



REPUBLIC OF ZAMBIA

## THE ENVIRONMENTAL INDICATOR DEVELOPMENT PROCESS THE CASE FOR ZAMBIA



A PAPER PRESENTED AT A WORKSHOP ON ENVIRONMENT STATISTICS, ADDIS  
ABABA, ETHIOPIA, 16-20 JULY 2007.

BY

MASILISO SOOKA and GIFT SIKAUNDI

## **Indicator Development Process:**

Zambia has made efforts towards environmental conservation by enacting regulations, plans and programmes. These include; the adoption and implementation of the National Conservation Strategy (NCS) in 1985, National Environmental Action Plan (NEAP) in 1994 and the Environmental Protection and Pollution Control Act (EPPCA) in 1990 which led to the establishment of the Environmental Council of Zambia (ECZ) in 1992 whose mandate is to regulate and coordinate environmental management for the sustainable development of our country. Zambia is in the process of developing a National Policy on Environmental (NPE) which is designed to create a comprehensive framework for effective natural resources utilization and environmental conservation which will be sensitive to the demands of sustainable development.

Recognizing that management and communication of environmental information is fundamental to sustainable development, the country has been engaged in a process of periodic production of the State of Environment (SoE) Outlook Reports. This provides for an assessment of the state of environment, monitor environmental trends and report so as to increase awareness and facilitate the measurement of progress towards sustainable development efforts. Three SoE Reports have been produced to date (1990, 1994 and 2000). The next report is due to be produced at the end of 2007. One of the key lessons learnt in the production of these reports was the need to produce a national set of environmental indicators and improve stakeholder participation in the environmental reporting process.

Zambia began the process of developing indicators at a stakeholders' consensus workshop in August 2002 at which a wish list of applicable indicators to be used in environmental reporting was discussed. It was also resolved that an environmental reporting framework that is used by the Southern Africa region DIPSIR framework be adopted so that the Zambian report can fit into the regional report.

However, it was later considered that, developing indicators required a process of progressing from the general framework and under-lying basic values, to priority issues, to issue-specific indicators and, finally, to concrete performance criteria and analysis.

To define the general framework, stakeholders in Zambia identified the themes and issues for the indicators; and that these would be used in the development of subsequent SoE outlook reports,. For the 2006 Zambia Environment Outlook report, the following themes were adopted:

1. Land
2. Atmosphere;

3. Settlement;
4. Socio-Economic Issues;
5. Mineral Resources;
6. Biodiversity;
7. Water Resources and
8. Cross-Cutting Issues such as HIV/AIDS, public awareness, Information and Communications Technologies and Gender.

Based on these themes, Seven (7) Technical Working Groups (TWGs) were formed. Members of the TWGs were drawn from a variety of disciplines and organizations. In order to build capacity, members of the TWGs were trained in indicator development and Integrated Environmental Assessment (IEA) and Reporting. Each TWG held a series of meetings, identified and prioritized issues for the 2006 Zambia Environment Outlook. The groups went further to develop indicators for each of the issues identified.

### **Challenges in collecting Environmental Indicators Data**

Collecting of the Environmental Indicators data remains a big challenge for Zambia mainly because of the following:

- Central Statistics Office (CSO) is the only institution mandated to collect various statistical data, including environmental statistics. However, in Zambia, environmental statistics does not seem to be a major priority, and as such, CSO branch in charge of environmental statistics is not given adequate resources to carry out these activities. For Zambia only one publication on energy statistics has been produced and is yet to be published. Due to lack of funding, CSO is unable to carry out surveys on various environmental issues, and also lacks skilled manpower to carryout activities.
- The draft environmental indicators that have been prioritized for Zambia require strong stakeholder involvement, as some of the data will be collected by participating institutions, which are mostly government departments. These however face other challenges among them, lack of funding, lack of equipment such as GIS labs, lack of sufficient and skilled human resource.
- Institutional arrangement has been observed to be one of the major challenges. Certain institutions do not want to cooperate, even to release data that they have collected. Most institutions want to stick to their mandated activities.
- Absence of a Memorandum of Understanding (MoUs) for data sharing among institutions has been identified as a challenge. Many institutions will not release data unless they can be given something in return, e.g other form of data, or funding. Most institutions sell their data for cost recovery purposes, and they would not want to give it for free.
- Data standards and units in which data is collected, is an obvious challenge as different institutions involved collect data in a format that suits them. This usually brings up issues of data incompatibility.

## **Way forward:**

A proposed way forward is that the AEIN process in the country must be strengthened. The AEIN process in Zambia has brought together a number of stakeholders from various sectors, that include government departments, the private sector, academic and research institutions who are the generators/collectors of different aspects of environmental data.

Among the responsibilities for AEIN in Zambia is to help resolve challenges being faced in the indicator development process and strengthen information sharing and networking in the country. These include establishment of the data standards, capacity building and resource mobilization to help institutions that are lacking. During a national stakeholders review workshop held in December 2006, for AEIN member institutions, the EnviroInfo database, a tool that has been customized from the DevInfo system was adopted as a system that could be used to collect and analyze the performance of environmental indicators for Zambia. This tool was developed using political boundaries, and is able to collect data up to ward level but it was felt that collecting data at such low levels will be very difficult and costly. The meeting resolved that for environmental indicators, Zambia will monitor these up to district level. This is in line with the additional activity of producing Integrated Environmental Assessment reports at district level. The data that is collected through the EnviroInfo can be linked to the respective MDGs and can easily be exported to GIS, Word or Excel applications for further analysis.

The EnviroInfo will also have a metadata that will have all necessary information on various indicators, information on who collects, the methodology used to collect, and the frequency of collection.

## **Sources and data Collection Times:**

- The SOE reports are produced every 5 years, therefore, most data for this activity will be collected for in that period.
- The License Information System, a system that ECZ uses to monitor licensed industries has a collection of most pollution data, as discharged by industries. This has been a good source for indicators on pollution, and thus provides a good source of data. This is populated once every 6 months.
- EnviroInfo will be another source of data, as it has a collection of all adopted environmental indicators. This will update once every year.
- The environmental statistics publications will be another good source of data, and these are likely to be updated on yearly basis.
- Most social economics data will be collected from various reports published by CSO.
- Various stakeholders that have been incorporated in the indicators development process will be a source of data collected from their mandated sector

## **List members of the Technical Working Groups (TWGs)**

The following institutions participated in the indicator development process through the following Technical Working Groups;

### **WATER**

Department of Water Affairs  
National institute for industrial and Scientific Research (NISIR)  
University of Zambia (UNZA, School of Mines)  
National Water and Sanitation Council (NWASCO)  
Riverine Development Associates

### **MINERAL RESOURCES**

National institute for industrial and Scientific Research (NISIR)  
Mines Safety Department (MSD)  
Zambia Association of Manufacturers (ZAM)  
Zambia Geological Survey

### **LAND**

UNZA-School of Natural Sciences  
Chemical Society of Zambia  
Mt. Makulu Research Centre  
Department of Survey

### **ATMOSPHERIC ISSUES**

Alfred Knight  
Meteorological Department  
University of Zambia  
Factories Department

### **BIODIVERSITY**

Forestry Department, Ministry of Environment and Natural Resources  
Zambia Wildlife Authority (ZAWA)  
Fisheries Department  
Ministry of Tourism Environment and Natural Resources (MTENR)

### **SETTLEMENT ISSUES**

NISIR  
TDAU –UNZA  
ZCCM-Investment Holdings  
Institute of Waste Management  
Lusaka City Council (LCC)

### **SOCIO ECONOMIC ISSUES**

Central Statistical Office (CSO)  
WWF-Zambia Education Programme

UNZA-Department of Economics  
Jesuit Centre for Theological Reflection (JCTR)

**List of Environmental Indicators:**

Issue	Indicator	Frequency	Collection Method	Limitations	Source
<b>INDICATORS ON WATER</b>					
<b>Water availability</b>	<ul style="list-style-type: none"> <li>• Internal renewable water resources available per capita or per year, <b>D</b></li> <li>• Amount of water abstracted in particular sectors (e.g. agriculture, domestic, industrial), <b>P</b></li> <li>• change in ecosystem processes, <b>P</b></li> <li>• change in amount of rainfall over a period of time (30 or 60 years), <b>P</b></li> <li>• Internal renewable water resources available per capita or per year, <b>S</b></li> <li>• Freshwater available for use (household, agriculture, industry, etc), <b>S</b></li> <li>• Percentage of population with water supply, <b>S</b></li> <li>• Percentage of degraded wetlands, <b>S</b></li> <li>• Urban/rural water supply, <b>R</b></li> <li>• Annual water use/consumption (per capita/per day), <b>R</b></li> </ul>				
<b>Water Accessibility</b>	<ul style="list-style-type: none"> <li>• Percentage of population with access to safe drinking water. <b>D</b></li> <li>• Amount of water consumed by industries and agricultural sectors. <b>D</b></li> <li>• Distance to sources of safe drinking water. <b>D</b></li> <li>• Percentage of population with access to water. <b>P</b></li> <li>• Water loss in catchment areas. <b>P</b></li> <li>• Amount of surface and ground water abstracted. <b>P</b></li> <li>• Percentage of population with access to water. <b>S</b></li> <li>• Water use per capita, <b>S</b></li> <li>• Percentage of rivers dammed or with abstraction schemes in place, <b>S</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Change in area of irrigated land, I</li> <li>• Change in productivity of irrigated arable land, I</li> <li>• Ratio of crop production to annual water volumes available, I</li> <li>• Number of water related conflicts, I</li> <li>• Improved drinking water coverage - total population (urban, peri-urban and rural), R</li> <li>• Number (density) of borehole per capita unit area (rural), R</li> <li>• Number of dams constructed, R</li> </ul>				
<b>Water Quality</b>	<ul style="list-style-type: none"> <li>• Discharge of organic water pollutants into aquatic environments - BOD and COD. D</li> <li>• Discharge of heavy metals into aquatic environments (Manganese, Lead). D</li> <li>• Amount of mine discharges, D</li> <li>• Discharge of organic water pollutants into aquatic environments - BOD and COD. P</li> <li>• Number and types of industries along major water sources. P</li> <li>• Number of people affected by waterborne diseases. S</li> <li>• Area or number of rivers/streams silted. S</li> <li>• Amount of pollutants measured as total loads/concentration, S</li> <li>• Incidences of waterborne diseases (Number of people affected per thousand population), I</li> <li>• Loss of habitat, I</li> <li>• High costs of water quality, I</li> <li>• Number of water treatment facilities, R</li> <li>• Number of sewage/waste water treatment plant, R</li> <li>• Level of enforcement of water quality standards, R</li> <li>• Status of river rehabilitation, R</li> <li>• Level of implementation of EMPS and legislation, R</li> </ul>				



	<ul style="list-style-type: none"> <li>• Extent of adoption of cleaner production technologies, <b>R</b></li> </ul>				
<b>INDICATORS FOR BIODIVERSITY</b>					
<b>Deforestation</b>	<ul style="list-style-type: none"> <li>• Population growth, <b>D</b></li> <li>• Energy consumption per household, <b>D</b></li> <li>• Percentage change of land being used for agriculture and human settlement, <b>D</b></li> <li>• Volume of timber harvested. <b>D</b></li> <li>• Percentage of encroachment on protected areas (Forests, National Parks, Heritage Sites, Ramsar sites etc). <b>P</b></li> <li>• Hectarage of lands cleared for agriculture. <b>P</b></li> <li>• Rate of deforestation. <b>S</b></li> <li>• Percentage of protected forest area cleared for use as land for human settlement. <b>S</b></li> <li>• Extent of habitats degraded (NDVI), <b>I</b></li> <li>• Extent of soil erosion in deforested areas, <b>I</b></li> <li>• Number of forests areas under Joint Forestry Management Programme, <b>R</b></li> <li>• Number of tree planting programmes initiated. <b>R</b></li> <li>• Number of Statutory Instruments and enactment of the policy. <b>R</b></li> <li>• Number of income generating activities in forestry management put in place. <b>R</b>Percentage share of consumption/use of renewable energy sources. <b>R</b></li> </ul>				
<b>Depletion and Loss of Species</b>	<ul style="list-style-type: none"> <li>• Percentage of species of harvested quotas, <b>D</b></li> <li>• Number of quota allocation for trophies, <b>D</b></li> <li>• Changes in land use, <b>D</b></li> <li>• Number of tourist facilities developed in GMAs and National Parks. <b>D</b></li> <li>• Number of blocked wildlife corridors through infrastructure development, <b>D</b></li> <li>• Change in species composition and distribution, <b>P</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Off take of trophy species, <b>P</b></li> <li>• Percentage of encroached protected areas, <b>P</b></li> <li>• Rate of tourist inflow, <b>P</b></li> <li>• Change in fish stocks and fish catches (including aquaculture), <b>S</b></li> <li>• Scarcity of specific species, <b>S</b></li> <li>• Percentage of encroached protected areas, <b>S</b></li> <li>• Number of trophy animals, <b>S</b></li> <li>• Extinction rates of endangered species, <b>S</b></li> <li>• Change in species composition and size in catch, <b>S</b></li> <li>• Displacement of species, <b>S</b></li> <li>• Limited carrying capacity in National Parks, <b>S</b></li> <li>• Changes in species abundance and distribution, <b>I</b></li> <li>• Reduction in range lands, <b>I</b></li> <li>• Rate of human/wildlife conflicts, <b>I</b></li> <li>• Number of international conventions signed and part to, <b>R</b></li> <li>• Number of established PWE and game ranches, <b>R</b></li> <li>• Number of species and stocks in established PWE and GR, <b>R</b></li> <li>• Number of prosecutions/convictions and exhibits produced per unit time, <b>R</b></li> </ul>				
<b>Invasive Alien Species (IAS)</b>	<ul style="list-style-type: none"> <li>• Types of IAS introduced in e.g. Forestry, Fisheries, Tourism and Agriculture. <b>D</b></li> <li>• Number of IAS that have become invasive. <b>D</b></li> <li>• Use of alien species in plantations and reclamation. <b>D</b></li> <li>• Rate of spread of selected IAS. <b>P</b></li> <li>• Total population plant and animal species threatened by IAS. <b>S</b></li> <li>• Change in species composition and size in catch. <b>I</b></li> <li>• Economic loss (cost of managing IAS). <b>I</b></li> <li>• Changes in species abundance and distribution. <b>I</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Number of prevention programmes on IAS. <b>R</b></li> <li>• Number of established awareness programmes. <b>R</b></li> <li>• Number of established monitoring programs. <b>R</b></li> </ul>				
<b>Hybridization</b>	<ul style="list-style-type: none"> <li>• Rate of change in consumption <b>D</b></li> <li>• Number of new ornamental plants and animals <b>D</b></li> <li>• Number of hybrids on the market (both plants and animals). <b>P</b></li> <li>• Rate of introductions of types of hybrids. <b>P</b></li> <li>• Rate of consumption of hybrid foods. <b>P</b></li> <li>• Number of hybrid species. <b>S</b></li> <li>• Number of ornamentals on the market. <b>S</b></li> <li>• Changes in gene pools, <b>I</b></li> <li>• Number of programmes to regulate and enforce the ornamental industry and control of translocation and use of specific species, <b>R</b></li> <li>• Number of conservation measures in place, <b>R</b></li> <li>• Number of monitoring programmes in place, <b>R</b></li> </ul>				
<b>INDICATORS FOR SOCIO - ECONOMIC</b>					
<b>Literacy Levels</b>	<ul style="list-style-type: none"> <li>• Population growth rate, <b>D</b></li> <li>• GDP, <b>D</b></li> <li>• Per capita income, <b>D</b></li> <li>• Percentage of population at various levels of education , <b>S</b></li> <li>• Teacher pupil ratio, <b>S</b></li> <li>• Percentage of population with basic education (Grade 9 and below), <b>S</b></li> <li>• literacy rate, <b>S</b></li> <li>• Percentage of people with direct dependency on natural resources for fishing, agriculture, fuelwood etc.</li> <li>• Number of educational reform programmes implemented. <b>R</b></li> <li>• Increase in the number of school places. <b>R</b></li> <li>• Number of teachers trained and employed. <b>R</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Increase in budget allocation to education sector. <b>R</b></li> </ul>				
<b>Health Status</b>	<ul style="list-style-type: none"> <li>• sources and levels of pollution, <b>D</b></li> <li>• incidences of extreme natural and other events, <b>D</b></li> <li>• Poverty, <b>D</b></li> <li>• Percentage of population at various levels of education, <b>D</b></li> <li>• Population growth rate, <b>P</b></li> <li>• Number of unplanned settlements, <b>P</b></li> <li>• Prevalence of diseases, <b>S</b></li> <li>• Percentage of population with access to basic health care facilities, <b>S</b></li> <li>• public expenditure on health as a percentage of GDP</li> <li>• Number of skilled human resource lost by sector, <b>I</b></li> <li>• Mortality rate, <b>I</b></li> <li>• Infant mortality rate, <b>I</b></li> <li>• Maternal mortality rate, <b>I</b></li> <li>• Enforcement and compliance monitoring of environmental regulations. <b>R</b></li> <li>• Policies on environmental regulation. <b>R</b></li> <li>• Number of awareness campaigns conducted <b>R</b></li> <li>• Number of health reform programmes implemented. <b>R</b></li> </ul>				
<b>Urbanization</b>	<ul style="list-style-type: none"> <li>• Number of people in employment/labour force (formal and informal), <b>D</b></li> <li>• Urban population growth rate, <b>D</b></li> <li>• Access to basic social services (housing, water, electricity, sanitation etc), <b>P</b></li> <li>• Number of unplanned settlements , <b>S</b></li> <li>• Population density in urban and rural areas, <b>S</b></li> <li>• Percentage of urban population, <b>S</b></li> <li>• Prevalence of water borne diseases, <b>I</b></li> <li>• Sources and levels of pollution e.g. domestic, industrial, mobile, <b>I</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Incidence of crime (e.g. thefts, murder, rape, assault, vandalism), I</li> <li>• Incidence of street kids/vendors, I</li> <li>• Percentage of population with access to basic services e.g. electricity, water, telephones, housing etc), I</li> <li>• Number of planned settlements. R</li> <li>• Availability and implementation of city/town development plans, R</li> <li>• Police to population ratio, R</li> <li>• Number of community based crime prevention programmes implemented, R</li> <li>• Number of economic empowerment programmes in place R</li> </ul>				
<b>Governance</b>	<ul style="list-style-type: none"> <li>• Established provisions, procedures and processes for decision making and participation e.g. youth and women representation, government decision making hierarchy etc, D</li> <li>• Levels of literacy, D</li> <li>• Number of pressure campaigns/groups, D</li> <li>• Per capita income, D</li> <li>• Number of people with access to media, D</li> <li>• Number of community radio stations per province and their coverage, D</li> <li>• Distribution of benefits , P</li> <li>• Access to resources average ratios by class/gender, P</li> <li>• Registered voters vs. eligible voters, S</li> <li>• Corruption index, S</li> <li>• Poverty rate, I</li> <li>• Depletion of resources , I</li> <li>• Rate of implementation of programmes, I</li> <li>• Number of policies, institutional and structural provisions, R</li> </ul>				

	<ul style="list-style-type: none"> <li>• Number of active advocacy groups, institutions and structures, <b>R</b></li> <li>• Access to justice/remedy, <b>R</b></li> </ul>				
<b>Food Security</b>	<ul style="list-style-type: none"> <li>• Capacity of operational storage facilities, <b>D</b></li> <li>• Number of accessible roads, <b>D</b></li> <li>• Access to extension services and markets, <b>D</b></li> <li>• Frequency and extent of drought, <b>D</b></li> <li>• Crop diversification, <b>D</b></li> <li>• Irrigation schemes, <b>D</b></li> <li>• Prevalence of HIV/AIDS, <b>D</b></li> <li>• Population growth rate, <b>P</b></li> <li>• Migration, <b>P</b></li> <li>• Dependency on food aid, <b>S</b></li> <li>• Food Poverty (Hunger) , <b>S</b></li> <li>• Number of malnourished children, <b>S</b></li> <li>• Number and amount of strategic food reserves , <b>S</b></li> <li>• Crop yield per hectare, <b>S</b></li> <li>• Number of animals that can be supported per unit land area, <b>S</b></li> <li>• Land under cultivation vs. arable land, <b>S</b></li> <li>• Mortality rates, <b>I</b></li> <li>• Infant mortality rates, <b>I</b></li> <li>• Maternal mortality rates, <b>I</b></li> <li>• Labour productivity, <b>I</b></li> <li>• Incidence of crime, <b>I</b></li> <li>• Prostitution, <b>I</b></li> <li>• Child labor, <b>I</b></li> <li>• Unsustainable use of natural resources (forestry, wildlife, fisheries), <b>I</b></li> <li>• Government capital investment as a ratio of total budget, <b>R</b></li> <li>• Land under irrigation as a ratio of land under cultivation,</li> </ul>				

	<ul style="list-style-type: none"> <li>• <b>R</b></li> <li>• Ratio of agriculture extension officers to population served, <b>R</b></li> <li>• Agriculture land under private tenure vs. other tenure systems, <b>R</b></li> <li>• Food in reserves as ratio of food produced, <b>R</b></li> <li>• No of mitigation programmes in place to enhance food security (e.g. early warning, diversification etc), <b>R</b></li> </ul>				
<b>Condition of Physical Infrastructure</b>	<ul style="list-style-type: none"> <li>• Public fixed investment vs. total budget, <b>D</b></li> <li>• Road investment vs. GDP, <b>D</b></li> <li>• Tax revenue base, <b>P</b></li> <li>• Budget allocation to social sectors vs. total budget or GDP, <b>P</b></li> <li>• Rate of infrastructure development, <b>P</b></li> <li>• Number of gravel or unpaved roads vs. tarred roads per province. <b>S</b></li> <li>• Number of people with access to telecommunication facilities. <b>S</b></li> <li>• Expenditure on physical infrastructure, <b>R</b></li> <li>• No of private/public investment initiatives in infrastructure development. <b>R</b></li> </ul>				
<b>Employment Levels</b>	<ul style="list-style-type: none"> <li>• Foreign Direct Investment (FDI) vs. GCF, <b>D</b></li> <li>• Overseas Development Aid (ODA) vs. GDP, <b>D</b></li> <li>• Private domestic investment vs. gross investment, <b>D</b></li> <li>• Tax vs. GDP, <b>D</b></li> <li>• MGDP vs. GDP, <b>D</b></li> <li>• Manufacturing/ Formal Employment/total labour force, <b>D</b></li> <li>• Revenue vs. GDP, <b>I</b></li> <li>• Per capita income, <b>I</b></li> <li>• Rate of urbanization, <b>I</b></li> <li>• Population density, <b>I</b></li> <li>• GDP growth rate, <b>S</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Unemployment rate, S</li> <li>• Formal employment vs. total labor force, S</li> <li>• Industrial contribution to GDP, S</li> <li>• Levels of poverty (urban vs. rural), I</li> <li>• Access to basic social services (education, health, transport, water &amp; sanitation), I</li> <li>• Level of investment, R</li> <li>• Policies for economic empowerment (e.g. PRSP, Informal sector reforms, SAP, Liberalization programmes), R</li> <li>• Commercial and industrial reforms, S</li> <li>• Tax reforms, S</li> <li>• Level of participation in decision making, S</li> </ul>				
<b>International Trade</b>	<ul style="list-style-type: none"> <li>• Trade volume/GDP, D</li> <li>• Labour migration (Brain drain), D</li> <li>• Export subsidies , S</li> <li>• Trade Barriers, S</li> <li>• Primary export vs. total exports, S</li> <li>• Loss of biodiversity , I</li> <li>• Damage to infrastructure, I</li> <li>• Level of economic development, I</li> <li>• International and regional trade reforms/ agreements for which Zambia has a comparative advantage, R</li> <li>• National trade policies, R</li> </ul>				
<b>INDICATORS FOR MINERALS RESOURCES</b>					
<b>Mineral Exploration</b>	<ul style="list-style-type: none"> <li>• World Market Mineral Prices D</li> <li>• Number of mineral exploration licenses issued. D</li> <li>• Level of investment in the mining sector. D</li> <li>• Grade and tonnage of mineral resources, S</li> <li>• Area covered by exploration pits. S</li> <li>• Area of land degraded by mineral exploration. I</li> <li>• Contribution to GDP, I</li> <li>• Creation of employment, I</li> </ul>				



	<ul style="list-style-type: none"> <li>• Level of enforcement of relevant legislation, <b>R</b></li> <li>• Status of land and river rehabilitation, <b>R</b></li> <li>• Level of implementation of Environmental Management Plans (EMPs) and legislation. <b>R</b></li> </ul>				
<b>Mineral Exploitation</b>	<ul style="list-style-type: none"> <li>• World mineral market prices. <b>D</b></li> <li>• Equity and collateral, <b>D</b></li> <li>• Number of mining exploitation licensed. <b>D</b></li> <li>• Amount of mineral resources available. <b>D</b></li> <li>• Area of land mined. <b>S</b></li> <li>• Rate of mineral exploitation. <b>S</b></li> <li>• Area affected by subsidence. <b>I</b></li> <li>• Number of orphaned/abandoned sites. <b>I</b></li> <li>• Level of enforcement of relevant legislation. <b>R</b></li> <li>• Status of site rehabilitation. <b>R</b></li> <li>• Level of implementation of Environmental Management Plans and legislation. <b>R</b></li> </ul>				
<b>INDICATORS FOR SETTLEMENT</b>					
<b>WASTE</b>	<ul style="list-style-type: none"> <li>• Population density, <b>D</b></li> <li>• Number and type of industries, <b>D</b></li> <li>• Demand for products that yield more waste, <b>D</b></li> <li>• Rate of growth of manufacturing industry (Investment levels) , <b>D</b></li> <li>• Generation rate, <b>P</b></li> <li>• Collection rate, <b>P</b></li> <li>• Amount of waste disposed, <b>P</b></li> <li>• Type of waste generated, <b>P</b></li> <li>• Consumption patterns, <b>P</b></li> <li>• Number of street Vendors, <b>P</b></li> <li>• Amount of uncollected waste, <b>S</b></li> <li>• Amount of waste disposed at unauthorized places, <b>S</b></li> <li>• Number of households with access to waste management</li> </ul>				

	<p>services, <b>S</b></p> <ul style="list-style-type: none"> <li>• No of complaints regarding nuisances such as visual impacts, rodents &amp; other vermins or smell from uncollected waste , <b>I</b></li> <li>• Prevalence and incidences of communicable diseases, <b>I</b></li> <li>• No of disposal sites not complying to legislation on waste, <b>I</b></li> <li>• No of non compliances to water, air quality standards and other guidelines, <b>I</b></li> <li>• Aesthetic value of the dump sites, <b>I</b></li> <li>• Amount of waste reused, recycled, recovered, <b>R</b></li> <li>• Number of laws and regulations dealing with waste, <b>R</b></li> <li>• Increase in collection rates, <b>R</b></li> <li>• Ratio of receptacles for waste collection to number of people, <b>R</b></li> <li>• Number of appropriate technologies for waste recovery, reuse and recycling, <b>R</b></li> <li>• Amount of waste disposed of at designated areas, <b>R</b></li> <li>• No of communities actively participating in management of waste, <b>R</b></li> <li>• No of awareness campaigns leading to behavioral change, <b>R</b></li> <li>• No of designated disposal sites, <b>R</b></li> <li>• No of companies implementing waste minimization programmes, <b>R</b></li> <li>• No of monitoring and enforcement exercises, <b>R</b></li> <li>• No of licenses issued for generation, storage and transportation of waste, <b>R</b></li> <li>• No of companies trained and implementing cleaner production options, <b>R</b></li> </ul>				
<b>Rural-urban drift</b>	<ul style="list-style-type: none"> <li>• Poverty levels, <b>D</b></li> <li>• Employment rate in urban and rural areas, <b>D</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Access to services and infrastructure, <b>D</b></li> <li>• Distribution of industries and economic activity, <b>D</b></li> <li>• Incidences of natural disasters, <b>D</b></li> <li>▪ Number of people demanding basic social services such as land, water, schools, health , <b>P</b></li> <li>▪ Area of land de-gazetted for land settlement , <b>P</b></li> <li>▪ Government expenditure in urban areas compared to rural areas, <b>P</b></li> <li>▪ Change in population density , <b>S</b></li> <li>▪ Change in land use, <b>S</b></li> <li>▪ Number of unplanned settlements, <b>S</b></li> <li>▪ Reduction in quality of social amenities, <b>S</b></li> <li>▪ Number of people not in employment, <b>S</b></li> <li>▪ Percentage increase in waste generation, <b>S</b></li> <li>▪ Rate of urbanization, <b>S</b></li> <li>• Increased levels of HIV/AIDS, <b>I</b></li> <li>• Increase in social evils such as crime, prostitution, <b>I</b></li> <li>• Poor remuneration, <b>I</b></li> <li>• Increase in environmental degradation, <b>I</b></li> <li>• Peri-urban deforestation, <b>I</b></li> <li>• Increased amount of domestic energy consumption, <b>I</b></li> <li>• Distribution of social amenities, <b>R</b></li> <li>• Number of empowerment policies in place, <b>R</b></li> <li>• Number of laws and regulations, <b>R</b></li> <li>• Number of monitoring and enforcement exercises, <b>R</b></li> <li>• Number of economic reform policies, <b>R</b></li> <li>• Effective town and country planning, <b>R</b></li> </ul>				
<b>HOUSING</b>	<ul style="list-style-type: none"> <li>• Population growth rate, <b>D</b></li> <li>• Increased demand for housing, <b>D</b></li> <li>• Number of unplanned settlements, <b>S</b></li> <li>• Change in land use, <b>S</b></li> <li>• Area of degraded environment, <b>S</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Average household size, S</li> <li>• Number of housing units per population, S</li> <li>• Number of habitable housing units, S</li> <li>• Area of land degraded, I</li> <li>• Number of people living in poor sanitation, I</li> <li>• Levels of diseases related to poor sanitation, I</li> <li>• Housing policy, R</li> <li>• Economic policies, R</li> <li>• Number of people accessing improved housing units, R</li> <li>• Increase in housing density (high rise flats) , R</li> <li>• Number of housing units constructed over a period, R</li> <li>• Area of land available for housing units, R</li> </ul>				
<b>SANITATION</b>	<ul style="list-style-type: none"> <li>• Number of unplanned settlements, D</li> <li>• Rate of rural- urban migration, D</li> <li>• Population growth rate, D</li> <li>• Ratio of municipal sewage treatment facilities to population, S</li> <li>• No of people per onsite sanitation facility (e.g. pit latrine, septic tanks), S</li> <li>• No of people with access to proper sanitation, S</li> <li>• Percentage of population with access to safe drinking water, S</li> <li>• Morbidity (prevalence and incidence of waterborne diseases) , I</li> <li>• Levels of groundwater contamination, I</li> <li>• Proportion of wells contaminated, I</li> <li>• Mortality rate due to water borne diseases, I</li> <li>• Amount of money invested in infrastructure development &amp; service delivery, R</li> <li>• Policies on sanitation in place, R</li> <li>• Number of awareness campaigns in place, R</li> <li>• Number of monitoring inspections, R</li> </ul>				

	<ul style="list-style-type: none"> <li>• Proper planning of settlements, <b>R</b></li> </ul>				
<b>Noise Pollution</b>	<ul style="list-style-type: none"> <li>• GDP, <b>D</b></li> <li>• Population density, <b>D</b></li> <li>• Human Development Index, <b>D</b></li> <li>• Traffic density, <b>D</b></li> <li>• Number of industries in a given area, <b>D</b></li> <li>• Change in noise level, <b>S</b></li> <li>• Number and location of entertainment centers, <b>S</b></li> <li>• Number and location of bars and tavern, <b>S</b></li> <li>• Number of complaints on noise pollution, <b>S</b></li> <li>• Number of noise induced hearing loss cases, <b>I</b></li> <li>• No of occupational accidents attributed to noise, <b>I</b></li> <li>• Number of public awareness campaigns, <b>R</b></li> <li>• Enhanced town and city planning, <b>R</b></li> <li>• Traffic reducing measures, <b>R</b></li> <li>• Development and enforcement of regulations, <b>R</b></li> </ul>				
<b>INDICATORS FOR ATMOSPHERE</b>					
<b>Ambient Air quality/Climate Change</b>	<ul style="list-style-type: none"> <li>• Change in population density. <b>D</b></li> <li>• Emissions of NO<sub>x</sub>, SO<sub>x</sub> from industrial sources. <b>D</b></li> <li>• Fossil fuel combustion. <b>D</b></li> <li>• Percentage of households electrified. <b>D</b></li> <li>• Traffic density <b>D</b></li> <li>• Concentrations of NO<sub>x</sub>, CO, SO<sub>2</sub>, VOCs, POPs, Soot. <b>S</b></li> <li>• Trend in temperature variation, <b>S</b></li> <li>• GHG emissions, <b>S</b></li> <li>• Number of respiratory cases and other related diseases, <b>I</b></li> <li>• Number of eye irritation cases, <b>I</b></li> <li>• Existence of regulations and policies to minimize industrial/vehicular emissions. <b>R</b></li> <li>• Ratification and implementation of UNFCC and Kyoto Protocol, <b>R</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Number of public awareness activities in place, <b>R</b></li> <li>• Number of cleaner production technologies, <b>R</b></li> <li>• Control and elimination of Ozone Depleting Substances, <b>D</b></li> </ul>				
<b>INDICATORS FOR LAND</b>					
<b>Land Tenure</b>	<ul style="list-style-type: none"> <li>• Population growth rate. <b>D</b></li> <li>• GDP/Per capita income. <b>D</b></li> <li>• Demand for land measured by number of applications and size. <b>P</b></li> <li>• Direct Foreign Investment in industry and agriculture. <b>P</b></li> <li>• Land available for development. <b>P</b></li> <li>• Population density per land tenure type, <b>S</b></li> <li>• Percentage of land under different tenure systems</li> <li>• Access to land by groups (gender minorities and other minority groups-youth, people with disability etc.), <b>S</b></li> <li>• Change in land use. , <b>S</b></li> <li>• Animal/human conflicts, <b>I</b></li> <li>• Number of land disputes, <b>I</b></li> <li>• Crop yield per hectare, <b>I</b></li> <li>• Number of animals that can be supported per unit land area, <b>I</b></li> <li>• Policies on land tenure/ownership, <b>R</b></li> <li>• Land delivery system, <b>R</b></li> </ul>				
<b>Sustainable Land Use</b>	<ul style="list-style-type: none"> <li>• Percentage of contaminated sites, <b>D</b></li> <li>• Rate of fertilizers and agricultural chemicals application, <b>D</b></li> <li>• Arable land per capita, <b>D</b></li> <li>• Land area opened up per year for agricultural production, <b>D</b></li> <li>• Percentage land use, <b>S</b></li> <li>• Forest area as a percentage of land area, <b>S</b></li> <li>• Area under cultivation, <b>S</b></li> <li>• Change in crop yields, <b>I</b></li> </ul>				

	<ul style="list-style-type: none"> <li>• Loss of soil fertility, I</li> <li>• Loss of vegetation cover, I</li> <li>• Land tenure/ownership, R</li> <li>• Percentage of population who own land by group, R</li> <li>• Sustainable farming programmes, R</li> </ul>				
<b>Rangeland</b>	<ul style="list-style-type: none"> <li>• Stocking density,</li> <li>• Carrying capacity, S</li> <li>• Change in livestock unit per hectare per year, I</li> <li>• Change in vegetation cover, I</li> <li>• Number of land disputes, I</li> <li>• Strategies and education programmes, R</li> <li>• Expenditure on extension services, R</li> <li>• Livestock development programmes, R</li> </ul>				
<b>Land Degradation</b>	<ul style="list-style-type: none"> <li>• Uncontrolled forest fires, D</li> <li>• Deforestation, D</li> <li>• Area of land used for quarrying, D</li> <li>• Land area for mining, D</li> <li>• Land area for agriculture, D</li> <li>• Percentage land cover, S</li> <li>• Percentage of soils degraded (e.g. irrigation, erosion, use of pesticides), S</li> <li>• Loss of productive land (crop yield per unit area; livestock unit per hectare), I</li> <li>• Extent of land rehabilitated, R</li> <li>• Ratio of land being rehabilitated to total area of degraded land. R</li> <li>• Strategies and education programmes in place. R</li> <li>• Policies in place R</li> <li>• Implementation of the Convention to Combat Desertification (CCD). R</li> </ul>				