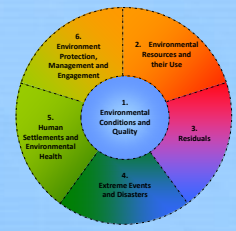
Data collection methods in Environment Statistics – Characteristics and Challenges

Prepared by the Environment Statistics Section, United Nations Statistics Division for National Technical Training Workshop on Environment Statistics
Windhoek, Namibia, 3 – 5 December 2019



This presentation has been elaborated by the Environment Statistics Section of the United Nations Statistics Division.

It is based on Chapter 1 of the Framework for the Development of Environment Statistics (FDES) 2013 that can be downloaded here:
https://unstats.un.org/unsd/environment/FDES/FDES-2015-supporting-tools/FDES.pdf

Table of Contents

1. Main users of environment statistics

The type, the level of thematic, spatial and temporal aggregation, and the format of environment statistics depend on the type of user and the intended purpose of use.

Users	Main Types of Environment Statistics
Policy and Decision Makers	**Environmental indicators and more aggregated statistics**
General Public (including media and civil society)	**Environmental indicators and more aggregated statistics**
Analysts, Researchers, and Academia	**Extensive and detailed environment statistics**

Products of Environment Statistics

Common products of environment statistics are:

- Detailed descriptive environment statistics series
- Environmental indicators

Both can be:

- Stored in multi-purpose databases
- Disseminated in the form of:
  - Online databases
  - Publications (e.g. compendia, yearbooks)
  - Thematic reports
  - Analytical publications (e.g.,state of the environment reports)

2. Environmental information, data, statistics and indicators

Examples of quantitative environmental information
Environmental data
Environment statistics
Environmental indicators
Environmental indices
Environmental-economic accounts

2. Environmental information, data, statistics and indicators

Environmental information

- Environmental information describes quantitative, qualitative or geographically referenced facts representing the state of the environment and its changes.
- **Quantitative environmental information**
  - **Consists of data, statistics and indicators and is generally disseminated through databases, spreadsheets, compendia and yearbook type products.**
- Qualitative environmental information
  - Consists of descriptions (e.g. textual, pictorial) of the environment or its constituent parts that cannot be adequately represented by accurate quantitative or geographically referenced descriptors.
- Geographically referenced environmental information
  - Provides facts on the environment and its components using digital maps, satellite imagery and other sources linked to a location or map feature.

2. Environmental information, data, statistics and indicators

Environmental data

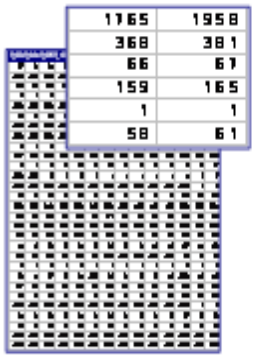
- Environmental data are large amounts of unprocessed observations and measurements about the environment (or its components) and related processes.
- They can be collected or compiled by:
  - NSOs, environmental ministries, sectoral authorities (water, forest, mining, etc.)
  - Using different types of sources:
    - Statistical surveys (censuses or sample surveys)
    - Administrative records, registers, and inventories
    - Monitoring networks, remote sensing, scientific research, and field studies.

Environment statistics

- Environment statistics structure, synthesize and aggregate environmental and other data according to statistical methods, standards and procedures.
- Environment statistics process environmental data into meaningful statistics describing the state and trends of the environment and the main processes affecting it.
- Not all environmental data are used in the production of environment statistics.
  - The FDES provides a framework that identifies environmental data that fall within its scope
  - The FDES contributes to structuring, synthesizing and aggregating data into statistical series and indicators

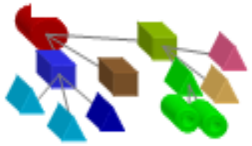
	LINK Transaction Volumes (millions)				
Month	2007	2008	2009	2010	2011
Jan	208.00	214.00	224.90	224.00	232.90
Feb	204.50	224.00	216.40	224.20	229.90
Mar	236.10	234.00	245.20	253.90	259.79
Apr	226.30	232.00	241.06	252.20	259.70
May	237.90	251.50	255.19	262.00	262.20
Jun	233.80	235.90	246.00	255.00	257.48
Jul	231.60	244.70	251.30	266.70	268.04
Aug	236.00	244.21	247.60	256.30	259.24
Sep	229.00	237.22	244.00	253.30	260.52
Oct	239.00	250.40	260.20	263.10	268.06
Nov	234.00	236.70	241.00	246.60	
Dec	230.00	237.20	244.00	242.00	
Total	2,746.20	2,841.83	2,916.85	2,999.30	2,557.83

Environment statistics units compile, collect, validate, describe and structure environmental data to produce environment statistics series



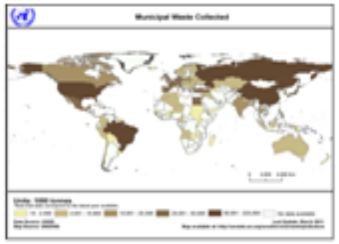
Data & Microdata

Validation



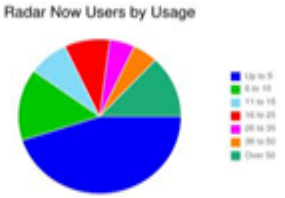
Structure

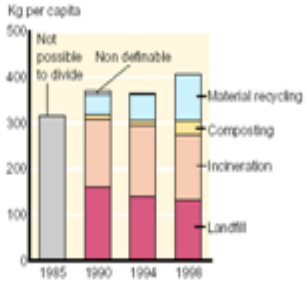
Metadata (description)



Statistics (Compendia & Databases)

Statistics, selection & processing





Indicators

Statistical process: from raw data to statistics and indicators

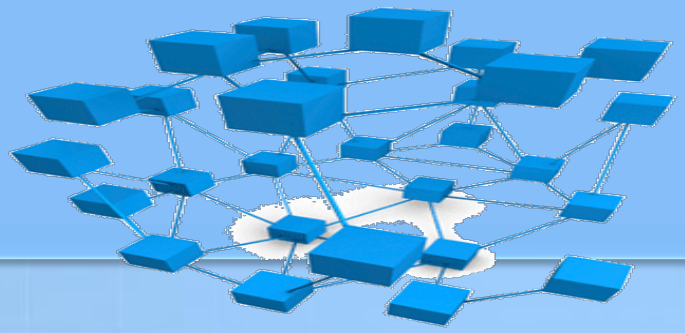
Environmental indicators

- Environmental indicators:
  - are environment statistics that are in need of further processing and interpretation. Environment statistics are usually too numerous and detailed to satisfy the needs of policy makers and the general public
- Environmental indicators:
  - Synthesize and present complex statistics
  - Are measures that summarize, simplify and communicate information
  - Define objectives, assess present and future direction with respect to goals and targets
  - Evaluate specific programmes, demonstrate progress, measure changes in a specific condition or situation over time.
  - Determine impact of programmes and conveying messages.

Policy frameworks such as the S**ustainable Development Goal indicator framework** are used for the identification and structuring of indicators

3. Sources of environment statistics

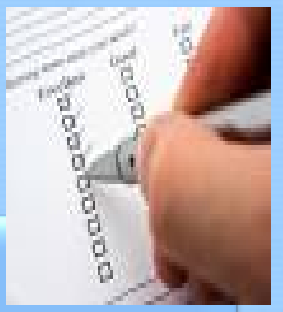
- Environment statistics synthesize data originating from a wide range of source types.
- Data used for the production of environment statistics are compiled by many different collection techniques and institutions.
- Understanding and knowing pros and cons of each source is key in environment statistics production



Types of sources

1. Statistical surveys (i.e., censuses or sample surveys of population, housing, agriculture, enterprises, households, employment, and different aspects of environment management)
2. Administrative records of government and non-government agencies in charge of natural resources as well as other ministries or authorities
3. Remote sensing and thematic mapping (i.e., satellite imaging of land use, water bodies or forest cover)
4. Monitoring systems (i.e., field-monitoring stations for water quality, air pollution, temperature, etc.)
5. Scientific research and special research projects undertaken to fulfill national or international demand

3. Sources of environment statistics



Statistical Surveys

(a) **Censuses**: collection of data from the entire population of interest

(b) **Sample Surveys**: carried out using a sampling method, in which data are collected from a representative portion of the population of interest

Environment statistics can be collected from surveys by:

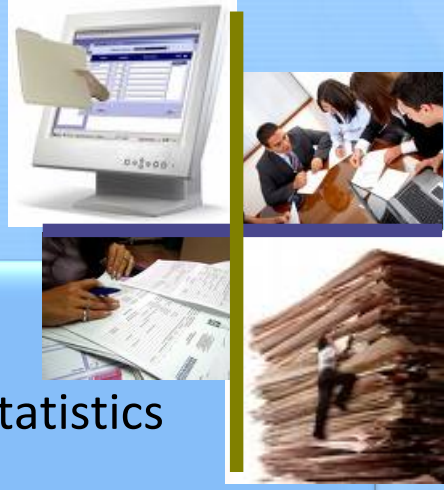
(i) adding environment-related questions (modules) to surveys primarily intended to collect data on other topics

(ii) using surveys primarily intended to collect environment statistics

When environmental data are collected through environment statistics surveys, the survey is designed according to its objective of producing environment statistics.

- Environment statistics surveys are not always feasible or economical with restricted budgets
- Many environment-related surveys and censuses are available at: https://unstats.un.org/unsd/envstats/censuses/

3. Sources of environment statistics



Administrative records

Administrative data kept by **government agencies and other organizations** may be used for the production of environment statistics

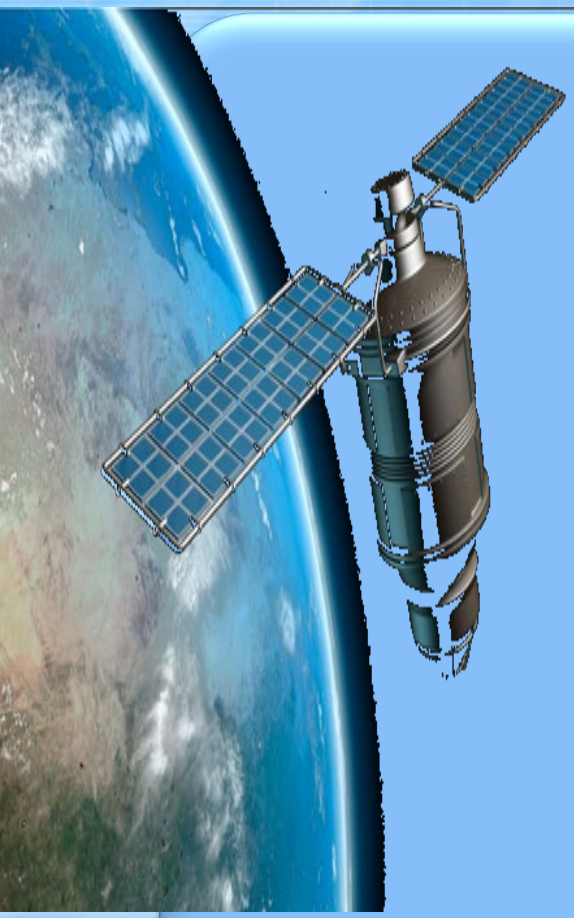
Advantage:

- Cost of collecting such data is significantly less than establishing and conducting a survey
- Level of response burden is minimized
- Complete coverage is assured of units under administration

Possible Limitations:

- Differences between administrative and statistical terms and definitions
- Risk of deliberate misreporting
- Data may not be checked or validated for statistical purposes; there may be restrictions of access to the data
- Coverage of data, though complete for administrative purposes, might not match statistical requirements

Remote Sensing and Thematic Mapping



Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites.

Remote sensing makes it possible to:

- Collect data on dangerous or inaccessible areas
- Replace costly and slow data collection on the ground, ensuring in the process that areas or objects are not disturbed

- Uses: satellite, aircraft, spacecraft, buoy, ship, balloon and helicopter images
- Result can be: mapped, imaged, tracked and observed

Example:

Remote sensing data can be captured and analyzed to measure forest cover, compare the impact of natural disasters, changes in the area of soil erosion, the extension of pollution, changes in land cover **or** population estimates of different animal species.

3. Sources of environment statistics

Monitoring systems

Typically comprised of **field-monitoring stations** which are used to describe the qualitative and quantitative aspects of environmental media, i.e. air, water or soil quality; hydrological or meteorological parameters and characteristics.

Main advantages of these data are that they are:

(i) Usually collected using verifiable scientific methods
(ii) Usually validated
(iii) Often available as time series
(iv) Frequently use modeling to improve data quality

Possible limitations of data from monitoring systems are:

- Field-monitoring stations are usually located in "hot-spot" areas where there are
  (i) high levels of pollution
  (ii) highly sensitive areas
  (iii) large numbers of the population are affected

Consequently, the measurements will be location-specific and due to the limitations of their representativeness, they are difficult to aggregate over space

3. Sources of environment statistics

Scientific Research

Main advantages of using data from scientific research and special projects are:

(i) these data are usually available for free or for low cost

(ii) they minimize response burden

(iii) they can be used to fill in data gaps

(iv) they are useful for developing coefficients for models

Possible limitations of using these sources include:

(i) they often use terms and definitions that differ from those used in statistics

(ii) access to microdata may be limited

(iii) metadata may be missing

(iv) often data are available only for case examples (i.e. limited areas or industries)

(v) often data are available on a one-time basis

4. Institutional dimension of environment statistics

- The institutional dimension can be as important as technical capacity when developing environment statistics at the national level.
- Given the multi-disciplinary and cross-cutting nature of environment statistics, the production of environmental data and statistics involves numerous stakeholders, actors and producers.
- Insufficient institutional development, overlapping mandates and functions, inadequate interagency coordination and other institutional issues are very common in many countries.

These limitations also exist at international level: multiple partner agencies operate with different mandates, work programmes, and production timetables.

4. Institutional dimension of environment statistics

Resolving institutional concerns

- Identifying the primary institutional obstacles that impede the production of environment statistics and developing a strategy to overcome these is vital for countries keen on developing or strengthening their environment statistics programmes.
- Key elements pertaining to the institutional dimension:
  - The legal framework, clear mandate, clear Memoranda of Understanding
  - Institutional development
  - Inter-institutional collaboration
  - Institutional cooperation of national, regional and global bodies
- Applying the Environment Statistics Self-Assessment Tool (ESSAT) can help in this regard: https://unstats.un.org/unsd/envstats/fdes/essat.cshtml

4. Institutional dimension of environment statistics

Institutional development

- A well defined mandate and a specific unit in charge of carrying out the production of environment statistics is critical for the successful organization of a national environment statistics programme within the official institutions responsible for the production of statistics.

- This unit requires a regular budget for operations and a minimum number of trained personnel for the tasks entailed.

It is ideal for environment statistics units to have a capacity building programme for staff.

4. Institutional dimension of environment statistics

Inter-institutional collaboration

Institutions and people

- Environment statistics cover several topics for which the data are being generated by NSOs, specialized agencies, ministries, provincial and municipal governments and scientific institutions.
- Inherent to environment statistics: collaboration of these stakeholders, both at the strategic and technical level.

4. Institutional dimension of environment statistics

Inter-institutional collaboration

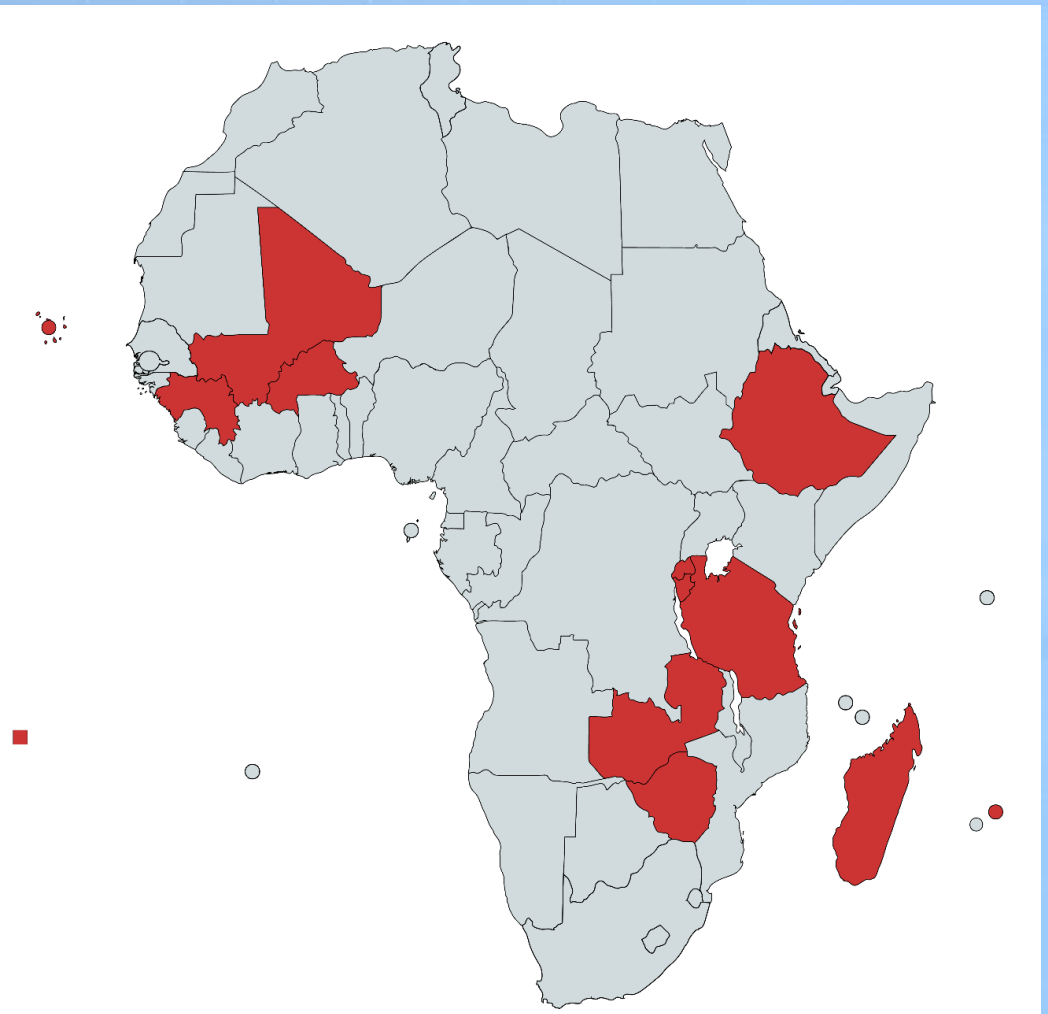
- Formalized by inter-agency platforms/committees tasked with coordinating the production of environment statistics: brings together all institutions that produce and use environmental data and statistics.
- One of the tasks of the platform is to ensure that common statistical methodology, protocols and tools are being used to ensure comparability and statistical soundness. Another relevant function is to preserve continuity over time, despite significant turnover of staff in the different partner institutions.
- Depending on the institutional set-up, in many developing countries the coordination role in such platforms lies with the NSO or the environmental ministry or equivalent institution.
- The NSO, if tasked with overseeing the national statistical system and coordinating these platforms, must have adequate authority, resources or capacities to lead the multi-stakeholder processes.

Compilation of Environment Statistics

How can we move from the existence of data sources spread across institutions to well compiled environment statistics?

Compilation of Environment Statistics

Let us look at some successful cases among African countries…



Burkina Faso
Burundi
Cabo Verde
Ethiopia
Guinea
Madagascar
Mali
Mauritius
Rwanda
United Republic of Tanzania
Zambia
Zimbabwe

All compendia are available at: https://unstats.un.org/unsd/envstats/fdescompendia.shtml and on each country's respective website.

ZimStat
Zimbabwe National Statistics Agency

FRAMEWORK FOR THE DEVELOPMENT OF ENVIRONMENT STATISTICS (FDES) IN ZIMBABWE

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ANNUAIRE DES STATISTIQUES DE L'ENVIRONNEMENT

2013

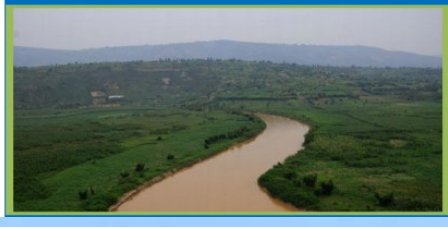
Edition juin 2015

Rwanda Environment Management Authority (REMA)

REMA

Rwanda Compendium of Environment Statistics, 2018

February 2019



COMPENDIUM OF ENVIRONMENT STATISTICS, 2015

Published by

Central Statistical Office,
P. O. Box 31908, Lusaka, Zambia.

Tel: 260-1-251377/253468
Fax: 260-1-253468

E-mail: info@zamstats.gov.zm

Website: www.zamstats.gov.zm

04 April 2018

Vol. 14

Ministry of Finance and Economic Development

Statistics Mauritius

Digest of Environment Statistics

2015

November 2016
(Price Rs 200)

REPUBLIQUE DU MALI
Un Peuple – Un But – Une Foi

Ministère de la Planification, de l'Aménagement du Territoire et de la Population

Institut National de la Statistique

RECUEIL DES DONNEES SISE

Recueil de données du système d'informations statistiques environnementales (SISE 2010-2015)

Edition d'octobre 2016

Statistics Sweden
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MINISTERE DU PLAN ET DU DEVELOPPEMENT ECONOMIQUE

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ANNUAIRE DES STATISTIQUES DE L'ENVIRONNEMENT

2016

COMPENDIUM OF ENVIRONMENT STATISETICS

ETHIOPIA

2016

(FIRST EDITION)

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
NATIONAL PLANNING COMMISSION
CENTRAL STATISTICAL AGENCY

September/ 2017
Addis Ababa. Ethiopia

All known compendia available here: https://unstats.un.org/unsd/envstats/fdescompendia.cshtml

Compendiums:

- Burkina Faso, Yearbook of Environmental Statistics, 2013, French - PDF Background Link
- Burkina Faso, Yearbook of Environmental Statistics, 2012, French - PDF Background Link
- Burundi, Directory of Statistics of the Burundi Environment, 2016, French - PDF Background Link
- Burundi, Directory of Statistics of the Burundi Environment, 2015, French - PDF Background Link
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- Mali, Information system data collection - Environmental statistics, 2016, French - PDF Background Link
- Mauritius, Digest of Environment Statistics, 2015 - PDF Background Link
- Nepal, Environment Statistics of Nepal, 2019 - PDF Background Link
- Nepal, Compendium of Environment Statistics, 2015 - PDF Background Link

Typical content of a compendium…

- Preamble
- Acknowledgements
- List of tables
- List of figures
- Abbreviations
- Introduction
- Methodology

Component 1: Environmental Conditions and Quality
Component 2: Environmental Resources and Their Use
Component 3: Residuals
Component 4: Extreme events and disasters
Component 5: Human settlements and environmental health
Component 6: Environmental protection, management and engagement

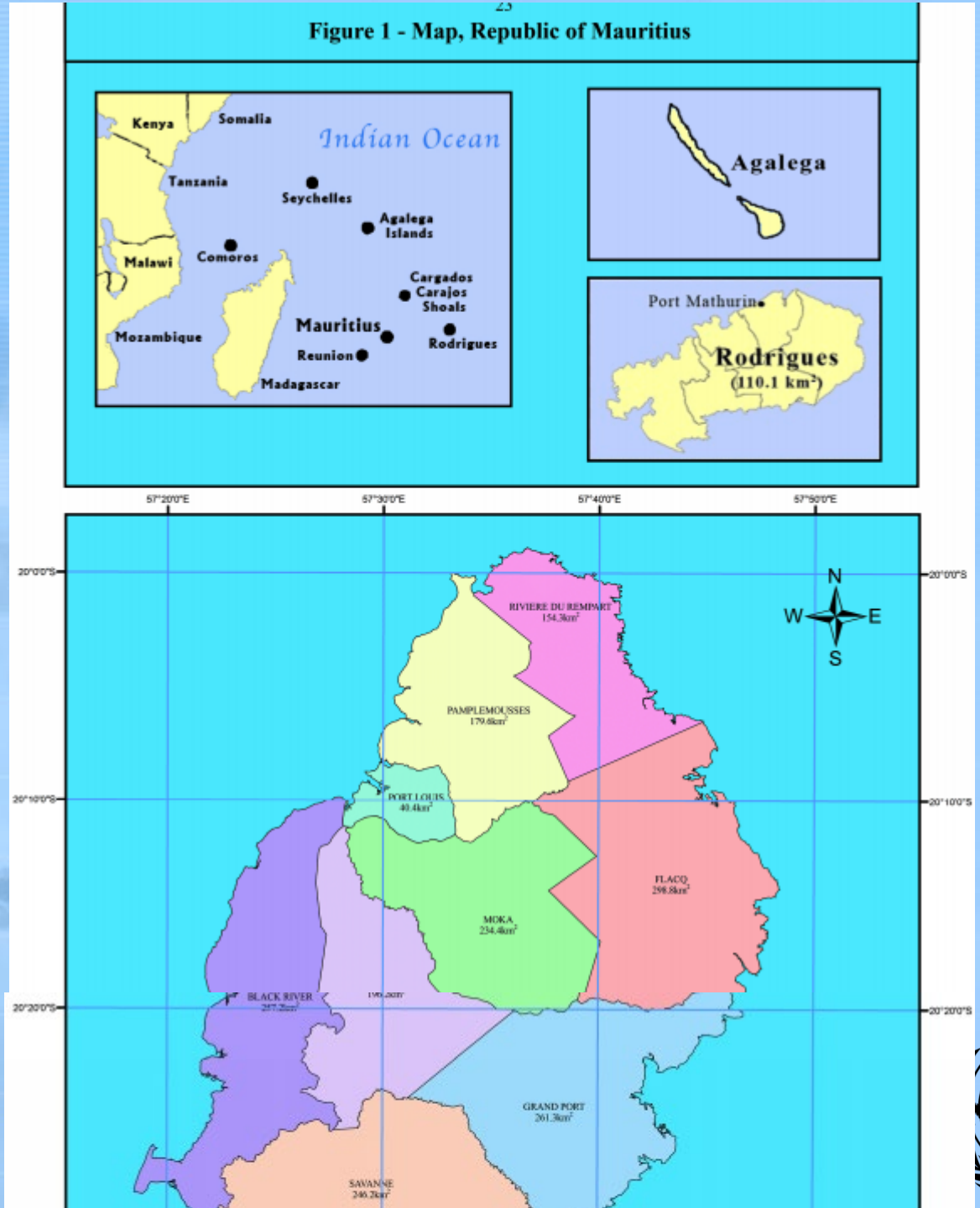
- References

All of the above undertaken per the situation and needs of The Namibia

Demonstration of the Mauritian example…

Contents

Demonstration of the Mauritian example… use of maps



Demonstration of the Mauritian example: descriptive text to complement data…

1.2 Temperature

In 2015, December was the warmest month in the Island of Mauritius with a mean of 26.7˚C and July, the coolest month with a mean of 21.5˚C (Table 1.2).

The mean maximum temperature was above the long term mean (1981-2010) for all the months of 2015 except for January and February. On the other hand, the mean minimum temperature was above the long term mean for all the months of 2015except for February which was same (Tables1.3&1.4).

The highest maximum temperature was 35.4˚C, recorded on 28February 2015 at Champs De Mars, Port Louis. The lowest minimum temperature was 9.7˚C, which was recorded on 7July 2015 at Mon Desir Alma.

1.3 Precipitation

During the year 2015, the mean amount of rainfall recorded around the Island of Mauritius was 2,377 millimetres (mm), representing an increase of 13.5% compared to 2,094 mm in 2014 and an increase of 18.7% compared to the long term mean (1981-2010) of 2,003 mm (Table 1.5).

Demonstration of the Mauritian example: descriptive text to complement data…

Table 1.2 Monthly Mean temperature, 2006 - 2015

Degrees celcius

Year \ Month	Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept		Oct		Nov		Dec		Mean annual temperature	
	LTM [1] (26.1)		LTM (26.2)		LTM (25.8)		LTM (24.9)		LTM (23.2)		LTM (21.4)		LTM (20.6)		LTM (20.7)		LTM (21.3)		LTM (22.3)		LTM (23.9)		LTM (25.3)		LTM (23.5)	
	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM	Mean	Difference from LTM
2006	25.8	*-0.2*	26.0	*-0.2*	25.9	*0.2*	25.2	*0.3*	23.1	*-0.1*	22.2	*0.8*	20.7	*0.1*	20.4	*-0.2*	21.4	*0.1*	22.5	*0.2*	24.5	*0.6*	26.2	*0.9*	23.7	*0.2*
2007	26.8	*0.7*	26.6	*0.4*	25.6	*-0.1*	25.2	*0.3*	23.7	*0.5*	21.3	*-0.1*	21.3	*0.7*	20.9	*0.3*	21.6	*0.3*	22.3	*0.1*	24.1	*0.3*	25.8	*0.6*	23.8	*0.3*
2008	26.1	*0.0*	26.2	*-0.1*	25.3	*-0.5*	25.0	*0.1*	23.1	*-0.1*	21.3	*-0.1*	20.4	*-0.2*	21.3	*0.6*	21.8	*0.5*	22.8	*0.5*	24.7	*0.8*	25.9	*0.7*	23.6	*0.1*
2009	26.9	*0.8*	26.8	*0.6*	26.2	*0.4*	25.8	*0.9*	23.8	*0.6*	22.4	*1.0*	21.0	*0.4*	20.9	*0.3*	21.5	*0.3*	23.0	*0.7*	24.2	*0.3*	25.8	*0.6*	24.0	*0.5*
2010	26.4	*0.4*	26.9	*0.7*	26.5	*0.7*	25.3	*0.4*	24.4	*1.2*	22.8	*1.4*	21.0	*0.4*	20.8	*0.2*	21.4	*0.1*	23.2	*1.0*	23.8	*0.0*	25.3	*0.1*	24.0	*0.5*
2011	26.2	*0.1*	26.6	*0.4*	26.1	*0.3*	25.5	*0.6*	23.7	*0.5*	22.9	*1.5*	21.4	*0.8*	21.1	*0.4*	21.8	*0.6*	22.9	*0.6*	24.8	*0.9*	25.5	*0.3*	24.0	*0.5*
2012	26.0	*0.0*	27.0	*0.8*	26.0	*0.3*	25.5	*0.6*	23.3	*0.1*	21.6	*0.2*	21.4	*0.8*	21.3	*0.7*	21.8	*0.5*	23.2	*0.9*	24.8	*0.9*	26.3	*1.0*	24.0	*0.5*
2013	26.4	*0.4*	26.7	*0.5*	26.1	*0.4*	25.0	*0.1*	23.0	*-0.2*	21.6	*0.2*	20.5	*-0.1*	21.1	*0.5*	22.2	*0.9*	23.6	*1.3*	24.6	*0.7*	25.9	*0.6*	23.9	*0.4*
2014	26.7	*0.6*	26.8	*0.6*	26.4	*0.6*	25.3	*0.4*	23.5	*0.3*	22.4	*1.0*	22.0	*1.4*	21.6	*0.9*	22.0	*0.7*	24.2	*2.0*	25.5	*1.6*	26.4	*1.1*	24.4	*0.9*
2015	26.4	*0.3*	26.2	*0.0*	26.0	*0.2*	25.3	*0.4*	24.0	*0.8*	22.7	*1.3*	21.5	*0.9*	21.6	*0.9*	22.1	*0.8*	23.7	*1.4*	24.5	*0.6*	26.7	*1.4*	24.2	*0.7*

Source: Mauritius Meteorological Services

[1] LTM: Long term mean, 1981-2010

Demonstration of the Mauritian example: descriptive text to complement data…

Table 1.5 - Mean annual rainfall [1] by region, 2006 - 2015

Region		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
West LTM [2] (912 mm)	Mean (mm)	740	1,012	1,154	1,200	609	1,050	631	971	906	1,242
	% of LTM	81	111	131	137	69	115	69	106	99	136
North LTM (1,294 mm)	Mean (mm)	1,463	1,094	1,645	1,688	1,062	1,443	963	1,262	1,264	1,386
	% of LTM	113	85	120	123	78	111	74	97	98	107
South LTM (2,572 mm)	Mean (mm)	2,200	2,355	2,943	2,828	2,400	2,213	1,996	2,668	2,607	2,958
	% of LTM	86	92	113	109	93	86	78	104	101	115
East LTM (2,568 mm)	Mean (mm)	2,646	2,736	2,999	3,155	2,756	2,794	2,289	2,716	2,758	2,959
	% of LTM	103	107	124	130	114	109	89	106	107	115
Centre LTM (2,568 mm)	Mean (mm)	2,433	2,744	3,043	2,959	2,153	2,228	2,158	2,898	2,833	3,238
	% of LTM	95	107	116	113	82	87	84	113	110	126
Whole Island LTM (2,003 mm)	Mean (mm)	1,914	1,946	2,381	2,383	1,806	1,948	1,621	2,126	2,094	2,377
	% of LTM	96	97	120	120	91	97	81	106	105	119

Source: Mauritius Meteorological Services

[1] Average of 23 stations for different regions

[2] LTM : Long Term Mean, 1981 - 2010

Demonstration of the Mauritian example: some (country-owned) definitions of terms used…

4. Extreme Events and Disasters

Warnings: The tropical cyclone warning system in Mauritius is as follows:

Class I: Issued 36 to 48 hours before Mauritius or Rodrigues is likely to be affected by gusts reaching 120 km/hr.

Class II: Issued so as to allow, as far as practicable, 12 hours of daylight before the occurrence of gusts of 120 km/hr.

Class III: Issued so as to allow, as far as practicable, 6 hours of daylight before the occurrence of gusts of 120 km/hr.

Class IV: Issued when gusts of 120 km/hr have been recorded and are expected to continue to occur.

Termination: Issued when there is no longer any appreciable danger of gusts exceeding 120 km/hr.

Demonstration of the Mauritian example: abbreviations used throughout…

ABBREVIATIONS AND SYMBOLS

Abbreviations

a.m.s.l	above mean sea level
%	Percentage
000	Thousand
c.i.f	Cost, insurance, freight
CFU/ ml	Colony-forming unit per millilitre
EIA	Environmental Impact Assessment
f.o.b	free on board
Gg	Gigagram (thousand tonnes)
GWh	Gigawatt hour (million kWh)
hPa	Hectopascal
IUCN	International Union for Conservation of Nature
ktoe	Thousand tonnes of oil equivalent
kWh	Kilowatt hour
LPG	Liquefied Petroleum Gas
mm	Millimetre
m^3	Cubic metres
Mm^3	Million cubic metres
n.e.s	Not elsewhere specified
NPCS	National Parks and Conservation Service
PER	Preliminary Environmental Report
Rs	Rupees
Rs mn	Rupees million
Toe	Tonne of oil equivalent
TSP	Total suspended particles
ug/m^3	Micrograms per cubic metre
mg/l	Milligram per litre
ug/l	Micrograms per litre

The value of an Environment Statistics Compendium

- Data and information can be shared with the public to inform perception and debate
- Data are more readily accessible to researchers, policy analysts, key decision makers
- The Namibia is in ownership of its own data
- A compendium is a natural follow-up to an assessment (e.g. if a country applies the Environment Statistics Self-Assessment Tool (ESSAT))
- Compendium serves as a tool of coordination among the Statistical Office and ministries/agencies
- Behind the scenes of a glossy compendium, there is invariably a database or several databases on several environmental themes which can be developed in the long-term
- Compendium can improve quality of data

Process toward realising an Environment Statistics Compendium

- Following an assessment, identification of who (which institution) collects data; at what periodicity; via which data collection instrument (survey/ monitoring station/ administrative data) etc. can be made
- Data may be centrally collected and compiled into a compendium by the NSO in collaboration with key stakeholders
- A National Committee on Environment or similar committee can provide forum for conversation between NSO and ministries/agencies