<td>1164</td>
<td></td>
</tr>
</tbody>
</table>

### Total uses 1735  Total resources 1735

### 18.3.5 Redistribution of Income Account

The redistribution of income in kind account takes the process one stage further by adjusting disposable income by the receipt and payment of social transfers in kind for the benefit of individual households. These may be of the social benefit or assistance nature but also include education and health services. The balancing item is then referred to as the adjusted disposable income.
18.3.6 The use of Income Account

The use of income account shows how household, government unit and non profit institutions serving households allocate their incomes between final consumption and saving. The account generated is entitled use of disposable income account. Below is an example for households.

<table>
<thead>
<tr>
<th>Use of disposable income account (households)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uses</strong></td>
</tr>
<tr>
<td>Final consumption expenditure</td>
</tr>
<tr>
<td>1015</td>
</tr>
<tr>
<td>Savings</td>
</tr>
<tr>
<td>160</td>
</tr>
<tr>
<td>Total uses</td>
</tr>
<tr>
<td>1175</td>
</tr>
</tbody>
</table>

The same measure of savings is obtained using adjusted disposable income as the actual final consumption which then includes the consumption of transfers in kind.

18.3.7 Accumulation accounts and balance sheets

The accumulation and balance sheets form a group of accounts concerned with: the value of assets and liabilities owned by institutional units or sectors at particular points in time. The changes in their value over time are also included. Balance sheets measure the values of stocks of assets and liabilities and thus net worth.

18.3.8 Capital account

The purpose of the capital account is to record the values of non-financial assets that are required, or disposed off, by resident institutional units and change in net worth due to saving and capital transfers. The right side of the capital account records the resources available for the accumulation of assets; net saving and capital transfers. The left side of the capital account records the value of non-financial assets acquired, or disposed off, in transaction of various kinds. Five categories of changes in assets in the capital account are listed below:

- Gross fixed capital formation;
- Consumption of fixed capital;
- Changes in inventories;
- Acquisitions less disposal of valuables; and;
- Acquisitions less disposals of non-produced non-financial assets.

<table>
<thead>
<tr>
<th>Capital Account (non-financial corporations)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Changes in assets</strong></td>
</tr>
<tr>
<td>Gross fixed capital formation</td>
</tr>
<tr>
<td>Tangible fixed assets, net</td>
</tr>
<tr>
<td>Non-produced non-financial assets</td>
</tr>
<tr>
<td>Consumption of fixed capital</td>
</tr>
<tr>
<td>Changes in inventories</td>
</tr>
<tr>
<td>Net acquisition of valuables</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Changes in net worth due to saving</td>
</tr>
<tr>
<td>and capital transfers</td>
</tr>
<tr>
<td>Net lending (+)/net borrowing (-)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

18.3.9 The financial account

The financial account records transactions that involve financial assets and liabilities between institutional units and between institutional units and the rest of the world. The left side of the account records the net acquisition of financial assets: the right side of the account records the net incurrence of liabilities. In the SNA financial assets and liabilities are classified as:
• Monetary gold and special drawing rights (SDR);
• Current and deposits;
• Securities other than shares;
• Loans;
• Shares and other equity;
• Insurance technical reserves; and;
• Other accounts receivable/payable.

### Financial account (financial corporations)

<table>
<thead>
<tr>
<th>Changes in assets</th>
<th>Changes in liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net acquisition of financial assets</td>
<td>Net incurrence of liabilities</td>
</tr>
<tr>
<td>Monetary gold and SDRs</td>
<td>Currency and deposits</td>
</tr>
<tr>
<td>Currency and deposits</td>
<td>Securities other than shares</td>
</tr>
<tr>
<td>Securities other than shares</td>
<td>Loans</td>
</tr>
<tr>
<td>Loans</td>
<td>Shares and other equity</td>
</tr>
<tr>
<td>Shares and other equity</td>
<td>Insurance technical reserves</td>
</tr>
<tr>
<td>Insurance technical reserves</td>
<td>Other accounts payable</td>
</tr>
<tr>
<td>Other accounts receivable</td>
<td>Net lending (+)/net borrowing (-)</td>
</tr>
<tr>
<td>237</td>
<td>232</td>
</tr>
<tr>
<td>-1</td>
<td>130</td>
</tr>
<tr>
<td>15</td>
<td>53</td>
</tr>
<tr>
<td>53</td>
<td>0</td>
</tr>
<tr>
<td>167</td>
<td>13</td>
</tr>
<tr>
<td>3</td>
<td>36</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>

The financial account is the final account in the sequence of accounts that record transactions between institutional units. However before completing the balance sheets there are changes in the volume and value of assets and liabilities which are not the result of transactions.

#### 18.3.10 Other changes in assets accounts

The “changes in the volume of assets account” records changes in issues such as discoveries or depletion of subsoil resources, destruction by war or other political events or destruction by natural catastrophes. The re-evaluation account records changes in the value of assets and liabilities due the level and structure of prices which are reflected in holding gains and losses.

#### 18.4 PRESENTATION OF ACCOUNTS

#### 18.4.1 Balance sheets

A balance sheet is a statement, drawn up at a particular point of time, of the value of assets owned and liabilities. A balance sheet may be drawn up for institutional units and sectors and for the total economy.

Balance sheet at the beginning of the period + changes in assets and liabilities = balance sheet at the end of the period. The balancing item - the difference between assets owned and liabilities - is the net worth.

#### 18.4.2 Matrix presentation

The general system of the SNA is based on double entry bookkeeping (T-accounts) because it consists of transactions between institutional units. The results in the use (payments) by one institutional unit is on the left side of an account and an increase in resources (receipts) of another institutional unit is on the right side of the account. This is a well known and well understood method of presentation, but it is not the only one possible. An alternative is a matrix presentation. The matrix is a grid of cells in which the rows contain additions to resources and the columns contain uses. Each transaction (or aggregate of similar transactions) thus appears only once on the matrix in the cell at the junction of the column relating the institutional unit “making the payment”.

---

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The matrix presentation has many advantages. The whole system can be presented on one table, although it require a very large sheet of paper; it is by definition fully articulated and must be internally consistent; and it can be manipulated by computer by using matrix algebra. On the other hand it has disadvantages in that many people have great difficulty in reading matrixes; the printed version, as opposed to the computer version, of a complete detailed matrix version is difficult to handle; it is not possible to produce a fully articulated set of accounts, i.e. it cannot be used for an incomplete set of accounts.

The main uses of the matrix presentation are in the input/output tables and the Social accounting matrix

18.4.3 Input-output tables
The supply and use tables are input/output tables but there analytical uses are limited because they are not symmetric or “square”, they cannot be manipulated by matrix algebra. The input/output element is producers and products and unless there is one-to-one relationship between the two, which unlikely, the matrix will be rectangular. By reallocating secondary products to homogeneous “single product” and on the basis of specific technical assumptions about production structure it is possible to drive a symmetric product by product matrix within the input/output table. Table 18.1 gives an example of input output table using hypothetical data.

18.4.4 Social Accounting Matrix (SAM)
The social accounting matrix is a matrix presentation of the complete system of national accounts. To a great extent it is an expansion of the input/output table, in particular an extension of the disaggregation of the household sector, but also includes details of the capital accounts of the “flow of funds”, that is transactions in financial assets. Table 18.2 gives and example of the presentation of a social accounting matrix using hypothetical data.

The SAM and input/output tables, including the supply and use tables serve two types of purposes and these are statistical and analytical. They provide a framework for checking the consistency of statistics on flow of goods and services obtained from different statistical sources. The system as a whole, and in particular the matrix tables, provides a framework for ensuring consistency through common concepts, definitions and classifications. As analytical tool the input/output tables and the SAM can be used as a macroeconomics model or more likely incorporated into macroeconomics models.

18.4.5 Satellite Accounts
The SNA provides a framework with an integrated accounting structure and is exhaustive and consistent within the boundaries of economic activities it covers. There is a great deal of flexibility over detail and emphasis but only within the limits of the system. The SNA is not the only possible system for national accounts. Satellite accounts are a means of expanding or modifying the system for areas of interest in a way which retains links with the central system but without burdening the whole system with the changes needed for that the particular purposes.
Typically satellite systems allow for

- Additional information of a functional or cross-sector nature;
- Complementary or alternative concepts, classification or accounting frameworks;
- Extended coverage of costs and benefits of human activities;
- Further analysis of data by means of relevant indicators and aggregates; and;
- Linkage of physical data sources and analysis to the monetary accounting system.

Satellite accounts and analysis is particularly attractive for those concerned with environment problems because the environment, and more particularly the effect of economic activities (and some social activities), is not fully contained or separately identified with the SNA.

The environment is not a sector of the economy but is “related” to all sectors. Thus the study of the sector is of a cross-sector nature. The analysis may need to linked with physical data. The coverage of costs of human activities need to be extended to include, for example, the costs of pollution.
### Figure 18.1 Input Output Table presentation

<table>
<thead>
<tr>
<th>OUTGOINGS/EXPENDITURES</th>
<th>Making of Food</th>
<th>Making of Things</th>
<th>Supplying Transport Services</th>
<th>Supplying Non-Fin. services</th>
<th>Supplying Financial services</th>
<th>Production of Govt services</th>
<th>Intern. Consumption by use</th>
<th>Final Consumption by H/Hs</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>40</td>
<td>5</td>
<td>-</td>
<td>-</td>
<td>5</td>
<td>50</td>
<td>276</td>
</tr>
<tr>
<td>Making Food</td>
<td>2</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>Making things</td>
<td>3</td>
<td>25</td>
<td>10</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>45</td>
</tr>
<tr>
<td>Supplying Transport Services</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>Supplying Non-Financial Services</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Supplying Financial Services</td>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Production of Government</td>
<td>7</td>
<td>20</td>
<td>10</td>
<td>25</td>
<td>9</td>
<td>8</td>
<td>33</td>
<td>105</td>
</tr>
<tr>
<td>Rest of World Imports</td>
<td>8</td>
<td>105</td>
<td>40</td>
<td>42</td>
<td>18</td>
<td>17</td>
<td>52</td>
<td>157</td>
</tr>
<tr>
<td>Intermediate Consumption by source</td>
<td>9</td>
<td>285</td>
<td>100</td>
<td>55</td>
<td>19</td>
<td>21</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>Compensation of employees</td>
<td>10</td>
<td>5</td>
<td>10</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Consumption of Fixed Capital</td>
<td>11</td>
<td>5</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indirect taxes</td>
<td>12</td>
<td>100</td>
<td>30</td>
<td>20</td>
<td>10</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Surplus/</td>
<td>13</td>
<td>500</td>
<td>185</td>
<td>130</td>
<td>52</td>
<td>50</td>
<td>127</td>
<td>689</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>13</td>
<td>500</td>
<td>185</td>
<td>130</td>
<td>52</td>
<td>50</td>
<td>127</td>
<td>689</td>
</tr>
</tbody>
</table>
Figure 18.2 Social Accounting Matrix presentation

<table>
<thead>
<tr>
<th>PAYMENTS</th>
<th>Factors</th>
<th>Institutions (current)</th>
<th>Redistribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>F1 F2 F3 F4 F5 F6 I1 I2 I3 I4 I5 I6 I7 I8</td>
<td>R1 R2 R3 R4 R5 R6</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Prof. Admin. and Tech. F1</td>
<td>138 58</td>
<td>4 3</td>
</tr>
<tr>
<td>C</td>
<td>Clerical workers F2</td>
<td>120 13</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Unskilled workers F3</td>
<td>48 20</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Operating surplus F4</td>
<td>138 58</td>
<td>4 3</td>
</tr>
<tr>
<td></td>
<td>Depreciation (CFC) F5</td>
<td>138 58</td>
<td>4 3</td>
</tr>
<tr>
<td></td>
<td>Indirect taxes F6</td>
<td>138 58</td>
<td>4 3</td>
</tr>
<tr>
<td>C</td>
<td>Poor households I1</td>
<td>1 4 17 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average households I2</td>
<td>3 7 11 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pension households I3</td>
<td>78 2 18 9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rich households I4</td>
<td>15 25 9 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rest of the world I5</td>
<td>48 120 386 169 29 18</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-financial enterprises I6</td>
<td>47 160</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Financial enterprises I7</td>
<td>28 20 21 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Government I8</td>
<td>28 20 21 1</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Interest R1</td>
<td>6 3 1 17 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dividends R2</td>
<td>23 18 15 174</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Insurance claims R3</td>
<td>46 25 10 4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Taxes on income R4</td>
<td>20 8 3 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other transfers R5</td>
<td>10 10 5 165 22 1 90</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Making food P1</td>
<td>15 174</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Making things P2</td>
<td>10 10 5 165 22 1 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplying transport svs P3</td>
<td>20 8 3 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplying non-financial svs P4</td>
<td>10 10 5 165 22 1 90</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplying financial svs P5</td>
<td>20 8 3 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Government P6</td>
<td>10 10 5 165 22 1 90</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Households Ia</td>
<td>5 1 4 1 13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rest of world Ib</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Non-financial enterprises Ic</td>
<td>1 4 1 13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supplying financial Government Id</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Ie</td>
<td>28 45 20 17 47 21</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Total</td>
<td>48 120 386 169 29 18</td>
<td>482 165 76 40 380 116 60 225 28 45 20 17 47 21</td>
</tr>
</tbody>
</table>
**19. NATURAL RESOURCE ACCOUNTING**  
by Prashant Vaze  
Office for National Statistics - London  
(May 26 - 30, 1997)

### 19.1 INTRODUCTION
Natural resource accounts is an accounting system that deals with stocks and stock changes of natural assets in physical terms. Natural resource accounts is an attempt to organise the wide range of environmental information into aggregate information to enable policy makers to make informed decision making. It is one of the three main approaches to environmental accounting. The second approach to environmental accounting is the monetary satellite accounting which identifies expenditures on environmental protection and deals with the treatment of environmental costs to natural and other assets caused by production activities in the calculation of net product. Monetary satellite accounting is generally more limited in coverage of environmental concerns than physical resource accounting. The third approach is a welfare-oriented one. It deals with the environmental effects borne by individuals and by producers other than the producers causing these effects. In terms of practical implementation natural resource accounting is the most advanced. Experience with monetary satellite accounting is much more recent, and many controversies still surround this approach, particularly with regard to valuation. The least consensus exists with regard to the welfare approach to environmental accounting.

Therefore the course topic on natural resource accounting was introduced to enable the participants to have an understanding of the targets and methods used in NRA. Examples on the construction of natural resource accounts for forests, water and subsoil assets were also given through exercises utilising the EXCEL windows based spreadsheet.

### 19.2 CONCEPTS AND DEFINITIONS
In an attempt to organise information related to natural resources it was noted that the SNA has various concepts and definitions which can be utilised and built upon. These are as identified below:

**Asset boundary:** Assets are those naturally occurring or man-made products over which ownership rights have been established and are effectively enforced. It was noted that ownership can be communal and that assets must be capable of providing an economic benefit to the owner under current technology and economic circumstances.

**Production boundary:** This is the creation of goods or services from inputs. It includes production by firms and, government but excludes domestic or personal services for consumption within the household.

**Balance sheet** gives data relating to the values of a system at a moment in time.

**Stock** appears in the balance sheet. It is a value, or physical quantity of a resource at a moment in time.

**Depletion** is the reduction in value of a sub-soil asset as a result of physical removal and use of the resource.

**Degradation** of land, water or other natural resources is recorded in the ‘other volume changes of assets’ account. Degradation is the deterioration resulting from economic activity...
for instance erosion and other damage to land from deforestation or improper agricultural practices and the harmful effects on fish stocks of acid rain or excess nutrients from agricultural run-off.

**Produced assets** are non-financial assets that have come into existence as outputs from production processes. Produced assets consist of fixed assets, inventories and valuables.

**Non-produced assets**: Tangible non-produced assets are those that occur in nature and over which ownership rights have been established. Environmental assets over which ownership rights have not, or cannot, be established, such as the high seas or air, are excluded because they do not qualify as economic assets.

**Environmental service** - Free service provided by nature (e.g. potable water)

In order to have an understanding of the differences between the GDP and the natural resource accounts the participants did an exercise to assess whether the GDP would rise or fall for various issues e.g. the accumulation of wood in a natural forest does not appear in the national accounts hence has no effect on the GDP. (old SNA)

### 19.3 BASIC STRUCTURE OF NRA

The SEEA is a method that builds on the concepts and definitions used by SNA in building up national accounts and is the United Nations favoured way of setting out natural resource accounts. Table 19.1 shows the basic structure of the SEEA.

**Explanation of terms in table 19.1**

The shaded areas are the usual flow and stock items in the SNA. The non shaded areas are alternative concepts used in environmental accounts.

- **P** Production covering output
- **Ci** Intermediate consumption
- **CFC** Consumption of fixed capital
- **NDP** Net domestic product
- **X** Exports
- **M** Imports
- **C** Final Consumption
- **Ig** Net Capital formation
- **-CFC** Net capital formation
- **X-M** Exports - Imports
- **Kop.ec** Opening stock of produced assets
- **Konp.ec** Opening stock of non produced natural assets
- **Usenp.ec** Use of non produced natural assets in that are economic assets in the SNA sense.
- **Inp.ec** Change in stock of non produced assets
- **Inp.env** Reduction of natural assets other than economic assets
- **Usenp** Use of non produced natural assets
- **Useenp.env** Degradation of other natural assets that are not economic assets.
- **Ap.ec** Net capital accumulation of produced economic assets
- **Anp.ec** Net capital accumulation of Non produced natural and economic assets
- **Anp.env** Net capital accumulation of other natural assets
- **Revp.ec** Holding gains on produced assets
- **Revnp.ec** Holding gains/losses of non produced natural assets
- **Volp.ec** Other changes in volume of produced assets
- **Volnp.ec** Other changes in volume of non produced assets
Klp.ec Closing stocks of produced assets
Klnp.ec Closing stocks of non produced natural assets

Table 19.1 Basic structure of SEEA

<table>
<thead>
<tr>
<th>Economic activities</th>
<th>Economic assets</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Production</td>
<td>Rest of the world</td>
</tr>
<tr>
<td>i. Opening stock of assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii. Supply</td>
<td>P</td>
<td>M</td>
</tr>
<tr>
<td>iii. Economic uses</td>
<td>Ci</td>
<td>M</td>
</tr>
<tr>
<td>iv. Consumption of fixed capital</td>
<td>CFC</td>
<td>M</td>
</tr>
<tr>
<td>v. Net domestic product</td>
<td>NDP</td>
<td>X-M</td>
</tr>
<tr>
<td>vi. Use of non-produced natural assets</td>
<td>Usenp</td>
<td></td>
</tr>
<tr>
<td>vii. Other accumulation of non-produced natural assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ix. Holding gains/losses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x. Other changes in volume of assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>xi. Closing stock of assets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The environmental adjusted GDP is therefore as stated in equation below:

$$\text{EDP} = C + (\text{Ap.ec} + \text{Anp.ec}) - \text{Anp.env} + (X-M)$$

19.4 VALUATION METHODS

Resources and environmental services have no market value, hence the SEEA proposes different methods for monetising environmental flows. The different methods for evaluation are as stated below:

Valuing depletion is done by using market values e.g. the price of sub-soil oil is valued at the price at which oil reserves are bought and sold at, however, there are a few environmental transactions of this nature. The second method utilised for evaluating depletion is the net rent which is the difference between market price and all input costs. The user cost is a final valuation method and it is that part of the rent which if reinvested that would generate a permanent income stream.

Valuing degradation is done using three methods. The first is the restoration costs methods which values based on the costs incurred in repairing the damage caused. The second method
is called damage costs and valuation is based on preventing the damage occurring. The last method is the willingness to pay which is the only means of valuing intrinsic values for example tourist attractions or beautiful scenarios.

Environmental goods are not bought or sold hence there is no market for them. In principle two methods are further utilised in coming up with costs these include the costs caused which depends on the polluter pay principle and the costs borne approach which depends on the victim pays principle. The cost caused approach is sometimes referred to as the maintenance method of valuation.

The maintenance method costs is based on costs; incurred while modifying processes or mitigating costs to avoid long term quantitative and qualitative change. The options usually available in this method are imply closing down industries or using end of pipe measure or modifying the processes.

The cost borne approach estimates are based on actual costs paid by victims to defend against pollution. In this method costs are imputed that victims would pay/accept to reduce or increase environmental problems are imputed. The problems of utilising the cost borne approach is to link costs to the accounting periods and to determine which polluter is responsible. How to link back to the industry is also a problem. There are three ways in which the costs borne approach to valuation is done. The first is based on costs incurred by existence of the problem, the second on is based on the costs of various options and the last one is based on the use value. In general the existence costs estimates tend to be lower than either option and use values. This is because they are based on hypothetical markets. However, the existence cost estimates are more commonly used than the other two methods.

There are three approaches used in the contingent method. The first is based on a hypothetical market. In this approach a questionnaire is used to ask the people their willing to pay for the non marketable natural resources. For better results the approach does not use open ended questions but uses a dichotomous choice. In addition the questions set are based on the idea of a constrained budget. The actual values are then estimated using a logit regression model which uses dichotomous variables as independent variables. In the “willingness to pay” questionnaires it is also important to ensure that less information is given about the product so that valuation of costs is not biased by information given.

The second approach used is the contingent valuation which is based on real expenditure incurred such as travel costs incurred to visit an attractive scenic area. In order to have a good estimate the element of time spent to get to the destination and population density of areas of origin are also considered. The second real expenditure method is the hedonic pricing which uses a surrogate market or market for leisure. The actual costs for leisure activities in relation to natural resources is determined. However, this method is suitable for only a few goods. Finally actual expenditure of costs incurred because of an environmental problem may be utilised. Such costs may include losses of income and export and sales prices of timber. The contingent valuation methods are good for valuing issues such as tourism, forest resources, biodiversity.

19.5 FOREST ACCOUNTS

Forests are grouped under the renewable resources accounts. The principles therefore are based on harvesting, growth and afforestation rather than depletion. In order to understand the operation of forest accounts participants were given an exercise to construct timber accounts. The data utilised was about Indonesia and was loosely drawn from ‘Wasting assets: natural
resources in the national income accounts’ by Robert Repetto and others, of the World Resources Institute.

In constructing timber accounts only productive forests are considered. In carrying out the exercise, the estimates utilised were based on a recent assessment by the land resources development centre and the Ministry of Transmigration which utilised aerial photographs dating mostly from the early 1980s, which roughly agreed with FAO totals. In coming up with the timber volumes since there was no data available in Indonesia to translate productive area into volumes of timber produced, Malaysia which is a country with similar forests was utilised. The assumption made was that Indonesia was expected to produce at 75% of the Malaysian forests because of lower forest densities. To determine annual rate of increment in volume a weighted average was used for two types of species. Table 19.2 below shows the account that was constructed from the exercise.

### Table 19.2 Forest Account for Indonesia

<table>
<thead>
<tr>
<th>Change in volume</th>
<th>Volume in M³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening stock at the beginning of the period</td>
<td>19,719</td>
</tr>
<tr>
<td>Change in volume</td>
<td>Volume in M³</td>
</tr>
<tr>
<td>Growth</td>
<td>74</td>
</tr>
<tr>
<td>Reforestation</td>
<td>25</td>
</tr>
<tr>
<td>Harvesting</td>
<td>55</td>
</tr>
<tr>
<td>Catastrophic loss</td>
<td>170</td>
</tr>
<tr>
<td>Changes in use to and from economic use</td>
<td></td>
</tr>
<tr>
<td>Closing Volume</td>
<td>19,543</td>
</tr>
</tbody>
</table>

#### 19.6 OIL ACCOUNTS

In constructing oil accounts an exercise based on actual data from the United Kingdom was used. The classification of oil in England is defined in terms of economic and physical existence. The McKelvey box is used to classify crude oil and natural gas reserves and resources. The classification made is based on the following criteria:-

- Proven - resource that is 90% chance or more of being economically and technically available for production;
- Probable - between 50% and 90% chance of being technically and economically available for production;
- Possible - a significant but < 50% chance of being technically and economically available; and;
- Undiscovered - reserves whose existence is estimated from statistical and geological information.

Three methods are used to value the oil depletion and these are market price, net rent and user cost. Formula i. and ii. below

\[
\text{i. net rent} = \text{sales} - \text{operating costs} - r \times \text{real stock of fixed capital}
\]

\[
\text{r - expected rate of return on capital}
\]

\[
\text{ii. true income} = \frac{\text{net rent}}{(1 + r)^n + r}
\]

\[
\text{n - life expectancy of the reserve}
\]

To have a better understanding on how subsoil assets can be handled the participants were given an exercise to calculate the life expectancy of the oil reserves using the definition of oil
reserves used in the United Kingdom. Table 19.3 shows the results of the exercise that was carried out. The following is a description of the various columns in the table.
Chapter 19 Natural Resource Accounting

Table 19.4 Shows how the present value of estimated proven and total remaining reserves was done. The columns are as described below:

Column 1 Year
Column 2 Proven reserves which includes all the oil that has been extracted as well
Column 3 Probable reserves which have between 50% and 90% chance of being technically and economically available for production.
Column 4 Possible reserves which have a 50% or less chance of being technically and economically available;
Column 5 Maximum which is a summation of all three types of oil reserves probable, possible and proven
Column 6 Cumulative production which is the cumulating amount of oil extracted
Column 7 Undiscovered oil reserves lower limit.
Column 8 Undiscovered oil reserves upper limit.
Column 9 Average of lower and upper limits of undiscovered oil reserves.
Column 10 Depletion of oil reserves or in other words extraction.
Column 11 This was calculated by subtracting cumulative production from maximum to attain the remain proven reserves.
Column 12 This one was calculated by subtractive cumulative production from maximum production column 10 and adding the average of lower and upper estimated undiscovered reserve in column 9.
Column 13 Division of column 11 by depletion to attain life expectancy of proven resources
Column 14 Division of column 12 by depletion to attain life expectancy total remaining oil reserves.

Table 19.4

<table>
<thead>
<tr>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
<th>Column 6</th>
<th>Column 7</th>
<th>Column 8</th>
<th>Column 9</th>
<th>Column 10</th>
<th>Column 11</th>
<th>Column 12</th>
<th>Column 13</th>
<th>Column 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Revenue generated</td>
<td>Operating costs</td>
<td>Capital development</td>
<td>Net capital formation</td>
<td>Operating surplus = Revenue (Column 2) - Operating costs (Column 3)</td>
<td>Rent = Operating surplus (column 6) - 10% of Development (Column 4) whereby 10 percent is the rate of return expected on capital that has been invested.</td>
<td>Production</td>
<td>Nominal rent per tonne which is rent (Column 7) divided by Production (column 8)</td>
<td>GDP deflator which is used to change oil costs to 1990 prices.</td>
<td>Real rent = Nominal rent (column 8) divided by GDP deflator (column 10) multiplied by 1000 tonnes.</td>
<td>Total rent = Real rent (column 11) multiplied by production (column 8.)</td>
<td>Life expectancy for proven resources.</td>
<td>Life expectancy for total remaining reserves.</td>
</tr>
</tbody>
</table>

Column 15 Present value based on life expectancy for proven resources.
Column 16 Present value based on life expectancy for total remaining reserves.
### Table 19.3 Estimation of Life expectancy

<table>
<thead>
<tr>
<th>End of Proven Year</th>
<th>Total initial oil reserves</th>
<th>Undiscovered oil</th>
<th>Reserves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1976</td>
<td>1380</td>
<td>920</td>
<td>900</td>
</tr>
<tr>
<td>1977</td>
<td>1405</td>
<td>625</td>
<td>590</td>
</tr>
<tr>
<td>1978</td>
<td>1397</td>
<td>509</td>
<td>605</td>
</tr>
<tr>
<td>1979</td>
<td>1200</td>
<td>625</td>
<td>575</td>
</tr>
<tr>
<td>1980</td>
<td>1125</td>
<td>575</td>
<td>600</td>
</tr>
<tr>
<td>1981</td>
<td>1050</td>
<td>575</td>
<td>675</td>
</tr>
<tr>
<td>1982</td>
<td>1450</td>
<td>475</td>
<td>625</td>
</tr>
<tr>
<td>1983</td>
<td>1500</td>
<td>450</td>
<td>625</td>
</tr>
<tr>
<td>1984</td>
<td>1500</td>
<td>500</td>
<td>650</td>
</tr>
<tr>
<td>1985</td>
<td>1580</td>
<td>480</td>
<td>650</td>
</tr>
<tr>
<td>1986</td>
<td>1660</td>
<td>620</td>
<td>720</td>
</tr>
<tr>
<td>1987</td>
<td>1760</td>
<td>600</td>
<td>640</td>
</tr>
<tr>
<td>1988</td>
<td>1760</td>
<td>620</td>
<td>610</td>
</tr>
<tr>
<td>1989</td>
<td>1790</td>
<td>690</td>
<td>610</td>
</tr>
<tr>
<td>1990</td>
<td>1910</td>
<td>660</td>
<td>620</td>
</tr>
<tr>
<td>1991</td>
<td>2020</td>
<td>675</td>
<td>730</td>
</tr>
<tr>
<td>1992</td>
<td>2170</td>
<td>755</td>
<td>710</td>
</tr>
<tr>
<td>1993</td>
<td>2265</td>
<td>800</td>
<td>690</td>
</tr>
<tr>
<td>1994</td>
<td>2360</td>
<td>920</td>
<td>580</td>
</tr>
</tbody>
</table>

Total estimated reserves includes an estimate of all unextracted oil.
### Table 19.4 Calculation of Present Value of Proven and Remaining Oil Reserves

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1976</td>
<td>81</td>
<td>1507</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>315</td>
</tr>
<tr>
<td>1977</td>
<td>2226</td>
<td>159</td>
<td>1559</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>359</td>
</tr>
<tr>
<td>1978</td>
<td>2805</td>
<td>258</td>
<td>1690</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>400</td>
</tr>
<tr>
<td>1979</td>
<td>5694</td>
<td>427</td>
<td>1846</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>458</td>
</tr>
<tr>
<td>1980</td>
<td>8851</td>
<td>619</td>
<td>2163</td>
<td>15237</td>
<td>8232</td>
<td>6708</td>
<td>80.467</td>
<td>83.37</td>
<td></td>
<td></td>
<td>152.41</td>
</tr>
<tr>
<td>1981</td>
<td>12340</td>
<td>929</td>
<td>2479</td>
<td>16958</td>
<td>11411</td>
<td>9715</td>
<td>89.454</td>
<td>108.61</td>
<td></td>
<td></td>
<td>178.04</td>
</tr>
<tr>
<td>1982</td>
<td>14441</td>
<td>1145</td>
<td>2304</td>
<td>18178</td>
<td>13296</td>
<td>11478</td>
<td>103.211</td>
<td>111.21</td>
<td></td>
<td></td>
<td>169.53</td>
</tr>
<tr>
<td>1983</td>
<td>17023</td>
<td>1315</td>
<td>1772</td>
<td>19275</td>
<td>15708</td>
<td>13781</td>
<td>114.960</td>
<td>119.87</td>
<td></td>
<td></td>
<td>173.48</td>
</tr>
<tr>
<td>1984</td>
<td>20587</td>
<td>1537</td>
<td>1804</td>
<td>20680</td>
<td>19050</td>
<td>16982</td>
<td>126.065</td>
<td>134.71</td>
<td></td>
<td></td>
<td>186.58</td>
</tr>
<tr>
<td>1985</td>
<td>19895</td>
<td>1918</td>
<td>1860</td>
<td>21755</td>
<td>17977</td>
<td>15802</td>
<td>127.611</td>
<td>123.83</td>
<td></td>
<td></td>
<td>162.29</td>
</tr>
<tr>
<td>1986</td>
<td>9295</td>
<td>1731</td>
<td>1761</td>
<td>22351</td>
<td>7564</td>
<td>5329</td>
<td>127.068</td>
<td>41.94</td>
<td></td>
<td></td>
<td>53.22</td>
</tr>
<tr>
<td>1987</td>
<td>9954</td>
<td>1660</td>
<td>1271</td>
<td>22747</td>
<td>8294</td>
<td>6019</td>
<td>123.351</td>
<td>48.80</td>
<td></td>
<td></td>
<td>58.93</td>
</tr>
<tr>
<td>1988</td>
<td>7239</td>
<td>1668</td>
<td>1454</td>
<td>24127</td>
<td>5571</td>
<td>3158</td>
<td>114.459</td>
<td>27.59</td>
<td></td>
<td></td>
<td>31.43</td>
</tr>
<tr>
<td>1989</td>
<td>7310</td>
<td>1877</td>
<td>1749</td>
<td>25659</td>
<td>5433</td>
<td>2867</td>
<td>91.710</td>
<td>31.26</td>
<td></td>
<td></td>
<td>33.26</td>
</tr>
<tr>
<td>1990</td>
<td>8647</td>
<td>2311</td>
<td>2572</td>
<td>26159</td>
<td>6336</td>
<td>3720</td>
<td>91.604</td>
<td>40.61</td>
<td></td>
<td></td>
<td>40.61</td>
</tr>
<tr>
<td>1991</td>
<td>7962</td>
<td>2646</td>
<td>3362</td>
<td>26746</td>
<td>5316</td>
<td>2641</td>
<td>91.261</td>
<td>28.94</td>
<td></td>
<td></td>
<td>28.94</td>
</tr>
<tr>
<td>1992</td>
<td>7727</td>
<td>2601</td>
<td>3774</td>
<td>28120</td>
<td>5126</td>
<td>2314</td>
<td>94.251</td>
<td>24.55</td>
<td></td>
<td></td>
<td>24.55</td>
</tr>
<tr>
<td>1993</td>
<td>8632</td>
<td>2885</td>
<td>3229</td>
<td>29781</td>
<td>5747</td>
<td>2769</td>
<td>100.085</td>
<td>27.67</td>
<td></td>
<td></td>
<td>27.67</td>
</tr>
</tbody>
</table>

Note: The table shows the calculation of the present value of proven and remaining oil reserves for various years from 1976 to 1994. The columns represent different economic measures including revenue, operating costs, development costs, net stock, operating surplus, sales-operating stock, rent, production, nominal rent, GDP deflator, real rent, and total rent.
19.7 WATER ACCOUNTS

In order to come up with water stocks one crucial consideration is that water is a renewable resource. Therefore, the main issues to consider when coming up with a water stock account are volume, accessibility, time, uses and storage. Analysis of water stock entails studying the water cycle. Analysing the spatial component requires study of water regions which does not necessarily tie in with administrative boundaries. This therefore makes it difficult to compare water data with other data that is usually compiled based on administrative boundaries. The scarcity of water is a seasonal issue hence constructing accounts on an annual basis to fit within ordinary accounts is not as useful as quarterly data which can be used to take account of the times when water is scarce. The economic uses of water vary. While some industries return all water back to source others consume some of it. Other considerations which are crucial for water accounts like any other are the flows and stock of water.

The type of water source is also of critical importance and these include lakes, reservoirs, springs, rivers, ground water, canals and glaciers. Issues related to quality of water have not yet been brought into the accounts because of various complications such as BOD has a short lived impact while heavy metals in water have a long impact hence making an aggregate yearly quality assessment is difficult.

It was noted that construction of water accounts was not necessary an easy task and no standard yet existed. The following table of accounts shows the exercise that was carried out based on actual data from one region in the UK including some hypothetical figures to give an understanding of what water accounts should look like.

Table 19.5 Water Accounts

<table>
<thead>
<tr>
<th>Inland Resources, mega litres</th>
<th>Lakes/Rivers</th>
<th>Reservoirs</th>
<th>Canals</th>
<th>Groundwater</th>
<th>Coastal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening Stock - 1/1/94</td>
<td>767,000</td>
<td>385,683</td>
<td>141,588</td>
<td>1,104,700</td>
<td>N/A</td>
<td>2,398,971</td>
</tr>
<tr>
<td>Net natural change</td>
<td>840,960</td>
<td>350,400</td>
<td>35,040</td>
<td>0</td>
<td>2,803,200</td>
<td>4,029,600</td>
</tr>
<tr>
<td>Abstractions</td>
<td>963,965</td>
<td>276,670</td>
<td>151,110</td>
<td>0</td>
<td>2,168,380</td>
<td>3,560,575</td>
</tr>
<tr>
<td>Returns (process waters)</td>
<td>634,593</td>
<td>136,189</td>
<td>82,435</td>
<td>2,154,413</td>
<td>3,007,629</td>
<td></td>
</tr>
<tr>
<td>Exports of water</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Imports of water</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Flows into other water bodies</td>
<td>630,720</td>
<td>262,800</td>
<td>26,280</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Closing Stock - 31/12/94</td>
<td>647,868</td>
<td>332,802</td>
<td>150,348</td>
<td>1,036,025</td>
<td>2,167,043</td>
<td></td>
</tr>
</tbody>
</table>

19.8 LINKS BETWEEN ENVIRONMENTAL ACCOUNTS AND THE NATIONAL ACCOUNTS

19.8.1 The NAMEA approach

The NAMEA approach concentrates on the main environmental themes. Hence the main methods of aggregation are based on thematic aggregation. In this regard in one single theme e.g. all natural resources or pollutants are aggregated based on scientific principles e.g. air pollution is aggregated based on the global warming potential. Unlike the SEEA approach the NAMEA approach does not use valuations. Rather linkages are drawn to the various sectors that are defined in the SNA and matrix methods of analysis utilised. The basis for non valuation is that long time effects have never been valued very well. It is assumed that politicians are aware of environmental issues hence there is no need to carry out valuation. Most valuation methods assume constant technology and market prices which is does not happen espe-
cially over the longer periods. (See Chapter 4 for further information on the NAMEA approach).

19.8.2 United Kingdom Environmental Accounting. (UKENA)
The United Kingdom has developed a system of extending national account to incorporate national resource accounts. The long term aim of UKENA is to produce a systematic and comprehensive account of the pressures placed by the economy on the environment. The accounts use standard national accounts classifications to reveal environmental impacts by different industries. This aggregation enables environmental data to be seen and analysed alongside economic data from the national accounts to assist in the modelling of interaction between environment and the economy.

19.9 CONCLUSION
To conclude the session it was observed that the field of NRA is evolving and the main work in progress is being carried out by various groups namely UNSD (SEEA), London group (annual meeting of OECD) and Nairobi group (UNEP). A paper entitled “Natural Resource Accounts Pilot Project” was presented by Dhitsupo Gaobotse. It served as a case study for construction of natural resource accounts for a developing country.

19.10 REFERENCES

UN, Integrated Environmental and Economic Accounting, Handbook of National Accounting Series F. No. 61, 1993

UN, System of National Account, 1993
20. ENVIRONMENTAL INDICATORS

By Reena Shah
UNSD
(June 2 - 6, 1997)

20.1 INTRODUCTION

The main aim of introducing environmental indicators was to sensitise the participants on the environmental and related socio-economic indicators proposed by the United Nations and those that have been proposed for sustainable development. In order to meet the above aims the topic was arranged under the following sub-topics:

- Organisation of Environmental Statistics;
- Framework for the Development of Environmental Statistics;
- Pressure-State-Response Framework;
- Framework for Indicators of Sustainable Development;
- Discussion of Selected Indicators; and;
- Development of an environmental statistics/indicator programme.

20.2 ORGANISATION OF ENVIRONMENT STATISTICS.

The presentation on organisation of environment statistics was based on the experience of the UN in organising environment statistics. During the period 1978 to 1982 the UN secretariat launched the first phase of a programme for the development of environment statistics. This phase consisted of surveys of data needs and statistical practices of countries and international organisations. One of the results of the survey was the approaches that have been utilised to organise environment statistics and these are highlighted as follows:-

- Media approach which organises environmental issues from the perspective of the major environmental components of air, water, land/soil and the man made environment;
- The Stress-Response approach which focuses on impacts of human intervention within the environment (stress) and the environment’s subsequent transformation (environmental response). This approach was first developed by statistics Canada;
- The resource accounting approach which aims at tracing the flow of natural resources from their extraction (harvest) from the environment through successive stages of processing and final use, to their return to the environment as waste or to the economic sector for recycling; and;
- The ecological approach which includes a variety of models, monitoring techniques and ecological indices. In this approach national boundaries are not used as units of analysis but rather the ecosystems. This method is mainly based on estimation and hypothetical data.

20.3 FRAMEWORK FOR THE DEVELOPMENT OF ENVIRONMENT STATISTICS (FDES)

The findings of the first phase of implementation revealed that the most commonly used approaches were the media and the Stress-Response approaches. Based on the findings, the UN developed the framework for development of Environmental statistics (FDES) which is a combination of both approaches and related methodologies. Table 20.1 shows the basic structure of the FDES.
Table 20.1 Framework for the Development of Environment Statistics (FDES)

<table>
<thead>
<tr>
<th>Components of the environment</th>
<th>Information Categories</th>
<th>Environmental impacts of activities/events</th>
<th>Responses to environmental impacts</th>
<th>Inventories, stocks and background conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Flora</td>
<td>Social and economic activities, natural events</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Fauna</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Atmosphere</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Freshwater</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Marine water</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Land/soil</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Sub-surface</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Human settlements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The information categories shown in Table 20.1 are further described below as follows:

**Social and economic activities and natural events**

The human activities and natural events included under this category are those that may have a direct impact on the different components of the environment. Human activities consist mostly of the production and consumption of goods and services but could also include activities in pursuit of non-economic goals. They produce environmental impacts through the direct use or misuse of natural resources or through the generation of waste and emissions in production and consumption processes. Natural events and disasters are also included in this information category because human activities frequently contribute to natural disasters and because natural events may have impacts on all environment components.

**Environmental impacts of activities/events.**

The statistical topics under this information category represent impacts of socio-economic activities and natural events. Responses to environmental impacts also affect the environment and ultimately, human welfare. Environmental impacts, which may include the depletion or discovery of natural resources, changes in ambient concentrations of pollutants and deteriorating or improving living conditions in human settlements, can thus be either harmful or beneficial.

**Responses to environmental impacts**

Individuals, social groups, non governmental organisations and public authorities respond to environmental impacts in different ways. Their responses are intended to prevent, control, counter, reverse or avoid negative impacts and to generate, promote or reinforce positive ones. Policies, programmes and projects designed to this end include monitoring and control of pollutants, the development and application of environmental sound technologies, changes in production and consumption patterns, management of sustainable use of natural resources, the prevention and mitigation of natural disasters and the development of human settlements.

**Inventories, Stocks, and background conditions**

Statistical topics in this category are intended to provide “benchmark” data and to illustrate links with other subject areas for possible further statistical analysis of these relationships. They include the stocks of natural resources and of capital assets of human settlements and refer to environmental inventories, as well as to economic, demographic, meteorological or geographical background conditions.
Table 20.2 presents the statistical topics within the framework for environmental statistics on the natural environment. The details for statistical topics on the man-made environment are as shown in Chapter 16.

### 20.4 FRAMEWORK FOR INDICATORS OF SUSTAINABLE DEVELOPMENT (FISD)

The framework is a modification of the FDES in that the agenda 21 clusters are taken into account however the information categories are the same as those described in section 20.2 above. In other words FISD combines the concerns of potential users as reflected in Agenda 21 with the framework for environmental data production, the FDES, endorsed by the statistical commission in 1985. The FISD can be seen as a framework which is the intersection of all other frameworks as described in chapter two of this report.
Table 20.2 Framework for the development of environment statistics: statistics of the natural env

<table>
<thead>
<tr>
<th>Social and economic activities and natural events (A)</th>
<th>Environmental impacts of activities and events (B)</th>
<th>Responses to environmental impacts (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Use of natural Resources and related activities</td>
<td>1. Resource depletion and increase</td>
<td>1. Resource management and rehabilitation</td>
</tr>
<tr>
<td>1.1 Agriculture</td>
<td>1.1 Biological resources</td>
<td>1.1 Protection and conservation of nature</td>
</tr>
<tr>
<td>1.2 Forestry</td>
<td>1.2 Cyclical and non-renewable resources</td>
<td>1.2 Management and conservation of natural resources</td>
</tr>
<tr>
<td>1.3 Hunting and trapping</td>
<td>2. Environmental quality</td>
<td>1.3 Rehabilitation of degraded environments</td>
</tr>
<tr>
<td>1.4 Fisheries</td>
<td>2.1 Atmospheric pollution</td>
<td>2. Pollution monitoring and control</td>
</tr>
<tr>
<td>1.5 Minerals, mining and quarrying</td>
<td>2.2 Water quality</td>
<td>2.1 Pollution research and surveillance</td>
</tr>
<tr>
<td>1.6 Energy production and consumption</td>
<td>2.3 Soil and land quality</td>
<td>2.2 Standards, control and enforcement</td>
</tr>
<tr>
<td>1.7 Water use for human activities</td>
<td>2.4 Quality of biota and ecosystems</td>
<td>2.3 Environmental clean-up and rehabilitation</td>
</tr>
<tr>
<td>1.8 Land use and environmental restructuring</td>
<td>3. Human health and environmental disasters</td>
<td>2.4 Public pollution control facilities</td>
</tr>
<tr>
<td>2. Emissions, waste loading and application of biochemical</td>
<td>3.1 Human health and contamination of environmental disasters</td>
<td></td>
</tr>
<tr>
<td>2.1 Emissions and waste loading in environmental media</td>
<td>3.2 Impacts of environmental disasters</td>
<td>3. Prevention and hazard mitigation of natural disasters</td>
</tr>
<tr>
<td>2.2 Application of biochemical</td>
<td></td>
<td>4. Private sector responses</td>
</tr>
<tr>
<td>3. Natural events</td>
<td></td>
<td>4.1 Enterprises</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4.2 households</td>
</tr>
</tbody>
</table>

Table 20.3 shows the core set of indicators that have been agreed upon by the fourth meeting of the intergovernmental working group on the advancement of environment statistics. Government found that the lists of statistical variables were too long for countries to embark on a national programme of environment statistics. UNSD, therefore, through an intergovernmental working group on the advancement of environment statistics developed a core set of indicators that was agreed on by the fourth meeting of the group in Stockholm in 1995.
### Table 20.3 Core set of Indicators agreed by IGWG

<table>
<thead>
<tr>
<th>Agenda 21 Issues (clusters)</th>
<th>FDES information categories</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> Socio-economic activities, events (pressure/driving force)</td>
<td><strong>B</strong> Impact and effects (part of state)</td>
</tr>
<tr>
<td>Air/Climate</td>
<td>- Emissions of CO$_2$, SO$_2$, NO$_x$</td>
</tr>
<tr>
<td>Land/soil</td>
<td>- Land use change</td>
</tr>
<tr>
<td>Water: Fresh water resources</td>
<td>- Annual withdrawals of ground and surface water</td>
</tr>
<tr>
<td>Other Natural resources: Biological resources</td>
<td>- Annual round wood production</td>
</tr>
<tr>
<td>Mineral (includes Energy) resources</td>
<td>- Annual energy consumption per capita</td>
</tr>
<tr>
<td>Waste</td>
<td>- Municipal waste disposal</td>
</tr>
<tr>
<td>Human settlements</td>
<td>- % of population in urban areas</td>
</tr>
<tr>
<td>Natural disasters</td>
<td>- Frequency of natural disasters</td>
</tr>
</tbody>
</table>
20.5 PRESSURE STATE RESPONSE FRAMEWORK (PSR) BY OECD.

The Pressure-State-Response is similar to the FDES. The PSR framework is based on a concept of causality which implies that human activities exert pressures the environment and change its quality and the quantity of natural resources. Society responds to these changes through environmental, general economic and sectoral policies. The responses form a feedback loop to pressure through human activities. In a wider sense, these steps form part of an environmental policy cycle which includes problem perception, policy formulation, monitoring and policy evaluation.

While the PSR framework has the advantage of highlighting these links, it tends to suggest linear relationships in the human activity-environment interaction. This should not obstruct the view of more complex relationships in ecosystems and in environment-economy interactions. Figure 20.1 below shows the conceptual framework for the PSR framework.

In the PSR framework an indicator is defined as follows:

"An indicator is a parameter, or a value derived from parameters, which points to/provides information about/describes the state of phenomena/environment/area with significance extending beyond the directly associated with a parameter value". OECD

Hence in other words indicators are a selection of the statistical variables which are used to interpret various situations or aggregated for further analysis. The other important criteria for indicator selection are as highlighted in Box 20.1.
Box 20.1 Criteria for indicator selection

<table>
<thead>
<tr>
<th>Policy relevance and utility for users</th>
</tr>
</thead>
<tbody>
<tr>
<td>An environmental indicator should</td>
</tr>
<tr>
<td>• Provide a representative picture of environmental conditions, pressures on the environment or society’s responses;</td>
</tr>
<tr>
<td>• Be simple, easy to interpret and able to show trends over time;</td>
</tr>
<tr>
<td>• Be responsive to changes in the environment and related human activities;</td>
</tr>
<tr>
<td>• Provide a basis for international comparisons;</td>
</tr>
<tr>
<td>• Be either national in scope or applicable to regional environmental issues of national significance;</td>
</tr>
<tr>
<td>• Have a threshold of reference value against which to compare it, so that users are able to assess the significance of the values associated with it.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Analytical soundness</th>
</tr>
</thead>
<tbody>
<tr>
<td>An environmental indicator should</td>
</tr>
<tr>
<td>• Be theoretically well founded in technical and scientific terms;</td>
</tr>
<tr>
<td>• Be based on international standards and international consensus about its validity;</td>
</tr>
<tr>
<td>• Lend itself to being linked to economic models, forecasting and information systems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurability</th>
</tr>
</thead>
<tbody>
<tr>
<td>The data required to support the indicator should be</td>
</tr>
<tr>
<td>• Readily available or made available at a reasonable cost/benefit ratio;</td>
</tr>
<tr>
<td>• Adequately documented and of known quality; and;</td>
</tr>
<tr>
<td>• Updated at regular intervals in accordance with reliable procedures.</td>
</tr>
</tbody>
</table>

20.6 DRIVING FORCE-STATE-RESPONSE FRAMEWORK

The commission on sustainable development (CSD) is a UN institution that was set up to monitor the implementation of Agenda 21. The CSD has utilised a similar framework to the PSR they have selected a list of approximately 130 indicators and organised it as a Driving force - State - Response Framework. The driving force is utilised in this case instead of pressure, because pressure tends to have a negative connotation. The indicators are meant to be used at the national level by countries in their decision making process and it is emphasised that not all indicators are applicable for every situation. The list of indictors are as shown in the table 20.4 below.
### Table 20.4 Working list of indicators of Sustainable development.

<table>
<thead>
<tr>
<th>Categories of Agenda 21</th>
<th>Driving Force indicators</th>
<th>State Indicators</th>
<th>Response Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Category: Social</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 3: combating</td>
<td>-Unemployment rate</td>
<td>-Head count index of poverty</td>
<td></td>
</tr>
<tr>
<td>poverty</td>
<td></td>
<td>-Squared poverty gap index</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Gini index of income Inequality</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Ratio of average female wage to male wage</td>
<td></td>
</tr>
<tr>
<td>Chapter 5: Demographic</td>
<td>-Population growth rate</td>
<td>-Population density</td>
<td></td>
</tr>
<tr>
<td>dynamics of sustainability</td>
<td>-Net migration rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Total fertility rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 36: Promoting</td>
<td>-Rate of change of school-age population</td>
<td>-Children reaching grade 5 of primary education</td>
<td>-GDP spent on education</td>
</tr>
<tr>
<td>education, public aware-</td>
<td>-Primary school enrol-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ness and training</td>
<td>ment ratio (gross and net)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Secondary school enrol-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ment ratio (gross and net)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Adult literacy rate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 6: Protecting</td>
<td>-Basic sanitation: percent</td>
<td>-Immunisation against infectious childhood dis-</td>
<td></td>
</tr>
<tr>
<td>and promoting human</td>
<td>of population</td>
<td>eases</td>
<td></td>
</tr>
<tr>
<td>health</td>
<td>-Per capita consumption</td>
<td>-Contraceptive prevalence</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of fossil fuel by motor</td>
<td>-Proportion of potentially hazardous chemicals</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vehicle transport</td>
<td>Monitored in food</td>
<td></td>
</tr>
<tr>
<td></td>
<td>human and economic loss</td>
<td>-National health expendi-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>due to natural disasters</td>
<td>ture devoted to local health care</td>
<td></td>
</tr>
<tr>
<td>Chapter 7: Promoting</td>
<td>-Rate of growth of urban</td>
<td>-Percent of population in</td>
<td>-Infrastructure expendi-</td>
</tr>
<tr>
<td>sustainable human set-</td>
<td>population</td>
<td>urban areas</td>
<td>ture per capita</td>
</tr>
<tr>
<td>tlement development</td>
<td>-Per capita consumption</td>
<td>-Area and population of urban formal and informal settlements</td>
<td></td>
</tr>
<tr>
<td></td>
<td>of fossil fuel by motor</td>
<td>-Floor area per person house price to income ratio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>vehicle transport human</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and economic loss due to</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>natural disasters</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Economic: Category</strong></td>
<td></td>
<td>-Environmentally adjusted net domestic products</td>
<td></td>
</tr>
<tr>
<td>International cooperation</td>
<td>-GDP per capita net</td>
<td>share of manufactured goods in total merchandise exports</td>
<td></td>
</tr>
<tr>
<td>to accelerate sustainable</td>
<td>Investment share in GDP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>development in countries</td>
<td>sum of exports and im-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>and related domestic poli-</td>
<td>ports as a percent of GDP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>cies</td>
<td></td>
<td>-Proven Mineral reserves</td>
<td></td>
</tr>
<tr>
<td>Changing consumption</td>
<td>-Annual energy cons-</td>
<td>-Proven fossil fuel energy reserves</td>
<td></td>
</tr>
<tr>
<td>patterns</td>
<td>umption</td>
<td>-Life time of proven energy reserves</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-Share of natural re-</td>
<td>-Intensity of material use</td>
<td></td>
</tr>
<tr>
<td></td>
<td>source intensive indus-</td>
<td>-Share of manufacturing value-added in GDP</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tries in manufacturing</td>
<td>-Share of consumption of renewable energy re-</td>
<td></td>
</tr>
<tr>
<td></td>
<td>value added</td>
<td>sources</td>
<td></td>
</tr>
<tr>
<td>Chapter 33: Financial</td>
<td>-Net resources transfer /</td>
<td></td>
<td></td>
</tr>
<tr>
<td>resources and mecha-</td>
<td>GDP</td>
<td>-Debt/ GNP</td>
<td>-Environmental protection expenditures as a percent of GDP</td>
</tr>
<tr>
<td>nisms</td>
<td>-Total ODA given or</td>
<td>-Debt service/export</td>
<td></td>
</tr>
<tr>
<td></td>
<td>received as a percentage of GNP</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Statistics for Environmental Policy, 1997
<table>
<thead>
<tr>
<th>Chapters of Agenda 21</th>
<th>Driving Force indicators</th>
<th>State Indicators</th>
<th>Response Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Sustainable development</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 34: Transfer of environmentally sound technology, co-operation and capacity-building</td>
<td>- Capital goods imports foreign direct investments</td>
<td>- Share of environmentally sound capital goods imports</td>
<td>- Technical cooperation grants</td>
</tr>
<tr>
<td></td>
<td><strong>Category: Environmental</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chapter 18: Protection of the quality and supply of freshwater resources</td>
<td>- Annual withdrawals of ground and surface water Domestic consumption of water per capita</td>
<td>- Ground water reserves Concentration of faecal coliform in fresh water Biochemical oxygen demand in water bodies</td>
<td>- Waste-water treatment coverage Density of hydrological networks</td>
</tr>
<tr>
<td>Chapter 10 Integrated approach to the planning and management of land resources</td>
<td>- Land use change</td>
<td>- Changes in land condition</td>
<td>- Decentralised local-level natural resource management</td>
</tr>
<tr>
<td>Chapter 12 Managing fragile ecosystems: combating desertification and drought</td>
<td>- Population living below poverty line in dryland areas</td>
<td>- National monthly rainfall index Satellite derived vegetation index Land affected by desertification</td>
<td></td>
</tr>
<tr>
<td>Chapter 13: Managing fragile ecosystems: Sustainable mountain development</td>
<td>- Population change in Mountain areas</td>
<td>- Sustainable use of natural resources in mountain areas Welfare of mountain populations</td>
<td></td>
</tr>
<tr>
<td>Chapter 14: Promoting sustainable agriculture and rural development</td>
<td>- Use of agricultural pesticides Use of fertilisers Irrigation percent of arable land Energy use in agriculture</td>
<td>- Arable land per capita Area affected by salinisation and water logging</td>
<td>- Agricultural education</td>
</tr>
<tr>
<td>Chapter 11: Combating deforestation’s</td>
<td>- Wood harvesting intensity</td>
<td>- Forest area change</td>
<td>- Managed forest area ratio Protected forest area as a percent of total forest area</td>
</tr>
<tr>
<td>Chapter 15: Conservation of biological diversity</td>
<td></td>
<td>- Threatened species as percent of total native species.</td>
<td>- Protected area as a percent of total area</td>
</tr>
<tr>
<td>Chapter 16: Environmentally sound management of biotechnology</td>
<td></td>
<td></td>
<td>- R&amp;D expenditure for biotechnology Existence of national biosafety regulations or guidelines</td>
</tr>
<tr>
<td>Chapter 9 Protection of the atmosphere</td>
<td>- Emissions of greenhouse gases Emissions of sulphur oxides Emissions on nitrogen oxides Consumption of ozone depleting substances</td>
<td>- Ambient concentrate of pollutants in urban areas</td>
<td>- Expenditure on air pollution abatement</td>
</tr>
<tr>
<td>Chapter 21: Environmentally sound management of solid wastes and sewage-related issues</td>
<td>- Generation of industrial and municipal solid waste Household waste disposed per capita</td>
<td></td>
<td>- Expenditure on waste management Waste recycling and reuse Municipal waste disposal</td>
</tr>
<tr>
<td>Chapter 19 Environmentally sound management of toxic chemicals</td>
<td></td>
<td>- Chemically induced acute poisonings</td>
<td>- Number of chemicals banned or severely restricted</td>
</tr>
<tr>
<td>Chapter 20 Environmentally sound management of hazardous wastes</td>
<td></td>
<td>- Generation of hazardous wastes Imports and exports of Area of land contaminated by hazardous wastes</td>
<td>- Expenditure on hazardous waste treatment</td>
</tr>
</tbody>
</table>
**Chapter 20 Environment Indicators**

**Chapter 21:** Driving Force indicators

<table>
<thead>
<tr>
<th>Chapters of Agenda 21</th>
<th>Driving Force indicators</th>
<th>State Indicators</th>
<th>Response Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 22 Safe and environmentally sound management of radioactive wastes</td>
<td>-Generation of radioactive wastes</td>
<td>-Sustainable development strategies</td>
<td>-Potential scientists and engineers per million population</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Scientist and engineers engaged in R &amp; D per million population</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>-Expenditure on R &amp; D as a percent of GDP</td>
</tr>
<tr>
<td>Category: Institutional</td>
<td>Chapter 8: Integrating environment and development in decision-making</td>
<td>-Potential scientists and engineers per million population</td>
<td>-Ratification of global agreements, implementation of ratified global agreements</td>
</tr>
<tr>
<td>Chapter 35: Science for sustainable development</td>
<td>-Physical scientists and engineers per million population</td>
<td>-Scientist and engineers engaged in R &amp; D per million population</td>
<td>-Programmes for national environmental statistics</td>
</tr>
<tr>
<td>Chapter 37: National mechanisms and international co-operation for capacity building in developing countries</td>
<td>-Main telephone lines per 100 inhabitants</td>
<td>-Ratification of global agreements, implementation of ratified global agreements</td>
<td>-Programmes for national environmental statistics</td>
</tr>
<tr>
<td>Chapter 38: International institutional arrangement</td>
<td>-Main telephone lines per 100 inhabitants</td>
<td>-Ratification of global agreements, implementation of ratified global agreements</td>
<td>-Programmes for national environmental statistics</td>
</tr>
<tr>
<td>Chapter 39: International legal instrument and mechanisms</td>
<td>-Main telephone lines per 100 inhabitants</td>
<td>-Ratification of global agreements, implementation of ratified global agreements</td>
<td>-Programmes for national environmental statistics</td>
</tr>
<tr>
<td>Chapter 40: Information for decision making</td>
<td>-Main telephone lines per 100 inhabitants</td>
<td>-Ratification of global agreements, implementation of ratified global agreements</td>
<td>-Programmes for national environmental statistics</td>
</tr>
<tr>
<td>Chapter 23-32: Strengthening the role of major groups</td>
<td>-Main telephone lines per 100 inhabitants</td>
<td>-Ratification of global agreements, implementation of ratified global agreements</td>
<td>-Programmes for national environmental statistics</td>
</tr>
</tbody>
</table>

**20.7 DIFFERENCES BETWEEN FDES, PSR AND DSR**

FDES relates components of the environment information categories. The components of the environment consist of the natural environment, that is, flora, fauna, atmosphere, water and land/soil, and the man-made environment (human settlements). The information categories are based on the recognition the environmental problems are the result of human activities and natural events. The information categories are divided into four i) social and economic activities, and natural events; ii) environmental impacts of activities and events; iii) responses to environmental impacts; and iv) inventories, stocks and background conditions.

The PSR/DSR frameworks have three categories, pressure/driving force, state and response and cross-related to issues in the PSR and to chapter of Agenda 21 in the DSR. The main difference between the FDES and the PSR/DSR frameworks lies with the state categories. In the FDES this category is divided into two categories, the impacts and the invento-
ries/stocks/background conditions while in the PSR/DSR these two categories are combined to make one, state, category. The reasons for the FDES are twofold.

Firstly, it allows for the separation between the stocks and the flows or changes in stocks. The stocks would be contains the inventories category and the changes in stocks, both in qualitative and quantitative terms, in the impacts category. The term, state, impacts category of the FDES refers to changes in “states” of the environment (environmental quality) and their effects on human well-being, i.e. flow categories referring to a period of time.

Secondly, the inventories category provides a direct link between the stock data presented in this category and the flow categories of quantitative and qualitative change in stock by means of natural resource accounting. The resource accounting approach focuses on the stocks and quantitative changes. Stocks or reserves of natural resources are listed in FDES under the information category of inventories, stocks and background conditions. The extraction, harvesting and use of natural resources are shown as part of the category of social and economic activities, and changes in the availability and quality of natural assets are listed under the impacts category.

20.8 DISCUSSION OF SELECTED INDICATORS

A few of the indicators were discussed in depth for their policy relevance and applicability and data availability. The indicators that were selected arose from issues that were identified by the participants. These were natural disasters, every growing urban populations, land use changes and land degradation, biodiversity, soil erosion, water pollution/quality, air pollution, overgrazing, male agricultural practices, floods, droughts, population pressure. Two sources of materials were then reviewed these were the questionnaires developed by OECD and the methodology sheets co-ordinated by the UN Department for Policy Co-ordination and Sustainable Development. Below is a summary of the indicators, definitions, policy relevance and some of the remarks made by participants.
<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Relevance to sustainable development</th>
<th>Remarks by participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Municipal waste disposal (tonnes per unit of Gross Domestic Product per annum)</td>
<td>This indicator relates to the volume of waste collected and disposed by official means, either land filling, incineration or other processing</td>
<td>High waste levels result from consumption and production. Adequate waste management indicates that the authorities are aware of the preventative nature and reduction of health and environmental risks</td>
<td>This indicator is difficult to collect. Kenya has attempted to collect this variable but the results have not always been good. The methodology sheets do not explain why the denominator is GDP and what relationship GDP has to waste disposal</td>
</tr>
<tr>
<td>2 Generation of industrial waste and municipal solid waste (Tonnes per capita)</td>
<td>The generation of industrial and municipal solid waste is derived from the production of waste on a weight basis at the point of production.</td>
<td>Generation of waste is linked to economic activity. It is an indication of the patterns of consumption of raw materials. Wealthier economies tend to produce more waste. In many developed countries a reduction in the volume of waste generated is an indication of changes in consumption patterns with respect to raw material and increase in recycling and reuse</td>
<td>This indicator unlike the first uses the population as the denominator. The OECD publication indicates the reverse, municipal waste is measured in per capita and Industrial waste is measured per unit of GDP</td>
</tr>
<tr>
<td>3 Land use change (Proportion of change of each category of land use)</td>
<td>Change with time of the distribution of land uses within a country</td>
<td>Information on land use change is critical for integrated and sustainable land use planning. Such information is useful in identifying opportunities to protect land uses or promote future allocation aimed at providing the greatest sustainable benefits for people. Changes in land use may result in changes in production from the perspective of economics whereas unsustainable land use leads to desertification</td>
<td>Land use change is an important indicator which requires good record keeping. It was observed that there is no uniform classification of categories of land.</td>
</tr>
<tr>
<td>4 Use of fertilisers (Metric tons of fertiliser nutrients per 10km²)</td>
<td>Extent of fertiliser use in agriculture per unit of agricultural land area</td>
<td>The challenge for agriculture is to increase food production in a sustainable way. This indicator shows the potential environmental pressure from agricultural activities Extensive fertiliser use is linked to eutrophication of water bodies, soil acidification, and potential of contamination of water supply with nitrates. The actual environmental effects depend on pollution abatement practices, soil and plant type and meteorological conditions.</td>
<td>Noted that data is available from the supply side and indirect techniques are used to estimate actual fertiliser use in the developing countries.</td>
</tr>
<tr>
<td>5 Forest Area change (ha)</td>
<td>The amount of natural and plantation forest area</td>
<td>Forests serve multiple ecological, socio-eco-</td>
<td>The deforestation rate suggested by the lead</td>
</tr>
</tbody>
</table>
### Chapter 20: Environment Indicators

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Definition</th>
<th>Relevance to sustainable development</th>
<th>Remarks by participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>6  Threatened species as a percent of total native species (%)</td>
<td>Number of species at risk of extinction in proportion to the total number of native species</td>
<td>Maintenance of biodiversity is essential for an economic system well being. Species diversity is one of the three main levels of biodiversity, the others being ecosystem and genetic diversity.</td>
<td>National data are available for many countries although they are not reported by class.</td>
</tr>
<tr>
<td>7  Emissions of greenhouse gases (annual emission levels in gigagrams of CO₂ equivalents by using global warming potentials; annual percentage change in total greenhouse gases emissions beginning with 1990 as a base year would provide trends and rate of change in emission levels for each party to the climate change convention.)</td>
<td>National anthropogenic emissions of carbon dioxide, Methane and nitrous oxide.</td>
<td>Emissions of Greenhouse gases beyond normal considerations results in climate change. Such emissions are largely influenced by a country’s energy use and production systems, its industrial structure, its transportation system, its agricultural and forestry sectors, and the consumption patterns of the population. Methane and nitrous oxide emissions are particularly influenced by a country’s agricultural production, waste management, and livestock management.</td>
<td>Impacts of green house gases are not felt in the short run. So there is a tendency for developing countries not to emphasise collection of data in this area. Secondly the developing countries are less industrialised hence do not contribute as much to greenhouse gases emissions.</td>
</tr>
</tbody>
</table>

#### 20.9 DEVELOPMENT OF ENVIRONMENTAL STATISTICS/INDICATORS PROGRAMME.

The co-ordination aspects of programme development were emphasised. Groups of twos brainstormed on the establishment of a national co-ordination mechanism by answering the following questions.

- **Co-ordination:** What kind of co-ordinating mechanism is appropriate in your country? Can existing institutional arrangements be used or modified? Which agency is best suited to lead and be the focal point?
- **Agencies:** Which national and international agencies will be involved in the development of indicators and what roles will they play? What will be the link to agencies responsible for policy formulation?
- **Initial tasks:** What are the initial tasks that will require attention, to get the programme started?
- **Capacity building:** What are the specific capacity building requirements necessary to support the development of an environmental indicator programme?

With regard to co-ordination aspects it was observed that there are policy and legislative instruments which enable the smooth co-ordination of aspects. In most countries there is a centralised mechanism for co-ordinating environment statistics and indicators. In some countries the national statistics offices are the co-ordinating institutions for environmental indicators while in others is it the institution responsible for environmental matters.
The key actors in the co-ordination of environmental statistics were identified to be multilar-
eral agencies such as the UN and its specialised agencies and the World Bank and European
Union, training institutions such as CDG, bilateral agencies such as SIDA, GTZ and interna-
tional NGOs.

The tasks for the agencies with regard to the mechanism were identified to be sensitisation,
awareness raising, education, formulation of working committees, workshops, development
plans and development projects.

The specific capacity building requirements were identified to be personnel, training, equip-
ment, inclusion in syllabus of schools and other learning institutions and informal methods of
education and information dissemination.

The development of a project was reviewed by analysing an example of Cote D’ivoire where
UNSD provided technical advisory services to assist in the development of their Environment
Statistics Programme.

20.10 CONCLUSION
The structures for some environment statistics compendia were reviewed to illustrate the di-
ferent approaches to data presentation as well as the fact that even a few environmental indi-
cators are sufficient to start with. These included Indonesia, Canada, Zimbabwe, Sweden and
Zanzibar. In addition a case study on the co-ordination aspects of developing environmental
indicators in Latin America and Carribean Region presented by Mary Jane Holupka. In this
regard therefore the participants were encouraged to start compiling environment statistics
from available data sources. Emphasis was given therefore on the need to strengthen the co-
ordination aspects.

20.11 REFERENCES
OECD, Environmental Indicators, 1994

UNSD, A Framework for the Development of Environment Statistics (UNSD), 1984


UNSD, Concepts and Methods of Environment Statistics: Statistics for Natural Environment,
1991

UNSD, Glossary of Environmental Statistics, 1997
21. INFORMATION SYSTEM ON SUPPLY AND USE OF MATERIALS

By Harlmut STAHL
and Sui-San LIM
Oko Institute of Ecology
(June 11 - 13, 1997)

21.1 INTRODUCTION

The targets for introducing the course topic on information system on supply and use of material was to sensitise the participants on how the information system on materials can be utilised to monitor and assess stocks, supply and use of energy and materials. To achieve this target an introduction to the material balances and flow concept was given. This was in addition to the characteristic and operations of the TEMIS model.

21.2 MATERIAL FLOW

Material flows occur at global and local levels. Economic operations are dependent on the various strengths of the different continents. For example iron is mined in different regions and processed in other parts of the world and the finished goods are later marketed to another country. Some of the quotations which enhance the global nature of materials balances are as highlighted below:-

“The news agency informs: Steel for the production of motor vehicles in China falls into short supply.”

“More Platinum from South Africa for the Industry”

“Asia has doubled its production capacity for the European market”

“The world oil trade gets into trouble.”

The field of material flows means a comprehensive view of the world and the material flows. It calls for a principal change in the perspectives and the ways of behaviour. For example environmental quality objectives such as the globe shall attain 0.1ºC global warming within 10 years, requires the political process to come up with a more definite environmental objective e.g. 25% reduction of CO₂. In order to lower the emissions to such an objective there is need to manage the material flows this requires a tool for analysis and an enabling environment. Material flow management entails focusing on tough environmental objectives and interactivities between different product lines, media and actors. The tools for the realisation of the management of material flows are:

- Eco audits;
- Environmental laws;
- Financial tools (e.g. CO₂ Taxes); and;
- Climate protection concept.

21.3 QUESTIONS IN THE AREA OF MATERIAL FLOWS

One of the key questions in analysis of material flows of metals and their resulting emissions. The other is how to treat imports such as aluminium, magnesium, renewable resources and renewable energies.
21.4 ANALYSIS OF MATERIAL FLOWS

The basic requirement for attaining sound management of material flows is a comprehensive material flow analysis. The process chain computer based model TEMIS is one such tool that can enable the rigorous analysis of material flows. The TEMIS focuses on processes, it is demand side based, flexible, can be expanded and is transparent. The TEMIS model provides coefficients, emission factors, consistent data and integrated processes utilised up to the final product. The TEMIS enables the conversion of activities such as electricity, transport, process heat into environment impacts such as emissions, pollution of the media and land use changes. Country specific analysis can be carried out. For example the graph below shows the environmental impacts caused by the production of aluminium in specific countries, with German as the standard.

Figure 21.1 Environmental impacts caused by the production of aluminium in specific countries (Standardised for Germany)

![Graph showing environmental impacts caused by the production of aluminium in specific countries.]

NB. Materials include hidden materials

The average family in Germany for example uses a lot of materials to meet their needs. These are raw materials such as ores and biotic resources which are later combined with energy (gas, electricity or fuels) to come up with basic products. In addition to products the average family utilises services which use up the various materials and these include urban traffic, post and construction sector. For the average household therefore the environmental impacts of material flows can be defined in terms of CO\textsubscript{2} and SO\textsubscript{2} equivalents. These emissions can be categorised as follows: heating, hot water, transport (road and air) and materials.

21.4.1 Characteristics of the TEMIS model

The TEMIS model is a database system which contains data on quantitative and qualitative impacts. It is an analysis system which determines full life cycle impacts of energy, transport, and material technologies. TEMIS is also an evaluation tool which measures deviation from multiple objectives (trade-offs). This information can be used for calculating trade-offs.

The database structure of TEMIS stores information of energy, materials, transport and this includes, technology, emission, cost data, location and references. The database store information on unit processes reflecting activities for which efficiency, emission can be measured, calculated, or derived. No formal distinction is made between energy and material flows. They are all interlinked.
21.4.2 Results from the TEMIS

The results of TEMIS are of three types and these are quantitative data such as costs impact and flow data, qualitative data such as biodiversity status and environmental impacts in terms of emission and pollution and environmental impacts in terms of emissions, pollution and land use changes.

**Figure 21.2 Results From TEMIS**

<table>
<thead>
<tr>
<th>Quantitative Data</th>
<th>Environmental Impacts</th>
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<tr>
<td>Cost impacts</td>
<td>Airborne emissions</td>
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<tr>
<td></td>
<td>(O_2, \text{NO}_x, \text{Particulate HCl, HF})</td>
</tr>
<tr>
<td>Internal</td>
<td>Greenhouse gases</td>
</tr>
<tr>
<td></td>
<td>(\text{CO}_2, \text{CO}, \text{CH}, \text{NMOVOC}, \text{N}_2\text{O, CFC})</td>
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<tr>
<td>External</td>
<td>Heavy Metals</td>
</tr>
<tr>
<td></td>
<td>(\text{such as Cd, Hg, Pb})</td>
</tr>
<tr>
<td>Net Present Value</td>
<td>Solid wastes</td>
</tr>
<tr>
<td></td>
<td>(\text{bottom/fly ash, FGD residuals})</td>
</tr>
<tr>
<td>Flow data</td>
<td>Liquid effluents</td>
</tr>
<tr>
<td></td>
<td>(\text{user defined})</td>
</tr>
<tr>
<td></td>
<td>Land use</td>
</tr>
</tbody>
</table>

All quantitative impacts are determined for their local and global components

TEMIS calculates life cycle costs of delivered products based on data for investment, operation and maintenance, and fuels. Capacity, load factor and life time of process are taken into account. For all processes a uniform (real) interest rate and a uniform time horizon are assumed to calculate annualised capital costs.

With regard to external costs the TEMIS monetarises the “core” emissions (air pollutants, greenhouse gases) based on abatement costs.

TEMIS can include also external cost factors for user-defined emissions and residuals, and can adjust the external cost data for “basic” emissions to user-specified data (e.g. those derived from damage costs).
21.4.3 Where does data come from?
Data collection from energy industry (oil, gas, coal), power equipment manufactures, and from industrial engineering. Emission data depends on the fuel definition and on whether it is controlled or not controlled. Green house gas emission inventories are also utilised by TEMIS. Other sources include environmental impact assessment studies, life cycle studies, operation experiences (measured data) specification of manufactures and regulation standards.

21.4.4 Where is TEMIS used
TEMIS is used in the European union in the countries Austria, Denmark, Finland, Germany, Italy, Luxembourg, Netherlands, Sweden, UK: Governmental agencies federal, states and municipal), research institutions (governmental and private), consulting firms, electric/gas utilities, NGO. Countries in Eastern Europe who utilise TEMIS include Czech Republic, Slovenia, Poland via “Environmental Manual”: Bulgaria, Croatia, Russia, Ukraine. Other countries include the United States. The use of TEMIS is free - the model and data installation files are available without charge via the internet for ÖKO Institute’s Website Http://www.oeko.de.

21.5 CONCLUSION
The participants were given exercise to gain an experience of how the model can be utilised to build scenarios and analyse the impacts of material flows. In addition the application of the model was discussed and the general observation made was that the TEMIS model is a useful tool for analysis of material flows however the data demands and available resources in the developing countries does not allow for such a system to be well established.
22. TRAIN THE TRAINER
by Michael Sindato
Eastern Africa Statistical Training Centre - Tanzania
and Mati Nemani
Bureau of Statistics - Fiji
(June 12 - 13, 1997)

22.1 INTRODUCTION
Train the trainer was a course topic that was introduced with the aim of enabling participants to manage in-service training and to use didactical tools. In specific terms it was expected that the participants would be able to

- Design training programmes of any topic learnt, with;
- Appropriate aims, objectives, and observable outcomes;
- Deliver or administer the training programme;
- Understand the need of the adult learner;
- Recognise different styles of learning; and
- Discuss evaluation of a course.

To achieve these objects the topic was arranged under the following sub-topics:

- What is training
- The training cycle
- Core skills for a trainer
- Learning styles
- Procedure for designing a training programme
- Evaluation

22.2 WHAT IS TRAINING
Training is about developing people as individuals and helping them to become more confident and competent in their lives and in their jobs. Training is carried out in order to build the capacity of an individual, organisation or institution. Training is a vital investment in human resource for the benefit of the individual and for the organisation. It promotes individual workers and the organisation in the competitive world.

In many developed and developing countries training is on high demand in order to keep with growing economy and technology. In the last decade for example, there have been several reports on the provision of training in Great Britain as stipulated by Coopers and Leybrand “A challenge to Complacency” highlighting two main areas of concern.

- The evidence of disturbingly low level of Investment in both Public and Private sector organisations;
- The widespread complacent, ill-informed and sceptical attitudes to training at all organisational levels, including that of practitioners, which needs to be challenged.
22.3 THE TRAINING CYCLE

The training cycle can be viewed as on-going activity where individuals are committed to life-long learning. There are five distinct stages in the cycle.

- Analysing training needs;
- Planning and designing the training approach;
- Developing the training materials;
- Delivering the training; and;
- Evaluating the training.

The evaluation stage not only cycles back to the first stage (a) but also cycles back to the others. Evaluation must be an ongoing process if the quality of the training courses is meant to improve. Figure 22.1 below shows the training cycle.

Figure 22.1 The Training Cycle

22.4 CORE SKILLS FOR THE TRAINER

The core skills of a trainer are as listed below:

- Designing and developing a course;
- Recruiting for a course;
- Planning and organising a course;
- Writing and preparing course material; and;
- Practitioners skills;
- Inter-personal skills;
- Evaluating courses;
- Report writing skills; and;
- Management skills.

22.5 LEARNING STYLES

Any trainer would like to know his trainees very well before even starting the actual training. Among important things a trainer would like to know, besides their name, educational back-
grounds, health etc., is their learning style or characteristics when they want to learn something. Different people have different learning styles and at times trainer do not know how to help the different learners. The learners may be classified in the following groups:

**Activists** involve themselves full without bias in new experiences. They enjoy the here and now and are happy to be dominated by immediate experiences. They are open-minded, not sceptical and this tends to make them enthusiastic about anything new. Their philosophy is: “I’ll try anything once”. They tend to act first and consider the consequences afterwards. Their days are filled with activity. They tackle problems by brainstorming. As soon as the excitement from one activity has died down, they are busy looking for the next. They tend to thrive on the challenge of new experiences but are bored with implementation and longer term consolidation. They are gregarious people constantly involving themselves with others but, in doing so, they seek to centre all activities around themselves.

**Reflectors** like to stand back to ponder experiences and observe them from many different perspectives. They collect data, both first hand from others, and prefer to think about it thoroughly before coming to any conclusion. The thorough collection and analysis of data about experiences and events is what counts so they tend to postpone reaching definitive conclusion for as long as possible. Their philosophy is to be cautious. They are thoughtful people who like to consider all possible angles and implications before making a move. They prefer to take a back seat in meeting and discussions. They enjoy observing other people in action. They listen to other and get the drift of the discussion before making their own points. They tend to adopt low profile and have slightly distant, tolerant, unruffled air about them. When they act, it is part of a wide picture which includes the past as well as the present on other’s observations well as their own.

**Theorists** adapt and integrate observation into complex but logically sound theories. They think problems through in a vertical step by step logical way. They assimilate disparate facts into coherent theories. They tend to be perfectionists who won’t rest easy until thing are tidy and fit into a rational scheme. They like to analyse and synthesis. They are keen on basic assumptions, principles, theories, models and systems thinking. Their philosophy prizes rationality and logic, “if it’s logical it’s good’. Questions they frequently ask are : “Does it make sense?” “What are the basic assumptions?” They tend to be detached, analytical and dedicated to rational objectivity rather than anything subjective or ambiguous. Their approach to problems is consistently logical. This is their “mental set” and they rigidly reject anything that doesn’t fit with it. They prefer to maximise certainty and feel uncomfortable with subjective judgement, lateral thinking and anything flippant.

**Pragmatists** are keen on trying out ideas, theories and techniques to see if they work in practice. They positively search out new ides and take the first opportunity to experiment with application. They are the sort of people who return from management courses bringing with new ideas that they want to try out in practice. They like to get on with things and act quickly and confidently on ideas that attract them . They tend to be impatient with ruminating and open ended discussions. They are essentially practical, down to earth people who like making practical decisions and solving problem. They respond to problems and opportunities ‘as a challenge”. Their philosophy is “there is always a better way’ and “if it works it’s good”.

It was observed that these skills can be identified through a structure questionnaire or the trainer can make the observations. It was also noted that a person can have more than one of the qualities in otherwords they are not mutually exclusive.
22.6 **DESIGNING A TRAINING PROGRAMME**

The following key questions can be considered in designing training programmes

- Why should the programme exist?
- Who is it aimed at?
- What do you want people to get out of it?
- What is the content and sequence?
- When and where will you hold it?
- What methods will you use?
- What material/resources will you need?
- How will the trainees be assessed?
- How are you going to evaluate the programme?

An exercise was given to design a training programme for developing the areas management of communication and energy statistics. It was observed that most of the groups considered only one of the training methodologies that is workshops and seminars. All the groups emphasised the important elements of train the trainer and programme design

22.7 **EVALUATION**

What do we mean? At the end of any activity one needs to revisit what has been going on. We answer the questions how are we doing? Are we accomplishing what we set out to do? These questions are answered in order to get the picture of what is happening in our training, say. We need to know if we are on target or not. We want to correct immediate mistakes before we are too much away from what we planned to do. Again evaluation helps us to make future adjustments.

Is evaluation part of planning and review? The objectives set in the course are our reference point. They help us know if certain training method leads us in accomplishing the task. Evaluation tries to interrelate the process of planning and implementation so as to get future inputs on decision making.
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<td>GAMBIA</td>
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<tr>
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<tr>
<td>Ditshupo Ms</td>
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<td>Gaborone BOTSWANA</td>
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<td>Tel. 00267-352201</td>
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<td>Fax 00267-35220</td>
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<tr>
<td>HLOPHE</td>
<td>Central Statistical Office</td>
</tr>
<tr>
<td>Walter Mbuso</td>
<td>P.O. Box 456</td>
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<tr>
<td></td>
<td>Mbabane SWAZILAND</td>
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<td></td>
<td>E-Mail: <a href="mailto:101663-1123@compuserve.com">101663-1123@compuserve.com</a></td>
</tr>
<tr>
<td>HOLUPKA</td>
<td>Division of Statistics and Economic Projections</td>
</tr>
<tr>
<td>Mary Jane Ms</td>
<td>UN Economic Commission for Latin America and the Caribbean ECLAC</td>
</tr>
<tr>
<td></td>
<td>Santiago CHILE</td>
</tr>
<tr>
<td></td>
<td>E-Mail: <a href="mailto:mholupka@eclac.cl">mholupka@eclac.cl</a></td>
</tr>
<tr>
<td>KIFUKO Brenda</td>
<td>Ministry of Gender and Community Development</td>
</tr>
<tr>
<td>Course assistant</td>
<td>P.O. Box 7136</td>
</tr>
<tr>
<td></td>
<td>Kampala UGANDA</td>
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<tr>
<td></td>
<td>Tel 00 256 41 251401 Fax 00 256 41 257869</td>
</tr>
<tr>
<td>Name</td>
<td>Address</td>
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<tr>
<td>KIMOLO Gabriel</td>
<td>Central; Bureau of Statistics P.O. Box 456 Mbabane TANZANIA Tel. 00255-51-111634 Fax 00255-51-112352</td>
</tr>
<tr>
<td>LEREKA Wilson MacDonald</td>
<td>Ministry of Lands and Valuation P/bag 311 Lilongwe 3 MALAWI Tel. 00265-780755 Fax 00265-742859</td>
</tr>
<tr>
<td>LI Suogiang</td>
<td>State Statistical Bureau 75 Yueten Nanjie Beijing 100826 CHINA Tel. 0086-1-68573311/87162 Fax 0086-1-63848609</td>
</tr>
<tr>
<td>LIMA Rafael</td>
<td>Central Statistical Office Ministry of Finance Belmopan BELIZE Fax 00501-8-23206</td>
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<tr>
<td>MACHADO Celestino Gomes</td>
<td>National Institute of Statistics Ministry of Planning and Finance P.O. Box 493 Maputo MOZAMBIQUE Fax 00258-1-491744 E-Mail: <a href="mailto:ine@inestat.uem.mz">ine@inestat.uem.mz</a></td>
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<tr>
<td>MATI Nemani Gabriel</td>
<td>Bureau of Statistics GPO Box 2221 Suva FIJI Tel. 00679-315822 Fax 00679-30315</td>
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<tr>
<td>MURAMIRA Telly Eugene</td>
<td>National Environment Management Authority P.O Box 22255 Kampala UGANDA Tel. 00256-41-236817 Fax 00256-41-257521 E-Mail: <a href="mailto:aryamany@starcom.co.ug">aryamany@starcom.co.ug</a> <a href="mailto:neic@starcom.co.ug">neic@starcom.co.ug</a></td>
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<tr>
<td>ODEGE Mark Odhiambo</td>
<td>Central Bureau of Statistics P.O. Box 30266 Nairobi KENYA Tel. 00254-2-333970</td>
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<tr>
<td>SINDATO Michael Paul</td>
<td>East Africa Statistical Training Centre P.O. Box 35103 Dar-es-Salaam TANZANIA</td>
</tr>
<tr>
<td>Name</td>
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<tr>
<td>SITOTAW BERHANU</td>
<td>Environmental Protection Authority P.O. Box 15965 Addis Ababa ETHOPIA</td>
</tr>
<tr>
<td></td>
<td>Tel. 00251-1-611389 E-Mail: <a href="mailto:Epa@padis.gn.apc.org">Epa@padis.gn.apc.org</a></td>
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<tr>
<td>SUN Hongjuan Ms</td>
<td>State Statistical Bureau 75 Yuetan Nanjie Beijing 100826 CHINA</td>
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<tr>
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<td>E-Mail: <a href="mailto:wy@public.intercom.co.cn">wy@public.intercom.co.cn</a></td>
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<tr>
<td>WIRHT Winston</td>
<td>Ministry of Planning and Development Cooperation Paramaribo SURINAME</td>
</tr>
<tr>
<td></td>
<td>E-Mail: <a href="mailto:wirhtww@sr.net">wirhtww@sr.net</a></td>
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### Annex III Programme on Statistics for Environmental Policy

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<thead>
<tr>
<th>Date</th>
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<td><strong>Organisation/Programme</strong></td>
<td>Munich Centre</td>
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<td>**Quantitative Aspects of Sustainable De-</td>
<td>Bartelmus UNSD</td>
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<tr>
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<td>**Use of microcomputing for enviromental</td>
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<td>19</td>
<td>Elaboration and layout of text, treatment of</td>
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<td><strong>Main Approaches to Monitor Environment</strong></td>
<td>Angermann STABA, Wiesbaden</td>
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<td><strong>Information System on Land Use</strong></td>
<td>Narain FAO, Rome</td>
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<td><strong>Statistics on Water and Air</strong></td>
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<td><strong>Effects of agricultural activities on the</strong></td>
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<td><strong>Human Settlement and Environment</strong></td>
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<td>Principles of SNA; evaluation; matrix presentation (IOT, SAM)</td>
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<td><strong>Natural Resource Accounting</strong></td>
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<td>Assessment of natural resources in satellite accounts with focus on forest accounts, subsoil assets and water accounts based on case studies</td>
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<td><strong>Environment Indicators</strong></td>
<td>Shah UNSD, New York</td>
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<td>Indicators according to agenda 21 and the Framework for the development of environment statistics; driving force-, state- and response indicators</td>
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<td>Munich Centre</td>
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<td>Production of a course related report by the participants</td>
<td>Jenseit and Lim ÖKO Institut, Darmstadt</td>
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<td><strong>Information System on Supply and Use of Material</strong></td>
<td>Sindato and Mati</td>
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<td>Presentation and discussion of the reports</td>
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<td><strong>Evaluation</strong></td>
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### Annex IV List of Contributions During Course

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<thead>
<tr>
<th>Name</th>
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<tr>
<td>AH POE</td>
<td>State of the Environment Report for Western Samoa</td>
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<tr>
<td>Anona Ms</td>
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<tr>
<td>FATTY</td>
<td>GEAP Monitoring and Assessment Strategy</td>
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<tr>
<td>Lamin</td>
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<tr>
<td>GAOBOTSE</td>
<td>National Resource Accounting in Botswana</td>
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<tr>
<td>Ditshupo Ms</td>
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<tr>
<td>HOLUPKA</td>
<td>Environmental Indicators and Statistics in Latin America</td>
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<tr>
<td>Mary Jane Ms</td>
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<tr>
<td>KIMOLO</td>
<td>Deforestation the Leading Environmental Problem in Tanzania</td>
</tr>
<tr>
<td>Gabriel</td>
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<tr>
<td>MATI</td>
<td>Asking Questions on the Environment in a Population Census</td>
</tr>
<tr>
<td>Nemani Gabriel</td>
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<tr>
<td>MURAMIRA</td>
<td>The Role of Environmental Economics in The Implementation of the Ugandan National Environmental Plan.</td>
</tr>
<tr>
<td>Telly Eugene</td>
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<tr>
<td>ODEGE</td>
<td>Type of Environmental Data Collected and Methods in Kenya</td>
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<tr>
<td>Mark Odhiambo</td>
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<tr>
<td>SITOTAW BERHANU</td>
<td>National Conservation Strategy Formulation Process</td>
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<tr>
<td>SUN Hongjuan Ms and</td>
<td>The State of the Environment in China</td>
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<td>LI Suogiang</td>
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<tr>
<td>WIRHT</td>
<td>Sustainable Utilisation of Forest Resources in Suriname</td>
</tr>
<tr>
<td>Winston</td>
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# Annex V List of Final Reports

<table>
<thead>
<tr>
<th>Author</th>
<th>Title</th>
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<tbody>
<tr>
<td>AH POE Anona</td>
<td>Environment Statistics and the State of Environment Report for Western Samoa</td>
</tr>
<tr>
<td>BADAGAWA Gideaon Nathan</td>
<td>The Challenges of a Statistician in Environmental Management and the Need for Environmental Education: The Case for Uganda</td>
</tr>
<tr>
<td>BEYENE HABEKIRSTOS</td>
<td>Facts on Ethiopian Highlands Soil Degradation, Its Economic, Social and Environmental Implications</td>
</tr>
<tr>
<td>DLAMINI Thobile Ms</td>
<td>Land Degradation in Swaziland</td>
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<tr>
<td>FATTY Lamin</td>
<td>Developing Environmental Statistics Framework in the Gambia</td>
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<tr>
<td>GAOBOTSE Ditshupho Ms</td>
<td>Livestock and Rangeland Degradation in Botswana</td>
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<td>KIMOLO Gabriel</td>
<td>Environmental Impacts of Population Growth and Economic Activities-Tanzania Mainland</td>
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<td>LEREKA Wilson MacDonald</td>
<td>The Malawi National Environmental Policy - The Role of Ministry of Lands and Valuation</td>
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<td>LIMA Rafael</td>
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<td>MACHADO Celestino Gomes</td>
<td>Agriculture and Food Security in Mozambique</td>
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<td>Developing of Environmental Statistics within the Framework of Sustainable Development in Fiji</td>
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<td>MURAMIRA Telly Eugene</td>
<td>Policy Relevant Environmental Indicators for Uganda</td>
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<td>ODÈGE Mark Odhiambo</td>
<td>Proposed Approaches for Improvement of Collection of Environmental Statistics in Kenya</td>
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<td>SINDATO Michael Paul</td>
<td>Forests in Tanzania</td>
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<td>SITOTAW BERHANU</td>
<td>Towards a System for a National Environmental Information in Ethiopia</td>
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<tr>
<td>SUN Hongjuan Ms</td>
<td>How to Develop Environmental Statistics in China</td>
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Annex VI Programme of Study Tour to Luxembourg and Berlin

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<th>Event</th>
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| **Sunday, April 27th** | Departure from the Munich Centre  
Guided visit of Trier  
Arrival in Luxembourg |
| **Monday, April 28th** | **Eurostat**  
Welcome, Bernard Langevin  
Introduction to Eurostat, David Bond  
Introduction to Unit C3: Cooperation between Eurostat and ACP Countries, Roger Edmunds  
Sustainable Development Indicators, Eva Guinomet  
Effects of Transport on the Ecosystem, Graham Lock |
| **Tuesday, April 29th** | **Eurostat**  
Geographical Information Systems:  
Purpose and organisational aspects, Daniel Rase  
Geographical Information Systems:  
Technical Aspects, Kostas Giannakouris |
| **Wednesday, April 30th** | **Eurostat**  
Organisation of Environment Statistics  
Water statistics and the environment, Theo van Chruchten |
| **Thursday, May 1st** | Departure from Luxembourg  
Arrival in Berlin |
| **Friday, May 2nd** | **Federal Statistical Office (STABA)**  
Organisation and Structure of the German Statistics, Mr. Kaiser  
Overview on environment statistics in Germany, Mr. Steinfelder  
Guided City Tour |
| **Saturday, May 3rd** | **Friedrichstadt-Palast**  
„CINEMA“ Revue |