ENVIRONMENT STATISTICS IN BOTSWANA
COUNTRY REPORT

By

Motshabi Moreti and Julia Ditlhong
Central Statistics Office and Department of Environmental Affairs

1.0 INTRODUCTION

It is now globally acknowledged that the state of the environment is of fundamental importance to human survival. The environment supports our existence in many ways that it is impossible to overstate its importance of the environment to the welfare of humanity. It provides the basic raw materials for the economic development and a carbon sink for the waste produced in various economic processes. However, in pursuit of economic development, the quality of environment and stocks of natural resources are affected, in most cases negatively. This in turn compromises the health and welfare of the economy, and as result we are faced with the challenges of dealing with environmental issues such as climate change, natural disasters, depletion of natural resources, just to mention a few.

Environmental data and statistics provides important information for monitoring is these changes, data is vital if we are to ascertain whether the depletion of natural resources does not exceed the regeneration for instance. This information is necessary to inform decision making, set targets and thresholds and indeed cause intervention through policy change. For instance, data on the media of the natural environment (e.g. air / climate, water, land / soil), the biota found within this media (animal and plant life) and human settlements are covered within this branch of statistics. The data collected within this broad range of subject areas describe the availability and quality of natural resources, the human activities and natural events that affect the environment, the impacts of these activities and events on the environment and the responses to these impacts. Therefore, the scope of environment statistics includes inter-alia, biophysical data (e.g. data on air land and water pollution) and related social, demograhic and economic statistics.

It is important, however to note that environment statistics are interdisciplinary in nature. Their sources are dispersed over a variety of data-collecting institutions, and a corresponding variety of methods are applied in their compilation. The purpose of compiling environment statistics is to overcome this heterogeneity by presenting the data from the various subject areas and sources in a coherent form that links bio-physical data with socio-economic data. Such presentation enhances the usefulness of the data in the formulation and evaluation of integrated socio-economic and environmental programs and policies. Therefore, it is necessary to integrate environmental concerns into the planning of the development process. Such integration has to be supported by similarly integrated databases.

2.0 BACKGROUND

In recognition of the need for sustainable development, the government of Botswana established the National Conservation Strategy (Government Paper No. 1 of 1990). The NCS the established the NCS Advisory Board and the NCS Coordination Agency within the then Ministry of Local Government, Lands and Housing. The agency services the board by coordinating the execution of its decisions and liaising with other organizations to ensure that the NCS goals and objectives are achieved. The primary goals of the NCS are to; increase the effectiveness with which natural resources are used and managed, so that beneficial interactions are optimised and harmful environmental side effects are minimised; Integrate the works of sectoral ministries and interest groups throughout Botswana, thereby improving the development of natural resources, and vice versa. Achievement of the foregoing requires a comprehensive evaluation of the economic, social and environmental implications prior to major new developments developments are undertaken, to foster sustainable development.

The Strategy addresses several environmental issues, mainly; Pressure on water resources; Degradation of rangeland resources; depletion of wood resources; exploitation of veld products; pollution; resource pressure due to growth in human population; depletion of wildlife resources. Section 7.3 (d) of the NCS mandates the obligates (now department to) to prepare annual/biennial State of the environment reviews. In pursuit of this mandate, the DEA published the National State of Environment Report in 2002. The objective of this report is to provide credible and science based information. SOER employs an integrated, holistic approach, the fundamental characteristic of this reports are; the interpretation, assessment and integration of high-quality data to generate meaningful information; the development of spatial and temporal trends information and linkages between and socio economic considerations within a sustainable development context. SOER incorporate a dynamic and continuous process to improve the generation and use of environmental information. This process includes the development of integrated databases, consultations and the use of partnerships, and capacity building.

Data and statistics, whether social, economic or environment is important, for planning and decision making. The Government recognized this need and crafted the Statistics Act (1969) which makes provision for the collection of statistical data. The act also establishes the Central Statistics Office, whose primary function is to provide government ministries and departments, non-governmental organizations and members of the general public with information for monitoring, evaluation and formulation of development plans. Within the Central Statistics Office is the Environmental Statistics Unit, whose portfolio responsibility is to compile statistics on the availability and the state of natural resources, human activities and natural events that have an impact on the state of environment and the responses. The data is collected from various sources and covers *interalia*; population numbers and distribution; mineral production; water production, consumption and quality; air quality; land tenure and land use; energy production and consumption; wildlife and biodiversity. The ESU has six publications since 2000 ad these are; Energy Statistics Publication; Selected Environmental Indicators Publications; Forestry Digests; Wildlife Statistics, Energy Stats Brief and Energy Statistics Publication. Work is ongoing to update the subsequent Environment Statistics.

3.0 ENVIRONMENT STATISTICS IN BOTSWANA

As much as possible, Botswana's environment statistics are being compiled in conformity to the UN recommended FDES Framework. Tables 1 to 4 present a sample of environment statistics topics (Land, Forestry, Energy, Agriculture and Water), and have been selected to highlight the availability of Environment Statistics in Botswana. Non-availability of the relevant data is indicated using grey shades. Data on unshaded variables is considered currently available although not all of it is necessarily of the required quality.

3.1 Land

Data on land tenure/use and the impacts of human activities on the land resource is an indispensable ingredient in mitigating the negative impacts of human activities on the resource. The impacts of human activities in various sectors of the economy, e.g. agriculture, forestry, and construction, all impact directly, though in diverse ways, on this resource. From an environmental point of view, the non-sustainable use of land contributes to soil erosion, desertification, and affects the ecosystem, natural habitats and the landscape. Data on land use changes highlight possible changes in the productive or protective uses of the land resource and therefore facilitate sustainable land use planning and long-term policy development. The information can be used to identify opportunities to protect land uses that are in line with sustainable development. Environmental restructuring is important in this regard because it contributes to changes in land use.

Table 1 Data Availability on Land

Variables	Classifications
STOCK	
1. Classifications of Land by e.g. soil type, (km^2)	Productive Capacity of Land
2. Land Tenure Systems, (km^2)	Type of Land Tenure
3. Land Use Categories, (km^2)	Time series data (years need not be consecutive)
A. Total Agricultural Land, (km^2)	
Arable land	
Land under permanent crops	
Land under permanent meadows and pastures	
Other agricultural land n.e.s.	
Fallow agriculture land	
B. Forest and other wooded land, (km^2)	
Total Land Under Forest And Other Wooded Land	
Land under mixed forests	
Other wooded land	
C. Built up and related land, (km^2)	
Residential land	
Industrial land	
Land Use for quarries, pits, mines, and related facilities	
Commercial land	

Variables	Classifications
Land used for public services (excluding transport, communication and technical infrastructure)	
Land of mixed use	
Land used for transport and communication	
Land used for technical infrastructure	
Recreational and other open land	
D. Dry open land with special vegetation cover, (km^2)	
Semi-arid land	
Arid land	
E. Waters, (km^2)	
Inland Waters	
4. Changes in land use between and within activity sectors, (km^2)	Major land use categories by selected time periods
5. Land Degradation : soil erosion, (km^2)	Selected land uses by intensity of erosion (e.g. light, moderate, Strong and extreme)
6. Permanent environmental re-structuring, (km^2)	
Transport network	
New agricultural / residential settlement	
New industrial site development	
Development of infrastructure for mines	
Development of major tourist sites	
Environmental rehabilitation projects	

2.2 Forestry

Forests provide raw commodities for commercial timber. Additionally, they are an important source of energy. They also provide habitats for a multitude of animal and plant life. Forest cover is an effective protector of soils and regulator of water flows and carbon cycles. In many parts of the world, conversion of forest land to agricultural uses, large scale commercial tree felling and increasing demand for woodfuel, have resulted in deforestation. This depletes a potential resource for wood and contributes to the loss of wildlife habitats and species, soil erosion, and siltation of rivers; among others.

Table 2 Data Availability on Forestry

Variables	Classifications
1. STOCK	
General Section	
Area of forests (km^2)	Type of forest (e.g. man made plantation or natural forest)

Variables	Classifications
Forest maturity (km^2)	Average age of trees
Forest Ecosystem (km^2)	Forest functions, (e.g., wildlife habitat and social and cultural functions) by area of forest
Genetic stock	
Number of tree species per ecosystems (nos.)	Type of Forest
Rare and endangered tree species, (nos., ha)	Type of species and Type of forest
Man-made Capital Stock	
Silviculture capacity (nos., ha)	Annual capacity of tree nurseries
Felling and hauling equipment (nos.)	Type of Operation
2. ACTIVITIES AND NATURAL EVENTS AND THEIR ENVIRONMENTAL IMPACTS	
Commercial harvesting, (m^3, km^2)	Types of species; by volume of wood, area harvested and method of felling.
Informal harvesting, (m^3, km^2)	Types of species; by purpose/use of the harvest, e.g. woodfuel, building, illegal harvesting.
In-place harvesting, (P, number of jobs)	Type of product e.g. phane collection, silk cocoon collection, etc. Include value of collected/harvested product and income generating capacity of the activity.
Natural tree mortality (m^3, km^2)	Types of species; by cause of mortality (e.g. forest fire, insect infestation, disease, drought, windfall, wildlife damage, etc.).
Deforestation (m^3, km^2)	Type of species; by causes (e.g. land clearing for agriculture or other uses, flooding, drought overgrazing and fuelwood gathering).
Annual new growth (m^3, t, km^2)	Type of species
Tree planting (nos., km^2)	Type of species by type of activity (afforestation and reforestation)
Trapping and Hunting (km^2)	Type of forest and area used

Variables	Classifications
Recreational Use (nos., km^2)	Type of activity by type of forest
3. ECONOMIC INDICATORS	
Logging (P, m^3)	Type of species by type of product.
Logs	Type of product, country of destination or of origin when referring to exports or imports, respectively.

2.3 Energy

Energy has traditionally been regarded as the powerhouse of economic development. This is particularly true in the modern technology based development, where a precondition for economic development is access to abundant (cheap) energy. A key indicator of a nation's energy security is the estimates of their energy reserves. The strategic importance of energy policies to economic development and the evident impact of energy production and consumption on the state of the environment are sufficient reasons for the inclusion of energy in environment statistics.

The production and use of energy and its byproducts have a major effect on the environment. The impacts vary considerably depending in the energy source and/or the energy conversion process. From an environmental perspective, a distinction can be made between renewable and non-renewable sources of energy. The later, in common with other mineral resources, are exhaustible and pollute the environment through the production of dangerous emissions when combusted, e.g. coal. The former, however are generally inexhaustible and more environment-friendly, e.g. solar energy.

Energy stock data are essential background information for the analysis of of the impact of energy on the environment. For non- renewable energy, reserves are to be classified by their physical and chemical properties. Distinction has to be made between proven and speculative reserves; and between reserves that are known but considered unfeasible to exploit under current conditions and those that are being exploited now or likely to be exploited in the future.

The major concern in developing data on renewable sources is to support policies on alternative energy sources. Data on renewable energy should document the energy conversion potential of solar, wind, biological (e.g. woodfuel supply, crop residues, and cowdung production) and other resources.

However, in order to consider the practical availability of the reserves, their exhaustibility, uncertainty of the reserves and the cost of production (technology, environmental and other costs) when weighed against price and importation alternatives have to be considered. Since in Botswana we do not produce any petroleum products, we refer here to coal reserves. Therefore data should be included on the quantity and type of coal reserves available in the country, their depletion rates (cumulative production over initial proven reserves) and life index (ratio of remaining reserves to annual production).

Table 3 Data Availability on Energy

Variables	Classifications
STOCKS	
Non renewable energy stocks	
Proven coal reserves, (t)	Location by exploitation type (i.e. whether currently exploited or held in reserve)
Speculative coal reserves, (t)	Location
Mine Capacity, (t)	Annual production time series
Mining town, (nos.)	Population as indicator of environmental stress
Renewable energy potential	
Woodland (TJ/ha)	Type (natural or calculated)
Crop Residual (TJ/ha)	Type of Crop
Wind (km/hr)	Identify area with reliable source
Solar (TJ/ha)	Solar Power potential across the country
Energy Infrastructure	
Solar facilities (kWh, TJ, nos.)	Type of facility (e.g. power station, household cooking or water heating)
Wind Stations (kWh, TJ, nos.)	Type of facility (large scale or individual household units)
Energy quantities (TJ)	Primary energy supply, net energy supply, and final energy consumption; by energy sources, (and use for final energy).
Impact of energy production and use	
Pollution of air	Type of pollution, emission quantities
Pollution of land	Type of pollution
Ratio of renewable to non-renewable energy consumption	Type of use, e.g. cooking, space heating, water heating
Ratio of domectic to foreign sources of energy (%)	Type of energy
Per Capita energy consumption	Type of energy

2.4 Agriculture

- Agriculture is an ecology-dependent industry. Agricultural activities therefore have an impact on the environment. Various natural resources are used in agricultural activities. A major environmental concern is to improve agricultural output and, at the same time maintain the natural factor inputs of production at the level required for long-term sustainable yields. This is especially necessary in view of the growing and sometimes competing demands for the resources.

Table 4 Data Availability on Agriculture

Variables	Classifications
STOCKS	
A. Output	
Annual crop production, (t, ha, kg/ha)	Name of crop, type of farming practice e.g. monoculture, shifting cultivation, subsistence, commercial.
Perennial crop, (t, km^2, kg/ha)	Name of crop, type of plantation
Livestock, (nos., ha, nos./km^2	Livestock type, type of practice e.g. commercial and traditional.
Other products, (t, kg, nos)	Product type e.g. milk, eggs, honey skins, manure
B. Nutrient input, (t, ha, kg/ha)	***Type of nutrient e.g. chemical fertilizers[1,2], manure, crop residues.***
Control of pests, fungi herbs, (l, t, ha, kg/ha)	Includes pesticides2 , fungicides and herbicides, if any, and their uses.
Disease and predator, (kg, ha)	Name of disease, type of control e.g. drugs, inoculations, spraying, shooting/poisoning of predators.
Energy used (J)	Type of practice,type of energy e.g. fossil fuels, electricity, animal and human labour.
C. Other	
Tillage, (ha)	Crop name, type of tillage e.g. hoe, tractor, draught plough.
Breeding, (nos.)	Name of livestock, type of breeding e.g. artificial insemination, incubator hatching, normal.
Productive soil loss due to erosion , (ha, t)	Soil type, causes (e.g. overgrazing, faulty tillage and other arable agriculture practices)
Areas of soil erosion, (ha)	Type of land use, distinguish areas of - high-, medium- and low-erosion intensity (overlay on graph with land use).
Areas affected by soil toxicity, (ha)	Type of contaminant e.g. pesticides

1 for chemical fertilizer, include ratio of active ingredient(s) in fertilizer compound
2 include method of application e.g. aerial, hand, machine spray, etc.

Variables	Classifications
	industrial chemicals, etc.
Soils affected by irrigation, (ha)	Type of soil, areas of salinisation, alkalinization and water logging.
Soils affected by acid deposition, (ha)	Type of soil, cause of problem
Loss of cultivated biota due to disease, insects and natural disasters, (nos., ha, %, value)	Crop, livestock and plantation forest loss e.g. from drought, flood, disease, etc.

2.5. Water

Adequate quantities of water for meeting basic human needs are prerequisite for existence, good health and development. Data on the annual volume of water resources and of ground and/or surface water abstracted shows the quantity of the water resource available and the annual level of uses of, and requirements for fresh water, respectively. These data make it possible to assess the rate at which available water resources are being depleted/recharged. Under the prevailing economic and technical conditions, a sustainable abstraction rate of water is one at which the abstractions do not exceed the renewal of resource in the long term. The data therefore enables policy makers to put in place policies and projects that ensure that basic water needs are met and that the rate of abstraction of the resource will not lead to the depletion of the resource in the long term.

The concept of water quality appears to be more complex than that of air quality, since water quality parameters depend on a variety of purposes and uses of water. For example, nutrient rich water may be beneficial for certain kinds of biotic life but is unacceptable for drinking and recreational purposes. Therefore, water quality is defined by a large variety of biological, chemical, physical and bacteriological characteristics of water. It is measured by the values of a correspondingly large number of variables.

The treatment of waste water refers to the collection of waste water from households, commercial, industrial or public premises and its conveyance to a location where it receives treatment sufficient to permit its discharge into the environment without adverse impact on public health and the ecosystem. The basic treatment is mechanical, in the sense of physical and mechanical processes (in particular sedimentation, floatation, etc.), which allows effluents to settle and sludge to be separated. The secondary treatment is biological and involves the use of aerobic and anaerobic micro-organisms. The advanced (or tertiary) treatment makes use of advanced technologies capable of breaking down the specific constituents of waste water and sludge, particularly any operations not classified above as mechanical or biological.

Table 5 Data Required on Water

Variables	Classification
STOCK	

Variables	Classification
A. Water Resources, (million m^3)	***Long term annual average and annual time series data***
Precipitation	
Evapotranspiration	
Inflow of surface waters	
Outflow of surface waters	
Ground Water available for annual abstraction	
Dependable surface water resources	
B. Water Abstraction, (million m^3)	***Annual time series data***
Fresh surface Water	
Fresh ground water	
Other surface water	
C. Water Supply, (million m^3)	***Annual time series data***
Public supply	
Agriculture, forestry and fishing	
Industrial Activities	
Mining and quarrying	
Manufacturing	
Electricity (production and distribution)	
Construction	
Other industrial activities	
Residential	
Other sectors	
Water loss during transport	
Self supply, ***, (million m^3)***	
Agriculture, forestry and fishing	
Industrial Activities	
Mining and quarrying	
Manufacturing	
Electricity (production and distribution)	
Construction	
Other industrial activities	
Residential	
Other sectors	
Water loss during transport	
Other supply, ***, (million m^3)***	
D. Water quality of selected rivers, dams, and selected boreholes	***Minimum, maximum and annual average time series data of indicators for each water source***
Selected overall measures (tonnes):	
Biochemical Oxygen Demand,	

Variables	Classification
(BOD)	
Chemical Oxygen Demand (COD)	
Total suspended solids	
Total dissolved solids	
Nutrients, (tons):	
Total phosphorus	
Total Nitrogen	
Harmful substances (tonnes)	
Arsenic	
Cadmium	
Chromium	
Copper	
Lead	
Mercury	
Nickel	
Zinc	
Aluminium	
Other harmful inorganic substances	
Petroleum Hydrocarbons	
Organic chlorinated hydrocarbons	
Other organic compounds	
Microbiological discharges (number/100ml)	
Thermo-tolerant coliforms	
Faecal streptococci	
Physical / Chemical properties (μg/l, %, pH)	
Turbidity	
Salinity	
Acidity	
Conductivity	
E. Waste water Treatment	***Public sewage, independent and other waste water treatment plants; number and time series annual data***

4.0 SOURCES OF DATA

A sample of the sources of data for different categories of environment statistics is presented in Table 6. We observe that several departments within and between ministries provide data on any one category. Additionally, data on just one aspect of a data category (e.g. wastewater under the water category or land use under land), is collected from several divisions within and between departments in the same or different ministries.

Table 6 Sources of Data by Environment Statistics Category

Category of Environment Data	Source of Data
Land	Department of Lands, MLE Department of Town and Regional Planning, MLE Department of Surveys and Mapping, MLGLH Department of Crop Production and Forestry, MoA Department of Roads, MWTC Department of Mines, MWTC Division of Agricultural Planning and Statistics, MoA Division of Land Utilisation, MoA
Forestry	Department of Customs and Exercise, MFDP Department of Crop Production and Forestry, MoA Energy Affairs Division, MMEWA NGO's involved in Afforestation efforts
Energy	Department of Geological Surveys, MMEWA Department of Mines, MMEWA Energy Affairs Division, MMEWA Botswana Power Corporation NGO's involved in promoting renewable sources of energy Petroleum Companies Department of Electrical and Mechanical Services, MWTC
Agricultue	Department of Crop Production and Forestry, MoA Department of Animal Health and Production, MoA Department of Agricultural Research, MoA
Water	Department of Meteorological Services, MWTC Department of Water Affairs, MMEWA Water Utilities Corporation District, Town and City Councils, MLGLH Department of Waste Management, MLGLH Department of Local Government Development, MLGLH
Mining	Department of Mines, MMEWA Department of Geological Surveys, MMEWA BCL

Category of Environment Data	Source of Data
	DEBSWANA Other mining companies
Biodiversity and Wildlife	National Conservation Strategy Agency, MLE
	Department of Wildlife and National Parks, MCI Department of Tourism, MCI Ministry of Agriculture Several NGOs
Waste Management	District, Town and City Councils, MLGLH
	Department of Sanitation and Waste Management, MLGLH Division of Community Health Services (Ministry of Health)
Environmental Disasters	Office of the President
	Department of Meteorological Services, MWTC
Atmosphere (Air quality)	Department of Mines, MMEWA
	Individual Mines Selected Industries
Responses to impacts on the environment	Attorney General's Chambers
	NGO's

5.0 INSTITUTIONAL ARRANGEMENTS AND LINKAGES

The natural resources base in Botswana, like elsewhere in the world, is an integrated functional system. Its utilisation, administration and management is however organised along separate but interrelated development and conservation processes, for administrative expediency. All ministries in central government have responsibility for aspects of development. Some ministries also have responsibility for certain aspects of conservation. A number of statutory and non-statutory have also been established to administer, manage and control some aspects of natural resources, and their products and

services. As part of their portfolio, the institutions collect, collate and analyse data to various levels. However there are certain institutional shortcomings in the current arrangement, including inadequate integration of management; gaps in environmental policy formulation; inadequate monitoring capability and inadequate coordination.

6.0 CHALLENGES

It is obvious from Table 7 that responsibility for the collection of environment statistics is highly fragmented, mainly due to the nature of the data itself. The various departments normally collect the data as a by-product of their day-to-day responsibilities.

Consequently, within Government, environment-related statistics are scattered over many departments, and when digitised, are stored in unlinked computers and in a wide range of formats (codes used for classification of the variables and data storage and exchange formats) using a wide range of computer software. As a result, simple requests for environmental statistics often take several weeks - or even months - and the integration of data is often an impossible task because data collection and storage standards invariably differ from department to department and sometimes even between sections in the same department. Environment-related data is seldom found in a format useful to a secondary user of the data. Consequently, after the data is obtained, the user usually has to spend a lot of time adjusting the formats in which the data is stored so as to make the compilation, integration and analysis of the data feasible. It appears that the absence of co-ordination among environment-related data producers and between them and the users of their data is the main cause of these hurdles.

7.0 STRATEGIES

- Put in place an effective coordinating mechanism for data collection
- Put in place a core set of indicators to inform data collection
- Develop data collection standards to harmonize data formats
- Develop the environmental Information system for easy storage and retrieval of data, including linking to other data sources
- Enhance the role of Department of Environmental Affairs in national development planning, implementation and monitoring
- Develop the Environmental Management Act to mandate data collectors to provide data to DEA
- Institutional capacity building

8.0 CONCLUSION

In connection with the use of natural resources and production of raw material, manufacturing, building and provision of amenities, a whole range of data and statistics are produced, coupled with the environmental dimension means more data. Usually it is more difficult to acquire relevant environmental data and information than to produce economic or demographic data. Where environmental data is available it usually needs to be standardized, aggregated and developed into useful information for decision makers. Such a process is time consuming and resource-demanding. Reliability of measurements and data also poses problems. Data and statistics need to e scrutinized in order to safeguard the follow-up of the impact by various pressures on the environment.

Otherwise reliable information on the state and trends in the environment will missing and considerable effort in environmental monitoring will not produce proper results, which may result in improper actions. Data and information as such about natural resources and the environment have to be put into proper context to be of value for decision makers. This can be done is many ways, for example by the use of benchmark data, indicators, norms and standards. Botswana is yet to define these in more coherent manner. The interdisciplinary nature of environment statistics, and the variety of data producers and users necessitate a coordinated analysis of data availability and collection. Additionally, coordination is necessary because the departments/organisations involved in the production/collection of the data might have not only different priorities/objectives for producing/collecting the data but also different administrative arrangements and capabilities in handling environment data. Coordination would therefore greatly avoid the duplication of government funds spent on the production/collection of such data. It would also minimise data gaps - especially in situations where responsibility for data production/collection could belong to more than one department and ensure the optimum use of human skills and technology. Thereby, coordination would enhance the quality and timeliness of environment statistics provision by the CSO.