FRAMEWORK FOR THE DEVELOPMENT OF ENVIRONMENT STATISTICS (FDES 2013)

United Nations


1.
Environmental Conditions and Quality
2.
Environmental Resources and their Use
3.
Residuals
4.
Extreme Events and Disasters
5.
Human Settlements and Environmental Health
6.
Environmental Protection, Management and Engagement

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Preface

This publication presents the Framework for the Development of Environment Statistics (FDES 2013), which is the revised version of the original FDES published in 1984 by the United Nations Statistics Division (UNSD). The United Nations Statistical Commission, at its forty-first session (23-26 February 2010), endorsed a work programme and the establishment of an Expert Group for the revision of the FDES and the development of a Core Set of Environment Statistics, taking into account the scientific, political, technological, statistical and experience-based developments of recent decades.

The United Nations Conference on Sustainable Development (Rio+20, June 2012) outcome document, "The Future We Want",[1] includes several references to the importance of environmental data, information and indicators. The FDES 2013 is expected to contribute significantly to improved monitoring and measurement of the environmental dimension of sustainable development and the post-2015 development agenda. The use of the FDES 2013 in national statistical systems will enhance developments in this field of statistics, as it is a multipurpose and flexible tool that can be tailored to address specific environmental policy concerns and priorities of countries, and can accommodate their levels of statistical development.

[1] United Nations (2012). Rio+20 outcome document, "The Future We Want", available from https://sustainabledevelopment.un.org/futurewewant.html (accessed 4 August 2017).

The FDES 2013 covers issues and aspects of the environment that are relevant for analysis, policy- and decision-making. It is designed to assist all countries in the formulation of environment statistics programmes by (i) delineating the scope of environment statistics and identifying its constituents; (ii) contributing to the assessment of data requirements, sources, availability and gaps; (iii) guiding the development of multipurpose data collection processes and databases; and (iv) assisting in the coordination and organization of environment statistics, given the inter-institutional nature of the domain.

The revision of the FDES was undertaken as part of UNSD's work programme on environment statistics. The Expert Group on the Revision of the FDES assisted UNSD in implementing the revision process. The United Nations Statistical Commission at its forty-fourth session (28 February-1 March 2013) endorsed the FDES 2013 as the framework for strengthening environment statistics programmes in countries, and recognized it as a useful tool in the context of sustainable development goals and the post-2015 development agenda.

Acknowledgements

The revised Framework for the Development of Environment Statistics (FDES 2013) consolidates the experience of countries and international organizations in the field of environment statistics. It has been developed in close collaboration with the Expert Group on the Revision of the FDES, which reviewed successive drafts of the FDES 2013 and commented on the issue papers drafted by the United Nations Statistics Division (UNSD), other experts who provided advice on specific subjects, as well as countries and organizations that took part in the Pilot Test of the Core Set of Environment Statistics and responded to the Global Consultation of the final draft of the FDES 2013. The revision was a complex process that entailed organizing the substantive contributions and participation of experts, countries and organizations from around the world at different stages of the process over a three-year period.

The Expert Group on the Revision of the FDES contributed valuable input throughout the process and, in particular, during the expert group meetings. It collaborated in the drafting process and revised various versions of the chapter and document drafts. Members of the Expert Group from national statistical offices and environmental ministries/agencies included Gemma Van Halderen, Michael Vardon and Mark Lound (Australia); Michael Nagy (formerly Austria, currently Qatar); Abul Kalam Azad (Bangladesh); Edgar Ek (Belize); Ditshupo Gaobotse (Botswana); Ricardo Moraes and Wadih Neto (Brazil); Carolyn Cahill, Andrew Ferguson and Robert Smith (Canada); Yixuan Wang (China); Iva Ritchelova (Czech Republic) who acted as Chair of the Expert Group; Kaia Oras (Estonia); Leo Kolttola (Finland); Fanta Kaba (Guinea); Sekhar Jeyalakshmi (India); Wynandin Imawan (Indonesia); Cesare Costantino (Italy); Janet Geoghagen-Martin (Jamaica); Soh Wah Lim (Malaysia); Chitranjan Ramnath and Anand Sookun (Mauritius); Jesús Romo-García and Adriana Oropeza-Lliteras (Mexico); Hendrik Jan Dijkerman (Netherlands); Philip Olatunde Bankole (Nigeria); Torstein Arne Bye and Svein Homstvedt (Norway); Raymundo Talento (Philippines); Kok Chew Cheang (Singapore); Andreas Talea (Suriname); Khamis Raddad (United Arab Emirates); Richard Guldin and William Sonntag (United States). Members from international organizations included: Jochen Jesinghaus (European Commission); Jean-Louis Weber (European Environment Agency (EEA)); Christian Heidorn (Statistical Office of the European Union—Eurostat), Rolf Luyendijk (United Nations Children's Fund (UNICEF)); Ashbindu Singh (United Nations Environment Programme (UNEP)); Robert Mayo, Mike Robson and Carola Fabi (Food and Agriculture Organization of the United Nations (FAO)); Matthias Bruckner (United Nations Department of Economic and Social Affairs (UN-DESA); Kristina Taboulchanas (United Nations Economic Commission for Latin America and the Caribbean (UNECLAC)); Peter Harper (Chair of the UN Committee of Experts on Environmental-Economic Accounting (UNCEEA)). Experts from non-governmental organizations included: Marc Levy (Center for International Earth Science Information Network (CIESIN), Columbia University); Robin O'Malley (Heinz Center for Science, Economics and Environment); and Christian Layke (World Resources Institute (WRI)).

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List of acronyms and abbreviations

AEI	agri-environmental indicator
BIP	Biodiversity Indicators Partnership
BOD	biochemical oxygen demand
CBD	Convention on Biological Diversity
CEA	Classification of Environmental Activities
CEPA	Classification of Environmental Protection Activities
CES	Conference of European Statisticians
CICES	Common International Classification of Ecosystem Services
CIESIN	Center for International Earth Science Information Network
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COD	chemical oxygen demand
COP	Conference of the Parties
CPC	Central Product Classification
CRED EM-DAT	Centre for Research on the Epidemiology of Disasters Emergency Events Database
CSD	Commission on Sustainable Development
DALY	disability-adjusted life year
DDT	dichlorodiphenyltrichloroethane
DPSIR	Driving force-Pressure-State-Impact-Response framework
DSR	Driving force-State-Response framework
ECOWAS	Economic Community of West African States
EEA	European Environment Agency
EEZ	exclusive economic zone
EGSS	Environmental Goods and Services Sector
EMEP	European Monitoring and Evaluation Programme
ESM	environmentally sound management
FAO	Food and Agriculture Organization of the United Nations
FDES	Framework for the Development of Environment Statistics
FRA	Forest Resources Assessment
GEO	Global Environment Outlook

GHG	greenhouse gas
GIS	geographic information system
GLASOD	Global Assessment of Human-induced Soil Degradation
GMOs	genetically modified organisms
GPS	Global Positioning System
HS	Harmonized Commodity Description and Coding System
IEA	International Energy Agency
IEMO	International Emergency Management Organization
IIASA	International Institute for Applied Systems Analysis
IISD	International Institute for Sustainable Development
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IRES	International Recommendations for Energy Statistics
IRWS	International Recommendations for Water Statistics
ISIC	International Standard Industrial Classification of All Economic Activities
ISRIC	International Soil Reference and Information Centre
ISSCAAP	International Standard Statistical Classification of Aquatic Animals and Plants
ITTO	International Tropical Timber Organization
IUCN	International Union for Conservation of Nature and Natural Resources
IUU	illegal, unreported and unregulated
IWRM	Integrated Water Resources Management
LCCS	Land Cover Classification System
MAR	Monitoring, Assessment and Reporting
MDGs	Millennium Development Goals
MEA	Multilateral Environmental Agreement
NASA	National Aeronautics and Space Administration
NGO	non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NSO	National statistical office
ODS	ozone-depleting substance
OECD	Organisation for Economic Co-operation and Development
PCB	polychlorinated biphenyl
PM	particulate matter (also known as suspended particulate matter)
POP	persistent organic pollutant
PSR	Pressure-State-Response framework

SDGs	Sustainable Development Goals
SDIs	sustainable development indicators
SEEA	System of Environmental-Economic Accounting
SEEA-CF	System of Environmental-Economic Accounting Central Framework
SIDS	Small Island Developing States
SIEC	Standard International Energy Product Classification
SNA	System of National Accounts
SPM	suspended particulate matter (also known as particulate matter)
S-RESS	Stress Response Environment Statistics System
TEEB	The Economics of Ecosystems and Biodiversity
TFSD	OECD Task Force on Measuring Sustainable Development
UNCCD	United Nations Convention to Combat Desertification
UNCED	United Nations Conference on Environment and Development
UNCSD	United Nations Conference on Sustainable Development
UNCEEA	United Nations Committee of Experts on Environmental-Economic Accounting
UNCLOS	United Nations Convention on the Law of the Sea
UN-DESA	United Nations Department of Economic and Social Affairs
UNECA	United Nations Economic Commission for Africa
UNECE	United Nations Economic Commission for Europe
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
UNEP	United Nations Environment Programme
UNEP GEMS	United Nations Environment Programme Global Environment Monitoring System
UNEP-WCMC	United Nations Environment Programme-World Conservation Monitoring Centre
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Science and Cultural Organization
UNFC	United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources
UNFCCC	United Nations Framework Convention on Climate Change
UNFF	United Nations Forum on Forests
UNFPA	United Nations Population Fund
UNGA	United Nations General Assembly
UNICEF	United Nations Children's Fund
UNISDR	United Nations Office for Disaster Risk Reduction
UNSD	United Nations Statistics Division
UV	ultraviolet
WCPA	World Commission on Protected Areas

WHO	World Health Organization
WMO	World Meteorological Organization
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development

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Introduction

Why is a framework needed?

Though environment statistics is still a relatively new statistical domain, the demand for such statistics is increasing in conjunction with continuing environmental degradation and the challenges associated with improved environmental management. The recognition that human well-being depends on the environment has led to a growing list of environmental issues on which decisions must be taken, such as climate change, biodiversity loss and natural resource management. Given the need for governments, businesses, households and other decision makers to deal effectively with these issues, the environment statistics informing them must be of the highest quality possible.

Environment statistics provide information about the state and changes of environmental conditions, the quality and availability of environmental resources, the impact of human activities and natural events on the environment and the impact of changing environmental conditions. They also provide information about the social actions and economic measures that societies take to avoid or mitigate these impacts and to restore and maintain the capacity of the environment to provide the services that are essential for life and human well-being.

Environment statistics thus cover a wide range of information and are multi- and interdisciplinary in nature. They originate from a variety of institutions that collect data and, similarly, numerous methods are used to compile them. The field of environment statistics requires an appropriate framework to guide its development, coordination and organization.

This environment statistics framework (i) marks out the scope of environment statistics; (ii) facilitates a synthesized presentation of data from various subject areas and sources; (iii) simplifies the complexity of the environment appropriately so that it can be measured more easily; (iv) helps to identify the range of statistics relevant to societal decision-making regarding the environment; (v) is consistent with statistical frameworks already used in other domains to facilitate the integration of environment statistics; and (vi) is conceptually based.

Background

A Framework for the Development of Environment Statistics[2] (FDES) was first published in 1984 by the United Nations Statistics Division (UNSD), along with its subsequent publications, *Concepts and Methods of Environment Statistics: Human Settlements Statistics*[3] (1988) and *Concepts and Methods of Environment Statistics: Statistics of the Natural Environment*[4] (1991). The 1984 FDES and subsequent publications have been a useful framework for guiding countries in the development of their environment statistics programmes. Since its publication, many scientific, political, technological, statistical and experience-based developments have occurred, which suggested that the FDES could benefit from revision.

Consequently, the United Nations Statistical Commission, at its forty-first session (23-26 February 2010), endorsed a work programme and the establishment of an Expert Group for the revision of the FDES and the development of a Core Set of Environment Statistics. The members of the Expert Group represented prod cers and users of environment statistics of

[2] United Nations Statistics Division (1984). *A Framework for the Development of Environment Statistics*, available from http://unstats.un.org/unsd/publication/SeriesM/SeriesM_78e.pdf (accessed 4 August 2017).

[3] United Nations Statistics Division (1988). *Concepts and Methods of Environment Statistics: Human Settlements Statistics—A Technical Report*, available from http://unstats.un.org/unsd/publication/SeriesF/SeriesF_51e.pdf (accessed 4 August 2017).

[4] United Nations Statistics Division (1991). *Concepts and Methods of Environment Statistics: Statistics of the Natural Environment—A Technical Report*, available from http://unstats.un.org/unsd/publication/SeriesF/SeriesF_57E.pdf (accessed 4 August 2017).

countries from all regions and at different stages of development, as well as several international organizations, specialized agencies and non-governmental organizations (NGOs).[5]

[5] United Nations Statistics Division. Expert Group on the Revision of the UN FDES, available from http://unstats.un.org/unsd/environment/fdes/fdes_egm.htm (accessed 4 August 2017).

The revision process

The revision was based on an agreed set of criteria and has been supported by extensive international expert consultation. The 1984 FDES was used as the starting point. It was revised taking into account the lessons learned during its application in different countries as well as improved scientific knowledge about the environment and new requirements created by emerging environmental concerns and policy issues, including major Multilateral Environmental Agreements (MEAs). The revision has also taken into account the increasing prominence of environmental sustainability issues and concepts, including the outcome of the Rio+20 Conference and the work on Sustainable Development Goals (SDGs). Existing environment statistics and indicator frameworks were analysed, including major developments in the field of environmental-economic accounting and selected thematic developments relevant to environment statistics. (For more information on developments since 1984 and on MEAs, see Annex B: Developments since 1984 and Annex C: Multilateral Environment Agreements.

The revision was undertaken as part of UNSD's work programme on environment statistics, supported by the Expert Group on the Revision of the FDES. The drafts were reviewed in four face-to-face meetings of the Expert Group and in several rounds of electronic discussion. The Basic Set of Environment Statistics was tested by 25 countries and two organizations. The final draft of the FDES underwent a Global Consultation, yielding feedback from 76 countries, areas and organizations. The present document is the result of this extensive consultation process.

The FDES 2013

The FDES 2013 is a flexible, multipurpose conceptual and statistical framework that is comprehensive and integrative in nature. It marks out the scope of environment statistics and provides an organizing structure to guide their collection and compilation and to synthesize data from various subject areas and sources, covering the issues and aspects of the environment that are relevant for analysis, policy- and decision-making.

The FDES 2013 targets a broad user community, including environmental statisticians in national statistical offices (NSOs), environmental ministries and agencies, as well as other producers of environment statistics. It helps to mark out the roles of the different data producers, thus facilitating coordination at different levels.

The FDES 2013 is structured in a way that allows links to economic and social domains. It seeks to be compatible with other frameworks and systems, both statistical and analytical, such as the System of Environmental-Economic Accounting (SEEA), the Driving force-Pressure-State-Impact-Response (DPSIR) framework, and the Millennium Development Goals (MDGs), SDGs and the sustainable development indicator (SDI) frameworks. When applicable, it is based on existing statistical classifications. As such, the FDES facilitates data integration within environment statistics and with economic and social statistics.

The FDES 2013 organizes environment statistics into six components and each of them is broken down into subcomponents and statistical topics. The six components include environmental conditions and quality; the availability and use of environmental resources and related human activities; the use of the environment as a sink for residuals and related human activities; extreme events and disasters; human settlements and environmental health; and social and economic measures to protect and manage the environment. The statistical topics

represent the quantifiable aspects of the components and are grouped into subcomponents, taking into account the types and sources of the statistics needed to describe them.

The FDES 2013 sets out a comprehensive, though not exhaustive, list of statistics (the Basic Set of Environment Statistics) that can be used to measure the statistical topics. The Basic Set is organized into three tiers, based on the level of relevance, availability and methodological development of the statistics.

Within this scope, a Core Set of Environment Statistics has been identified as Tier 1. The objective of the Core Set is to serve as an agreed, limited set of environment statistics that are of high priority and relevance to most countries. Harmonized international definitions, classifications and data collection methods for these statistics will be provided in subsequent methodological handbooks to facilitate their production in an internationally comparable manner.

The FDES 2013 is relevant to, and recommended for use by, countries at all stages of development. However, it is particularly useful for guiding the formulation of environment statistics programmes in countries at the early stages of developing environment statistics as it (i) identifies the scope and constituent components, subcomponents and statistical topics relevant for them; (ii) contributes to the assessment of data requirements, sources, availability and gaps; (iii) guides the development of multipurpose data collection processes and databases; and (iv) assists in the coordination and organization of environment statistics, given the inter-institutional nature of the domain.

Structure of the document

Chapter 1 of the FDES 2013 provides an overview of the main characteristics of environment statistics. It identifies the main uses and user groups and the relationship between environmental data, statistics, accounts and indicators. The typical sources of data and the most important temporal and spatial considerations are also introduced. A brief description of existing classifications, categorizations and other groupings widely used in environment statistics is also presented. Particular attention is paid to the institutional aspects of environment statistics.

Chapter 2 presents the conceptual foundation and scope of the FDES. It explains the underlying fundamental concepts and how they have been translated into the six components that constitute the Framework. It introduces the hierarchical layers of components, subcomponents and statistical topics that provide the organizational structure for environment statistics. Finally, Chapter 2 explores the relationship between the FDES and other frameworks, particularly the SEEA and the DPSIR analytical framework.

Chapter 3 provides an expanded discussion of the components, subcomponents and statistical topics of the FDES. It describes the relevance of the statistical topics, the typical data sources and institutional partners. It sets out the relevant statistics needed to describe the statistical topics and their relationships and provides information on the most important aspects of temporal and spatial aggregation, as well as on existing methodology. These statistics constitute the Basic Set of Environment Statistics.

Chapter 4 presents the three-tiered organization of the Basic Set of Environment Statistics, based on the relevance, availability and methodological development of the statistics. It introduces the Core Set of Environment Statistics (Tier 1 of the Basic Set) and describes the criteria and process for selecting them.

Chapter 5 provides examples of the application of the FDES to selected cross-cutting environmental and socioeconomic issues (such as climate change), as well as to specific sectoral or thematic analytical needs (such as agriculture and the environment, water management, the

energy sector and the environment). These examples illustrate the flexibility and adaptability of the FDES to different user and policy needs.

Annex A contains the full Basic Set of Environment Statistics. Annex B provides supporting information on the conceptual and policy developments since the publication of the FDES in 1984. Annex C describes the major MEAs relevant to environment statistics. Annex D presents some of the most important classifications and other groupings used in environment statistics.

Future work

Following the endorsement of the FDES 2013, work will focus on its implementation at the national level. Detailed methodological guidance and training material for the FDES, the Core and Basic Sets of Environment Statistics will be developed, including classifications, definitions and data collection and compilation methods, building on existing methodologies and ongoing methodological work in environment and sectoral statistics, and in environmental-economic accounting.

Chapter 1

Overview of environment statistics—characteristics and challenges

1.1. This chapter describes the domain of environment statistics, introduces its main characteristics and discusses some of the methodological and institutional challenges that should be considered when working in this field, keeping the Fundamental Principles of Official Statistics in mind (see box). These characteristics are the basis of the FDES 2013. The FDES as a tool for organizing the content and production of environment statistics will be described in depth in Chapter 2.

Fundamental Principles of Official Statistics

Principle 1. Official statistics provide an indispensable element in the information system of a democratic society, serving the Government, the economy and the public with data about the economic, demographic, social and environmental situation. To this end, official statistics that meet the test of practical utility are to be compiled and made available on an impartial basis by official statistical agencies to honour citizens' entitlement to public information.

Principle 2. To retain trust in official statistics, the statistical agencies need to decide according to strictly professional considerations, including scientific principles and professional ethics, on the methods and procedures for the collection, processing, storage and presentation of statistical data.

Principle 3. To facilitate a correct interpretation of the data, the statistical agencies are to present information according to scientific standards on the sources, methods and procedures of the statistics.

Principle 4. The statistical agencies are entitled to comment on erroneous interpretation and misuse of statistics.

Principle 5. Data for statistical purposes may be drawn from all types of sources, be they statistical surveys or administrative records. Statistical agencies are to choose the source with regard to quality, timeliness, costs and the burden on respondents.

Principle 6. Individual data collected by statistical agencies for statistical compilation, whether they refer to natural or legal persons, are to be strictly confidential and used exclusively for statistical purposes.

Principle 7. The laws, regulations and measures under which the statistical systems operate are to be made public.

Principle 8. Coordination among statistical agencies within countries is essential to achieve consistency and efficiency in the statistical system.

Principle 9. The use by statistical agencies in each country of international concepts, classifications and methods promotes the consistency and efficiency of statistical systems at all official levels.

Principle 10. Bilateral and multilateral cooperation in statistics contributes to the improvement of systems of official statistics in all countries.

Source: United Nations Statistics Division. Fundamental Principles of Official Statistics, available from http://unstats.un.org/unsd/dnss/gp/fundprinciples.aspx (accessed 4 August 2017).

1.2. Environment statistics cut across several disciplines and draw data from a wide range of sources. In addition to the NSOs and environmental ministries and agencies, several other

institutions are key players in producing data used in environment statistics. Statistical and environmental expertise, scientific knowledge, institutional development capabilities and adequate resources are also needed to produce environment statistics. Within this relatively new statistical domain, methodological resources, tools and good practices are being developed and systematized gradually. Consequently, many countries still require substantial technical assistance and capacity building to develop their national environment statistics programmes.

1.1. Objective of environment statistics

1.3. The objective of environment statistics is to provide information about the environment, its most important changes over time and across locations and the main factors that influence them. Environment statistics seek to provide high-quality statistical information to improve knowledge of the environment, support evidence-based policy- and decision-making, and provide information for the general public and specific user groups.

1.2. Scope of environment statistics

1.4. The scope of environment statistics covers biophysical aspects of the environment and those aspects of the socioeconomic system that directly influence and interact with the environment.

1.5. The scope of environment, social and economic statistics overlap. It is not easy—or necessary—to draw a clear line dividing these areas. Social and economic statistics that describe processes or activities with a direct impact on, or direct interaction with, the environment are used widely in environment statistics. They are within the scope of the FDES. Other relevant social and economic statistics, which are not part of environment statistics, are also required to place environmental issues in context and facilitate the integrated analysis of environmental, social and economic processes. The use of consistent definitions and classifications among these fields supports their integration. When properly integrated, data and other inputs from social and economic domains enrich the analysis of environment statistics.

1.3. Main users of environment statistics

1.6. Environment statistics serve a variety of users, including but not limited to:

i. Policy and decision makers at all levels;

ii. The general public, including media and civil society;

iii. Analysts, researchers and academia; and

iv. International agencies.

1.7. Different users need environment statistics at different levels of aggregation and depths of information. They may need cross-cutting environment statistics data sets, for instance regarding climate change. In other cases, they may be interested only in particular topics and themes pertaining to specific sectoral analysis and policymaking. Policy- and decision-makers at the highest levels and the general public would tend to use environmental indicators and more aggregated statistics. Environmental administration, researchers, analysts and academics may be more inclined to examine extensive and detailed environment statistics. International agencies typically have well-articulated needs for environment statistics based on environmental agreements or international data collection processes.

1.8. Environment statistics support evidence-based policymaking by making it possible to identify environmental policy issues and quantify the measures and impacts of policy initiatives objectively. They strengthen assessments through quantitative metrics, making analyses more robust through the use of timely and comparable data. The type; level of thematic, spatial and temporal aggregation; and format of environment statistics depend on the type of user and intended use. The main products of environment statistics are detailed tabulated environment statistics series and environmental indicators, both of which can be stored in multipurpose databases and disseminated in the form of online databases, as well as different types of publications, such as compendiums, yearbooks, thematic reports, and analytical publications, such as state of the environment reports.

1.4. Environmental information, data, statistics and indicators

1.9. Environmental information includes quantitative and qualitative facts describing the state of the environment and its changes. Quantitative environmental information is generally produced in the form of data, statistics and indicators, and is generally disseminated through databases, spreadsheets, compendiums and yearbooks. Qualitative environmental information consists of descriptions (e.g., textual or pictorial) of the environment or its constituent parts that cannot be adequately represented by accurate quantitative descriptors.

1.10. *Environmental data* are large amounts of unprocessed observations and measurements about the environment and related processes. They may be collected or compiled via statistical surveys (censuses or sample surveys) by the national statistical system or may originate from administrative records, geographic databases, registers, inventories, monitoring networks, thematic mapping, remote sensing, scientific research and field studies.

1.11. *Environment statistics* are environmental data that have been structured, synthesized and aggregated according to statistical methods, standards and procedures. The role of environment statistics is to process environmental and other data into meaningful statistics that describe the state of and trends in the environment and the main processes affecting them. Not all environmental data are used to produce environment statistics. The FDES provides a framework that identifies environmental and other data that fall within its scope and then contributes to structuring, synthesizing and aggregating the data into statistical series and indicators.

1.12. *Environmental indicators* are environment statistics that have been selected for their ability to depict important phenomena or dynamics. Environmental indicators are used to synthesize and present complex environment and other statistics in a simple, direct, clear and relevant way. Environmental indicators are generated because environment statistics are usually too numerous and detailed to meet the needs of policymakers and the general public, and often require further processing and interpretation to be meaningful. Environmental indicators may take various forms such as rates, ratios or proportions, and be constructed at different levels of aggregation. The purpose of these indicators is to assess present and future directions with respect to goals and targets, evaluate and determine the impact of specific programmes, monitor progress, measure changes in a specific condition or situation over time, and convey messages. Policy frameworks such as the Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), the Driving force-Pressure-State-Impact-Response (DPSIR) framework and national environment/sustainable development indicator sets, are typically used to identify and structure indicators.

1.13. Environmental indices are composite or more complex measures that combine and synthesize more than one environmental indicator or statistic and are weighted according

to different methods. An index can provide a valuable summary measure to communicate important messages in an accessible way and, thus, raise awareness. However, they often raise questions regarding their proper interpretation, methodological soundness, subjectivity of the weighting, and the quality of the underlying statistics.

1.14. Environment statistics organized primarily within the FDES may be structured for specific analytical purposes based on different analytical frameworks, such as the DPSIR framework, issue-based frameworks which focus on specific environmental problems (e.g., climate change, air pollution and land degradation), policy-based frameworks such as sustainable development strategies, or assessment frameworks such as those used in state of the environment reports.

1.15. Accounting frameworks, such as the SEEA, reorganize the relevant environment statistics according to stocks and flows within and between the environment and the economy, based on the principles of the System of National Accounts (SNA). In this way, it creates links between environment statistics and the SNA and facilitates the analysis of relationships between the economy and the environment.

1.16. These types of environment statistics are all important and interdependent. They feed back into each other to produce diverse and complementary products that can be used for different purposes and that fit specific user needs and resources of countries or agencies. Ideally, information about the environment should be produced and used as a multipurpose information system which would increase synergy, consistency and efficiency in the use of limited financial resources.

1.5. Sources of environment statistics

1.17. Environment statistics synthesize data originating from various types of sources. Thus, the data used to produce environment statistics are not only compiled by different collection techniques, but also by various institutions. Types of sources include:

i. statistical surveys (e.g., censuses or sample surveys of population, housing, agriculture, enterprises, households, employment, and different aspects of environment management);

ii. administrative records of government and non-government agencies responsible for natural resources, as well as other ministries and authorities;

iii. remote sensing and thematic mapping (e.g., satellite imaging and mapping of land use and land cover, water bodies or forest cover);

iv. monitoring systems (e.g., field-monitoring stations for water quality, air pollution or climate);

v. scientific research and special projects undertaken to fulfil domestic or international demand.

1.18. These multiple types of sources are usually used in combination. For instance, in estimating certain types of emissions to the air, statistical surveys are used in combination with scientific research. While statistical surveys and administrative records are commonly used in all areas of statistics (economic, social and environment) and the use of remote sensing data has become widespread, the use of data from monitoring networks, scientific research and special projects are specific mostly to the production of environment statistics.

1.19. Environment statistics rely considerably on data that are collected by direct measurements using a variety of methods, including remote sensing and field-monitoring stations.

Most countries have agencies that are primarily responsible for monitoring environmental resources and conditions. They may be entities in their own right or government agencies with other primary functions that also have departments concerned with environmental matters. These agencies typically produce two main types of data: (i) measured data (obtained by direct observation, field measurements and remote sensing); and (ii) calculated data (derived using estimates and modelling).

1.20. The use of estimates and modelling to generate environmental data can improve overall data quality, including accuracy and coverage, especially when models draw upon two or more sets of observations, such as field observations coupled with global satellite-based observations. Models may also incorporate administrative data or data resulting from statistical surveys or special projects.

1.21. The main characteristics, advantages and disadvantages of these types of sources of environment statistics are discussed below.[6]

[6] United Nations Statistics Division (2012). *International Recommendations for Water Statistics*, available from http://unstats.un.org/unsd/envaccounting/irws/irwswebversion.pdf (accessed 4 August 2017).

Statistical surveys

1.22. There are two types of surveys: (i) censuses and (ii) sample surveys. A census is a survey that collects data from the entire population of interest. A sample survey is a survey carried out using a sampling method, in which data are collected from a representative portion of the population of interest and not the whole population.[7]

[7] International Statistical Institute (2003). *The Oxford Dictionary of Statistical Terms*, Yadolah Dodge ed., Oxford University Press.

1.23. Environment statistics can be collected from surveys by (i) adding environment-related questions to surveys intended primarily to collect data on other topics and (ii) using surveys intended primarily to collect environment statistics. When environmental data are collected through environment statistics surveys, the survey design reflects the objective of producing environment statistics. However, it is not always feasible or economical to conduct such surveys, so data are frequently obtained from other existing statistical surveys (e.g., social, economic and sectoral) whose primary objective differs from the production of environment statistics.

1.24. Adding environment-related questions to other surveys is less expensive than collecting data through a separate survey, the response burden is minimized and the environmental data can be directly linked to other data collected. However, the challenges of adding questions to existing surveys include the following: (i) there may be limited space available for additional questions in existing surveys, (ii) the survey frame and stratification of the population and sampling selection may not be ideal for environment statistics, (iii) the data may need to be reorganized or reclassified to be used in environment statistics and (iv) respondents may not be familiar with environmental terms or the information needed to answer environment-related questions.

1.25. Environment-specific surveys may be censuses or sample surveys. The advantages of using environment-specific surveys are that (i) the survey frame and sampling used can be selected based on the requirements of environment statistics, (ii) consistent concepts and definitions can be used in survey questions and (iii) the most suitable type of survey modes for collecting environment statistics can be selected. On the other hand, environment-specific surveys create an additional response burden and are costly in terms of finance, human resources and time. In addition, in many cases, no suitable register, list or map is readily available to use as a survey frame.

Administrative records

1.26. Administrative data kept by government agencies or NGOs may be used for the production of environment statistics. Government agencies keep administrative records of the population, households and establishments in response to legislation or regulations, or for internal management purposes. While most administrative data have been obtained traditionally from government agencies, administrative records kept by NGOs (e.g., industry or services associations and environmental associations and groups) may also be of use for environment statistics.

1.27. The main advantage of administrative data sources is that it is usually much less costly to collect such data than to create and conduct a survey. The level of response burden is minimized and complete coverage of units under administration is assured. However, there are usually differences between administrative and statistical terms and definitions; deliberate misreporting may occur; data may not be checked or validated for statistical purposes; restrictions may be placed on access to data; and coverage, though complete for administrative purposes, might not match statistical requirements.

Remote sensing and thematic mapping

1.28. Remote sensing is the science of obtaining information about objects or areas from a distance, typically from aircraft or satellites. Sensors are able to detect and classify objects on, above or below the earth's surface. Remote sensing makes it possible to collect data on dangerous or inaccessible areas or to replace costly and slow data collection on the ground, thus ensuring that areas or objects are not disturbed. Using satellite, aircraft, spacecraft, buoy, ship, balloon and helicopter images, data are created to analyse and compare, for example, the impact of natural disasters, changes in the area of soil erosion, the extent of pollution, changes in land cover or population estimates of animal species. These can be mapped, imaged, tracked and observed. Combined with thematic mapping data and sufficient validation using actual measurements in the field, remote sensing usually provides consistent, high-quality data for environment statistics.

1.29. Environmental geographic data are geographically referenced (georeferenced) information that includes digital maps, satellite and aerial imagery, other data sources that are linked to a location, coordinate or a map feature, and is all structured in databases. These data provide much of the visualization and contextual elements that add significantly to the quantity and quality of information organized within the framework of environment statistics, particularly when stored in geographic information systems (GIS). GIS is an integrating technology that helps to capture, manage, analyse, visualize and model a wide range of data with a spatial or locational component. Such systems allow environmental conditions to be mapped, measured and modelled.

Monitoring systems

1.30. Monitoring systems for the production of environment statistics typically comprise field-monitoring stations, which are used to describe the qualitative and quantitative aspects of the environmental media (e.g., air, water or soil quality, or hydrological or meteorological characteristics). The main advantages of these data are that they (i) are usually collected using verifiable scientific methods, (ii) are usually validated, (iii) are often available as time series; and (iv) frequently use models to improve data quality.

1.31. The disadvantages of data from monitoring systems result from the fact that field monitoring stations, especially those monitoring concentrations of pollutants in the environmental media, are usually located in "hot spot" areas with high levels of pollution, high sensitivity or

large numbers of the population being affected. Therefore, the measurements will be location-specific and more difficult to aggregate over space to produce measures of quality over larger territories.

Scientific research and special projects

1.32. Scientific research programmes focus on specific scientific areas. The data collected and produced will thus depend on the focus of the research. Many such special projects may be relevant to environment statistics, such as studies on glacier retraction and global CO_2 concentration, and biological assays to measure environmental pollutants. Special projects undertaken to address domestic or international demand often produce research data that are collected by universities, as well as other research agencies and organizations that may be governmental or non-governmental. Their main purposes are usually to fill knowledge gaps, assess the effectiveness of different measures and develop alternative policies.

1.33. The main advantages of using data from scientific research and special projects are that they (i) are usually available at no or low cost, (ii) minimize the response burden, (iii) can be used to address data gaps and (iv) are useful for developing coefficients for models. Disadvantages of using these sources include that (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) data are often available only for case examples (i.e., limited areas or industries) and (v) data are often available on a one-time basis only.

1.34. Process-specific technological parameters of production and consumption processes relating to the input of natural resources and the output of residuals constitute a special category of data used in environment statistics. These data are used to produce per unit factors or coefficients that support the calculation and estimation of the resource and emission intensity of production and consumption processes.

1.35. Table 1.1 shows the main types of sources from which environment statistics are usually derived.[8] It provides examples of these statistics, the general advantages and disadvantages of each type of source and the challenges that these sources pose for developing countries.

[8] United Nations Economic Commission for Latin America and the Caribbean (2009). *Methodological Guide for Developing Environmental and Sustainable Development Indicators in Latin American and Caribbean Countries.* Manuales series No. 61, available from www.cepal.org/es/publicaciones/5502-guia-metodologica-desarrollar-indicadores-ambientales-desarrollo-sostenible (accessed 4 August 2017).

Table 1.1
Types of sources of environment statistics and their main characteristics

Type of source	Examples of source	Examples of statistics	Examples of advantages	Examples of disadvantages	Challenges for developing countries
Statistical surveys (i) Censuses	Censuses such as population and housing, economic, agricultural or other sectoral censuses may include environmental aspects. Specific environmental censuses may cover establishments engaged in activities such as water management or waste management.	• Drinking water supply • Basic sanitation • Waste management • Housing quality • Use of fertilizers and pesticides in agriculture	More representative of the universe of informants, more accurate data outcomes	• Low periodicity • Expensive	Requires that sections of the instrument be refined to capture more and better environmental information
(ii) Sample surveys	Includes general purpose instruments (which may cover environmental issues) such as household surveys, business surveys and other sectoral surveys. Also includes emerging surveys specifically designed to gather environmental information, i.e., environmental management surveys for business establishments (including industry, tourism and agriculture), municipal environmental management surveys and public opinion polls on the environment, among others.	• Drinking water • Basic sanitation • Housing quality • Establishments with environmental management systems • Production and handling of solid waste • Opinion barometers on environmental policies and management	Greater periodicity and therefore more frequently updating of data series	Sampling and representativeness of sample may be a concern in the case of surveys designed for other than environmental purposes	• Requires that sections of recurring instruments be refined to capture more and better environmental information • Requires developing and maintaining specialized environmental surveys of different sectors and on different levels
Administrative records	Use, for statistical purposes, of records maintained by different government and non-governmental agencies for administrative purposes, at various levels (including national, regional, provincial and municipal) such as: customs records (imports); sectoral ministry records; public finance and budget records; tax returns records; and environmental authority records.	• Number of motor vehicles • Environmental licensing • Designation of protected area • Environmental education actions • Public spending on environmental protection	High production periodicity (annual, quarterly and even monthly) and thus high updating frequency	Terms and definitions may differ from those used in statistics; access to microdata may be limited; metadata may be missing	• Requires building statistical capacities in sectoral ministries and public services • Requires stable national inter-institutional coordination
Remote sensing and thematic mapping	All kinds of remote sensing and atmospheric measuring tools that produce images and their interpretation: satellite imaging; aerial photography; geodata; geodesy; and geomatics.	• Satellite imaging to inventory forests • Remote imaging of urban sprawl (city surface) • Land cover and land use (types) • Level, height or retraction of principal glaciers	• Very accurate • Costs of imaging have fallen sharply	• High cost of interpreting images • Few national statistical offices and Ministries of the Environment have geomatics specialists	• Requires geospatial literacy among officials responsible for environment statistics • Requires sufficient resources to interpret images and build geospatial representations of data
Monitoring systems	Includes various quality and pollution monitoring stations and networks such as: urban air pollution monitoring stations; surface water quality monitoring systems; glacier monitoring systems; and seawater or coastal water quality monitoring systems. Meteorological, hydrological monitoring networks.	Various parameters sampled to establish: • quality of drinking water; • urban air quality; • coastal—marine pollution; and • temperature, precipitation and water flows of rivers.	In general, good to excellent quality and more accurate data and microdata	• High cost of installing and maintaining monitoring systems and thus of producing microdata • Point specific measurements usually do not allow for aggregation over space unless the network is dense enough	Requires coordinating the flow of data from primary source in terms of periodicity, aggregation and format required for input into statistical production (series, indicators)
Scientific research and special projects	Data collected by universities, research agencies and organizations to fill knowledge gaps and assess effectiveness of or develop alternative policies	• Ecosystem health • Diversity and population trends of selected species • Characteristics of solid waste • Process specific technological parameters of residuals	• Low cost • Minimize response burden • May be used to fill in data gaps • Useful for developing coefficients	• Terms and definitions may differ from those used in statistics • Access to microdata may be limited • Metadata may be missing • Often have limited scope and often produced on a one-time basis	Requires close collaboration between statisticians and experts from the various scientific fields

1.6. Classifications and other groupings relevant to environment statistics

1.36. Statistical classifications are sets of discrete categories which may be assigned to specific variables registered in a statistical survey or an administrative file and used to produce and present statistics.[9]

1.37. The field of environment statistics has no single overarching internationally agreed classification of the environment for statistical purposes, such as the International Standard Industrial Classification of All Economic Activities (ISIC).[10] Instead, there are many coexisting and emerging classifications and categorizations for specific subject areas. These include standardized statistical classifications, as well as less formalized groupings or categories. Some of the classifications and categories that have been used in the environmental field have not been developed specifically for statistical purposes and therefore must be linked to statistical classifications.

1.38. Standard economic and social-demographic statistical classifications, such as ISIC and the Central Product Classification (CPC),[11] or the International Classification of Diseases (ICD),[12] among others, are relevant for and used in environment statistics. The use of these classifications facilitates the integration of environment statistics with economic and social-demographic statistics.

1.39. The pioneering environment statistics classifications adopted by the Conference of European Statisticians (CES) have been used extensively for international data collection. These classifications, developed by the United Nations Economic Commission for Europe (UNECE), are heterogeneous, and most include more than one single hierarchical classification. They also include recommendations for definitions, measurement methods and tabulations. The UNECE Standard Statistical Classifications for the environment include classifications of Water Use (1989), Land Use (1989), Wastes (1989), Ambient Air Quality (1990), Surface Freshwater Quality for the Maintenance of Aquatic Life (1992), Marine Water Quality (1992), Environment Protection Activities and Facilities (1994), and Flora, Fauna and Biotopes (1996). These classifications have been used extensively by the UNECE, the Organisation for Economic Co-operation and Development (OECD), Eurostat, UNSD and various regional and national bodies for international data collection.

1.40. More recent statistical classifications, as well as less-formalized categorizations which pertain to specific subdomains of environment statistics, have been developed by international organizations, specialized agencies, intergovernmental organizations or NGOs. Examples include the Food and Agriculture Organization of the United Nations (FAO) Land Cover Classification System (LCCS) and the groupings and classifications developed for water statistics and energy products included in the *International Recommendations for Water Statistics* (IRWS)[13] and the *International Recommendations for Energy Statistics* (IRES).[14]

1.41. Many of the aforementioned classifications have been revised, adapted and used in the SEEA Central Framework (SEEA-CF), including the Classification of Environmental Activities (CEA), which covers the classes of activities considered to be environmental protection and resource management activities, used primarily to produce statistics on environmental protection and resource management expenditure. Other examples include the categories of solid waste or the interim classifications of land use and land cover. Additional work on classifications of ecosystem services is being conducted as part of the development of the SEEA Experimental Ecosystem Accounting.

1.42. There are also classifications and lists of categories that do not originate in the statistical community but are used in environment statistics, such as the classifications of natural and technological disasters produced by the Centre for Research on the Epidemiology of Disasters

[9] United Nations Statistics Division (1999). *Standard Statistical Classifications: Basic Principles*, available from https://unstats.un.org/unsd/class/family/basicprinciples_1999.pdf (accessed 4 August 2017).

[10] United Nations Statistics Division (2008). *International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4*, available from http://unstats.un.org/unsd/cr/registry/isic-4.asp (accessed 4 August 2017).

[11] United Nations Statistics Division (2008). "Central Product Classification, Ver. 2", available from http://unstats.un.org/unsd/cr/registry/cpc-2.asp (accessed 4 August 2017).

[12] World Health Organization (2011). "International Classification of Diseases", available from www.who.int/classifications/icd/en/ (accessed 4 August 2017).

[13] United Nations Statistics Division (2012). *International Recommendations for Water Statistics*, available from http://unstats.un.org/unsd/envaccounting/irws/irwswebversion.pdf (accessed 4 August 2017).

[14] United Nations Statistics Division (2011). *International Recommendations for Energy Statistics* (draft version), available from https://unstats.un.org/unsd/energy/ires/IRES_edited2.pdf (accessed 4 August 2017).

Emergency Events Database (CRED EM-DAT); classifications of protected areas and threatened species developed by the United Nations Environment Programme's World Conservation Monitoring Centre (UNEP-WCMC) and the International Union for Conservation of Nature and Natural Resources (IUCN); ecosystem reporting categories used by the Millennium Ecosystem Assessment; source categories for greenhouse gas (GHG) emissions from the Intergovernmental Panel on Climate Change (IPCC); or the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources (UNFC). Ensuring harmonization of these classifications and building bridges among them are among the most important roles of environmental statisticians.

1.43. For more information on classifications used in environment statistics, see Chapter 3 and Annex A, which contain the Basic Set of Environment Statistics. The Basic Set includes a column that lists commonly used classifications and categorization. Annex D contains relevant classifications and groupings in the field of environment statistics.

1.7. Temporal considerations

1.44. While it is important to align the temporal aggregations of environmental data with those used in economic and social statistics to ensure their proper integration, a uniform calendar or fiscal year often does not correspond to the diversity of natural phenomena. Therefore different time scales—or longer or shorter time periods—must also be used to aggregate environmental data over time.

1.45. The environmental data used in environment statistics are measured or monitored at various frequencies. Certain features of natural growth of biomass (e.g., in a natural, slow-growing forest that is not subject to logging) or processes such as changes in land cover or soil erosion do not justify or require frequent, diligent monitoring because the most relevant changes may be observed on an annual, or even much less frequent, basis. Other environmental processes, however, change so quickly that measurements are needed hourly or even more frequently. One example of frequent monitoring is air quality[15] in urban settings.

[15] Air quality is measured by the concentrations of particulate matter (PM_{10}, $PM_{2.5}$), also known as suspended particulate matter (SPM), ground-level ozone (O_3) or other pollutants specific to a particular city.

1.46. Determining the appropriate temporal aggregation of environment statistics often involves a variety of considerations. For example, fluid environmental phenomena call for careful consideration of the temporal dimension because ebbs and flows, droughts and floods, snow and runoffs can occur, which all influence measurements. Variations may be daily and, at other times, seasonal depending on what is being measured. Seasonal variations may be seen in the fluctuations in certain types of fish biomass, surface water levels, ice cap surface or the incidence of fires. In such cases, monitoring must focus more on certain months than others. Given these temporal aspects, statistics often point out the maximum, minimum and/or other ways of describing the relevant phenomenon and its levels below or above certain benchmarks and are not limited to a sum or average over a longer period. In addition, even when environmental data are produced at irregular intervals, environment statistics based on these data can still be produced at regular intervals if there are enough data points in each period to do so.

1.8. Spatial considerations

1.47. The occurrence and impacts of environmental phenomena are distributed spatially without regard for political-administrative boundaries. The most meaningful spatial units for environment statistics are: natural units, such as watersheds, ecosystems, eco-zones, landscape or land cover units; or management and planning units based on natural units, such as protected areas, coastal areas or river basin districts.

1.48. Economic and social statistics are aggregated traditionally according to administrative units. This difference can complicate the collection and analysis of environment statistics, particularly when they must be combined with data originating from social and economic statistics. However, there is a trend towards producing more georeferenced data, which would overcome some of the spatial complications of analysis.

1.49. While environment statistics are usually collected and aggregated for natural physical, geographical and administrative areas, the concept of economic territory is used for environmental-economic accounting. This involves a geographic boundary that defines the scope of an economy. Economic territory is the area under the effective control of a single government. It includes the land area of a country, including islands, airspace, territorial waters and territorial enclaves in the rest of the world. Economic territory excludes territorial enclaves of other countries and international organizations located in the reference country.

1.9. Geospatial information and environment statistics

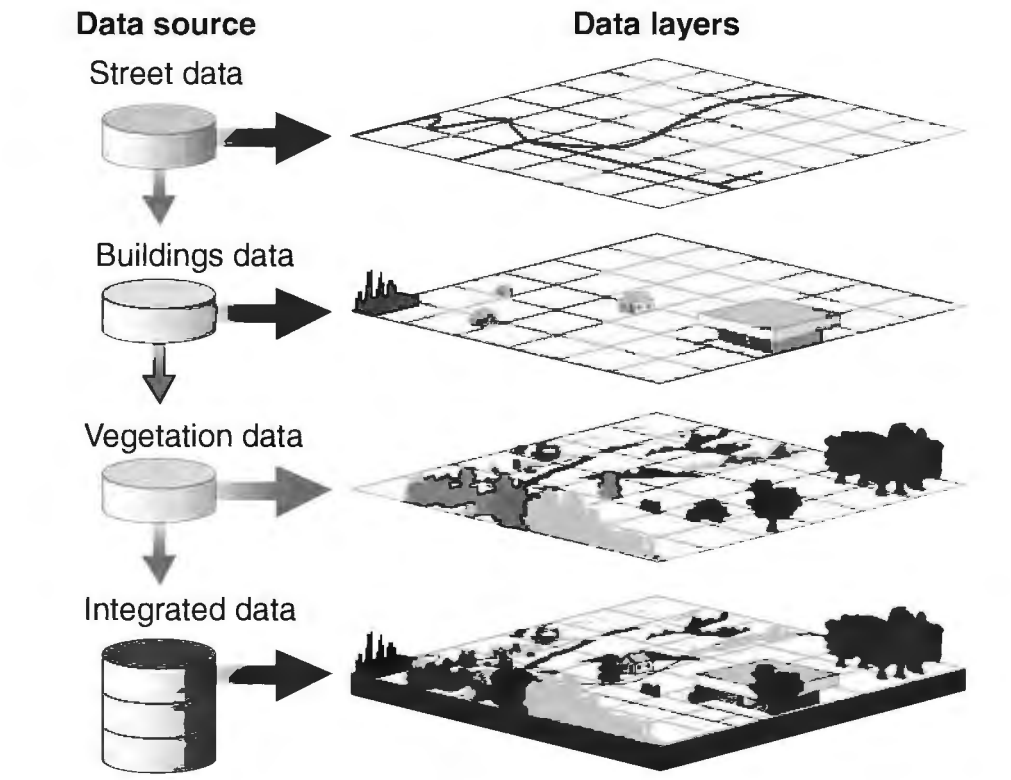
1.50. Geospatial information presents the location and characteristics of different attributes of the atmosphere, surface and subsurface. It is used to describe, display and analyse data with discernible spatial aspects, such as land use, water resources and natural disasters. Geospatial information allows for the visual display of statistics in a map-based layout, which can make it easier for users to work with and understand the data. The ability to overlay multiple data sets using software, for instance on population, environmental quality and environmental health, allows for a deeper analysis of the relationship among these phenomena.

1.51. The complexity of current environmental issues (e.g., climate change, biodiversity loss, ecosystem health, natural disaster frequency and intensity, population growth and food and water shortages) increasingly calls for the integration of geospatial information, statistics and sectoral data to achieve more effective and efficient monitoring of progress in strengthening the environmental pillar of sustainable development. GIS can help establish the links between different types and layers of data by providing powerful tools to store and analyse spatial data and by integrating databases from different sectors in the same format and structure.

1.52. Geospatial information adds significant value and utility to environment statistics. Ideally, geographic aspects of data should always be collected, represented and analysed at the most detailed scale possible, based on national capacities and priorities. Geospatial information enables better analysis of environmental issues as environmental, social and economic statistics can be aggregated or disaggregated according to a wide range of scales and zones that address diverse analytical and policy demands, such as natural units (e.g., watersheds and ecosystems); administrative units (e.g., municipalities, districts, counties and regions), management units (e.g., protected areas and river basin districts), planning units (e.g., coastal zones and urban areas); legal property units (e.g., cadastral units) and analytical units (e.g., land cover units, socioecological landscape units, eco-complexes, geosystems and eco-zones).

1.53. Geospatial data may be obtained using a variety of technologies such as Global Positioning Systems (GPS) and remote sensing satellites. Land surveyors, census takers, aerial photographers, police and even average citizens with a GPS-enabled cell phone can collect geospatial data using GPS or street addresses that can be entered into GIS. The attributes of the collected data, such as land-use information, demographics, landscape features or crime scene observations, can be entered manually or, in the case of a land survey map, digitized from a map format to a digital format by electronic scanning. The final representation of the data is constructed by superimposing different layers of information as required by the analytical and/or policy requirements.

Figure 1.1
Example of GIS data layers or themes[16]



[16] Government Accountability Office (2004). "Geospatial Information: Better Coordination Needed to Identify and Reduce Duplicative Investments", available from www.gao.gov/assets/250/243133.pdf (accessed 4 August 2017).

1.54. Remote sensing gathers information about an object without coming into physical contact with it. It involves the quantitative analysis of digital information where measurements can be taken from sensors on the ground, in aircraft or on orbiting satellites. The information is carried by electromagnetic signals. Remote sensing calls for skills in digital image analysis when computer programming, image display tools and statistics are required for interdisciplinary work that may involve scientists and experts in fields including biology, climatology, geology, atmospheric science, chemistry and oceanography. Satellite remote sensing can address global issues by detecting, monitoring and measuring regional and global changes.

1.55. Remote sensing data from satellites are obtained digitally and communicated to central facilities for processing and analysis in GIS. Digital satellite images, for example, can be analysed in GIS to produce land cover and land use maps. When geospatial data are combined in GIS (e.g., combining satellite remote sensing land use information with aerial photographic data on housing development growth), the data are transformed so that they are coincident and fit the same coordinates. GIS uses the processing power of a computer, together with geographic mapping techniques (cartography), to transform data from different sources onto one projection and one scale so that the data can be analysed and modelled together.

1.10. Institutional dimension of environment statistics

1.56. The institutional dimension of environment statistics refers to the institutional factors necessary to develop and strengthen the sustained production, dissemination and use of environment statistics. It comprises the legal framework that establishes the mandates and roles of the main partners, the institutional setting and institutional development level of environ-

ment statistics units, and the existence and effectiveness of inter-institutional cooperation and coordination mechanisms at the national level and with specialized international agencies. The institutional dimension of environment statistics is fundamental when developing environment statistics at the national level. Given the multidisciplinary and cross-cutting nature of environment statistics, the production of environmental data and statistics involves numerous stakeholders, actors and producers. The challenges of insufficient institutional development, overlapping mandates and functions, inadequate inter-agency coordination and other institutional issues are very common in many countries. The problems of coordination and heterogeneous development can also escalate to the regional and global levels, where multiple partner agencies operate under different mandates, work programmes and production timetables.

1.57. Identifying the primary institutional obstacles that impede the production of environment statistics and developing a strategy to overcome them is essential for countries that seek to develop or strengthen their environment statistics programmes. The following are four key elements pertaining to the institutional dimension that should be considered and dealt with simultaneously while developing environment statistics.

1.58. *The legal framework.* In most countries, the legal framework for the production of environment statistics commonly consists of statistical, environmental and other relevant sectoral legislation, such as for water, energy and agriculture. Each of these laws defines the mandate and competencies of the institutions in charge of the relevant sectors.

1.59. Under national statistical legislation, the NSO is usually the authority responsible for creating and coordinating the national statistical system. However, in most cases, these laws do not explicitly refer to environment statistics, as this is a relatively new statistical domain. Moreover, in many cases it neither provides explicit guidelines for statistical coordination among the relevant statistical parties at the national level nor spells out responsibilities and obligations. Nevertheless, since the environment is becoming increasingly important in the development agenda, NSOs have included the production of environment statistics in their programmes, though sometimes without clarifying the supporting institutional arrangements.

1.60. Overlapping mandates, duplication of efforts, and other coordination difficulties may exist in this complex institutional context. In fact, it is often difficult to determine the official figures for a specific statistic when different agencies produce the same or similar statistics but with different values.

1.61. *Institutional development.* A well-defined mandate and the designation of a specific unit responsible for producing environment statistics is critical for the successful organization of a national environment statistics programme within the official institutions that are responsible for producing statistics. This unit requires a regular operations budget and a minimum number of trained personnel for the tasks involved. Environment statistics units thus need a capacity-building programme for staff, together with the financial resources to implement it.

1.62. *Inter-institutional collaboration.* Environment statistics cover several topics for which the data, whether in the form of administrative records, remote sensing, scientific measurements or survey results, are generated by NSOs, specialized agencies, ministries, provincial and municipal governments and scientific institutions. This requires these stakeholders to collaborate, both at the strategic and technical level.

1.63. The collaboration of national and subnational institutions can take the form of a multi-stakeholder or inter-agency platform tasked with coordinating the strategic development and production of environment statistics. These inter-agency platforms bring together users and producers of environment statistics to identify users' needs and ensure the coordinated production of the necessary environment statistics from a variety of data sources. One of the tasks of the platform is to ensure that a common statistical methodology or protocol is used to ensure

comparability and statistical soundness. Another relevant function is to preserve continuity over time, despite significant turnover of staff in the partner institutions.

1.64. If tasked with overseeing the national statistical system and coordinating these platforms, the NSO must have adequate authority, resources or capacities to lead the multi-stakeholder processes. Depending on the institutional arrangement, the environmental ministry or equivalent institution in many developing countries coordinates such platforms.

1.65. *Institutional cooperation among national, regional and global bodies.* International organizations that produce environmental data and statistics also face the same institutional challenges as countries. Notwithstanding the legal requirements mentioned above, it is very important to consider the operational aspects that can improve coordination and resource utilization among the national, regional and global levels, with the understanding that all potential partners have different mandates, work programmes and deadlines. In addition, reporting requirements for certain international agreements and treaties, which are an important dimension of environment statistics, should be included in national environment statistics programmes.

1.11. The FDES 2013 and the domain of environment statistics

1.66. The FDES 2013 addresses the issues related to the multidisciplinary nature of environment statistics by marking out the scope of environment statistics and providing a conceptually based organizing structure that brings together the necessary biophysical data originating from various sources, as well as the relevant social and economic statistics needed to describe the activities affecting environmental conditions and to estimate their environmental impact.

1.67. The sections of this chapter have discussed the nature, scope and specific characteristics pertaining to the domain of environment statistics. The most relevant challenges to the work in the field of environment statistics have also been presented in synthesized form. The FDES 2013 has been developed to address these specific elements from a current and global perspective, while also acknowledging foreseeable developments.

1.68. The next chapter of this document describes the conceptual foundation, scope and organizing structure found in the FDES 2013. Subsequent chapters describe the components, subcomponents and topics of the FDES 2013, as well as its most relevant environment statistics. These chapters also indicate the corresponding availability of methodologies and classifications and the most common sources of data, and identify the typical institutional partners to facilitate inter-agency cooperation.

Chapter 2

Conceptual Foundation and Structure of the FDES

2.1. This chapter introduces the FDES, its conceptual framework and the main concepts that have been considered when designing its scope and structure. It ties the conceptual foundation to the main structural components of the FDES, which are further discussed in detail in Chapter 3. It also explains the relationship between the FDES and other commonly used systems and frameworks.

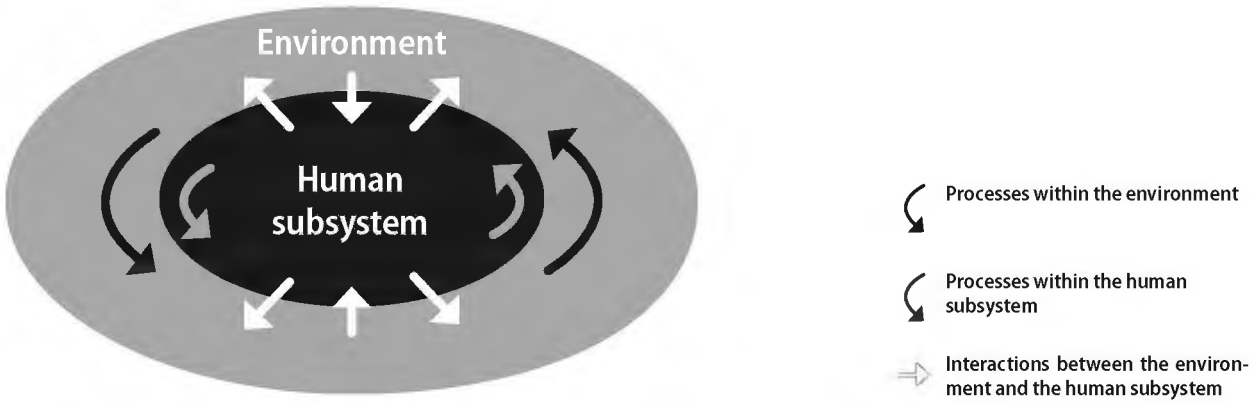
2.1. What is the FDES?

2.2. The FDES is a flexible, multipurpose conceptual and statistical framework that is comprehensive and integrative in nature and marks out the scope of environment statistics. It provides an organizing structure to guide the collection and compilation of environment statistics at the national level. It brings together data from the various relevant subject areas and sources, covering the issues and aspects of the environment that are relevant for policy analysis and decision-making.

2.3. The primary objective of the FDES is to guide the formulation of environment statistics programmes by (i) delineating the scope of environment statistics and identifying its constituents; (ii) contributing to the assessment of data requirements, sources, availability and gaps; (iii) guiding the development of multipurpose data collection processes and databases; and (iv) assisting in the coordination and organization of environment statistics, given the inter-institutional nature of the domain.

2.4. Though the FDES has been designed to guide countries at early stages in the development of their environment statistics programmes, it is relevant to, and recommended for use by, countries at any stage of development. It can also be used by international and regional institutions, as well as by other users and producers.

Figure 2.1
The environment, the human subsystem, and interactions between them

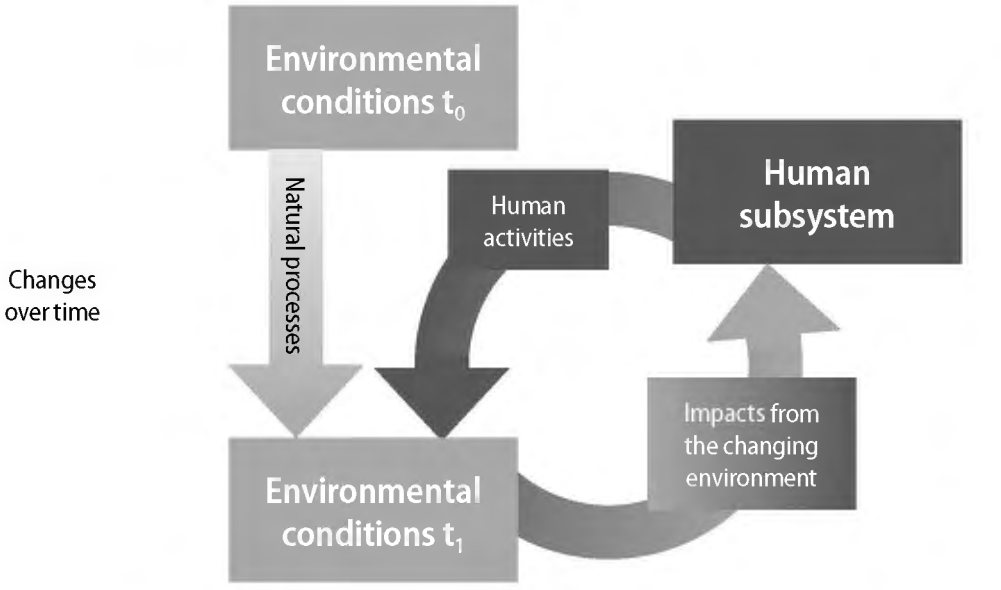


2.2. Conceptual foundation of the FDES

2.5. The FDES is based on a conceptual foundation that considers people and their demographic, social and economic activities (the human subsystem) as integral parts of, and interacting with, the environment. Figure 2.1 illustrates this concept with the arrows representing a variety of complex natural, demographic, social and economic processes and interactions within and between the environment and the human subsystem.

2.6. Human well-being depends upon the living and non-living elements of the environment and the goods and services they provide. Humans need the environment in order to survive and for various social, cultural and economic purposes. The human subsystem uses the environment for habitat, to obtain important physical resources and as a recipient or sink for various residuals. Human societies and their production and consumption patterns affect the environment that supports them and other life forms in general. The changing environment affects humans in various ways over time (see Figure 2.2).

Figure 2.2
Environmental conditions and their changes



2.7. Escalating human impacts on environmental systems worldwide have raised concerns about the consequences of environmental changes for the sustainability of human societies and for human well-being. Conditions in the living and non-living environment, natural processes and the capacity of ecosystems to provide goods and services all change as a result of human activities. The interconnectivity between the systems means that changes in one part of the system can influence changes in other parts.

Ecosystems and ecosystem services

2.8. The Millennium Ecosystem Assessment and the Convention on Biological Diversity (CBD) define an ecosystem as "a dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit."[17,18] Ecosystems are systems of interacting and interdependent relationships among their elements. They perform specific functions such as photosynthesis, biochemical cycling, including the cycling of energy, water, carbon and nutrients, and the cleansing of air and water.

[17] Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*, Washington, D.C., Island Press, available from www.millenniumassessment.org/documents/document.356.aspx.pdf (accessed 4 August 2017).

[18] Convention on Biological Diversity (1992). "Article 2. Use of Terms", available from www.cbd.int/convention/articles/default.shtml?a=cbd-02 (accessed 4 August 2017).

2.9. Ecosystems provide a great variety of goods and services upon which people depend.[19] These are commonly known as ecosystem services. Ecosystem services are the benefits supplied by the functions of ecosystems and received by humanity.[20] Ecosystem services are generated by biophysical, geochemical and other physical processes and interactions within and between ecosystems. The capacity of ecosystems to provide these services depends on their extent and conditions. The extent and conditions of ecosystems change as a result of both natural processes and human activities.

2.10. There is no internationally adopted standard classification of ecosystem services. Four main types of ecosystem services have been commonly distinguished:[21]

i. *Provisioning* services that provide goods and services which humans require to meet basic necessities like food and raw materials;

ii. *Regulating* services that keep the planet habitable like the regulation of climate and hydrological systems;

iii. *Supporting* services that arise from the continuous cycling of energy and materials necessary to support all living things like photosynthesis and nutrient cycling; and

iv. *Cultural* services that provide well-being to humans like scenic views, natural monuments and wildlife.

2.11. In the SEEA Experimental Ecosystem Accounting, ecosystem services constitute the contributions of ecosystems to benefits used in economic and other human activity.[22] As shown in Figures 2.1 and 2.2, this definition excludes certain flows that are considered ecosystem services in other contexts, particularly intra- and inter- ecosystem flows that relate to ongoing ecosystem processes, commonly referred to as supporting services. While these flows are not considered ecosystem services in the SEEA, they are considered as part of the measurement of ecosystem assets. A Common International Classification of Ecosystem Services (CICES) is emerging within the context of the ongoing work on the SEEA Experimental Ecosystem Accounting. For accounting purposes, the draft CICES distinguishes three main types of ecosystem services, namely provisioning, regulating and cultural services. The CICES lists those ecosystem services where a direct connection to humans can be established. Supporting services are thus considered to be embodied in the provisioning, regulating and cultural services that they underpin.[23]

2.12. People also use many abiotic materials and flows found in the environment, such as underground mineral and energy resources or the capture of energy from solar or wind sources. These are goods and services provided by the environment but they are not considered ecosystem services because they do not result from interactions within ecosystems. However, the extraction, capture and use of these abiotic goods and services significantly affect the extent and conditions of ecosystems.

2.3. Scope of the FDES

2.13. The scope of the FDES covers biophysical aspects of the environment, those aspects of the human subsystem that directly influence the state and quality of the environment, and the impacts of the changing environment on the human subsystem. It includes interactions within and among the environment, human activities and natural events.

2.14. The environment is the biophysical, biotic and abiotic surroundings in which humans live. Changes in the conditions and quality of the environment are central to the FDES. These changes show the balance of the negative and positive impacts of human activities and natural processes. In many cases, it is not possible to establish direct cause-effect relationships between

[19] Millennium Ecosystem Assessment (2005). Ecosystems and Human Well-being: Synthesis, Washington, D.C., Island Press, available from www.millenniumassessment.org/documents/document.356.aspx.pdf (accessed 4 August 2017).

[20] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2014). *System of Environmental-Economic Accounting 2012—Central Framework*, available from http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed 4 August 2017).

[21] Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*, Washington, D.C., Island Press, available from www.millenniumassessment.org/documents/document.356.aspx.pdf (accessed 4 August 2017).

[22] In this context "use" includes both the transformation of materials (for example, the use of timber to build houses or for energy) and the passive receipt of non-material ecosystem services (for example, the amenity that viewing landscapes offers).

[23] European Commission, Organisation for Economic Co-operation and Development, United Nations and World Bank (2014). *System of Environmental-Economic Accounting 2012: Experimental Ecosystem Accounting"*, available from http://unstats.un.org/unsd/envaccounting/seeaRev/eea_final_en.pdf (accessed 4 August 2017).

changes in environmental quality and individual human activities or natural processes because the impact results from combined and cumulative processes and effects over space and time. Certain environmental conditions are not affected significantly by human activities and natural processes or change very slowly, while others show more immediate change.

2.15. The elements of the environment that are affected by human use are ecosystems, land and subsoil resources. *Ecosystems* offer provisioning, regulating, supporting and cultural services that are essential for life and human well-being. Healthy ecosystems have the capacity to provide a continunous flow of ecosystem goods and services. Depending on the relationship between the scale and persistence of human use of the environment and the carrying capacity and resilience of ecosystems, human activities can exert pressure on and cause significant change in the quality and integrity of ecosystems, affecting their capacity to continue to provide services.

2.16. *Land* provides space for natural ecosystems, human habitats and human activities. As this space is finite, the expansion of human activities can reduce the space occupied by natural ecosystems, thus reducing ecosystems' capacity to yield ecosystem goods and services for all living beings.

2.17. *Subsoil resources* are underground deposits of various minerals that provide raw materials and energy sources for humans. When considered as resources for human use, these subsoil elements differ fundamentally from ecosystems in that they are non-renewable. Their use thus results in permanent depletion.

2.18. The factors affecting the conditions and quality of the environment may be both natural and anthropogenic.

2.19. Natural processes help to sustain ecosystem functioning and the generation of renewable resources, but they are also responsible for normal or extreme natural losses. On a human timescale, these natural processes do not affect non-renewable resources except in the form of natural disasters.

2.20. Human activities that directly affect the environment are related to the use of non-renewable and renewable resources, land use and the discharge of residuals to the environment from production and consumption processes. These activities often lead to environmental changes in the form of resource depletion and environmental degradation, which in turn have a negative impact on human well-being. On the other hand, human activities aimed at protecting the environment and managing its resources can reduce such negative impacts on the environment.

2.21. People and many of their activities with a direct impact on the environment are concentrated within and around human settlements. Human settlements also constitute the immediate environment where the population is directly exposed to environmental effects. Human settlements represent a special category in the measurement of environmental conditions and quality, and their impacts on human health and well-being.

2.22. Environmental protection and the management of environmental resources may be advocated, facilitated, supported or mandated by different policies, economic measures, instruments and actions. These policies, instruments and actions are aimed at mitigating environmentally harmful effects, managing environmental resources and restoring the environment's state and quality so that it can continue to provide sustainable support for life and human activities.

2.4. From the conceptual foundation to the FDES structure—the organization of the contents of the FDES

2.23. Using a multilevel approach, the FDES organizes environment statistics into a structure composed of components, subcomponents, statistical topics, and individual statistics. The first level of the structure consists of six fundamental components that follow the FDES conceptual framework.

2.24. The first component, Environmental Conditions and Quality, brings together statistics related to the conditions and quality of the natural environment and changes in those conditions and quality. The second component, Environmental Resources and their Use, groups statistics related to the availability and use of environmental resources (ecosystem provisioning services, land and subsoil resources). The third component, Residuals, includes statistics related to the use of regulating services of the environment for the discharge of residuals from production and consumption processes. Statistics related to Extreme Events and Disasters (both natural and technological) and their impacts are covered by the fourth component. The fifth component brings together statistics related to Human Settlements and Environmental Health. The sixth component, Environmental Protection, Management and Engagement, groups statistics relevant to societal responses and economic measures aimed at protecting the environment and managing environmental resources.

2.25. Environmental Conditions and Quality (Component 1) are central to the FDES. The other five components have been established based on their relationship to the central component. As shown in Figure 2.3, all six components are intrinsically related to each other.

2.26. Figure 2.3 shows the six components of the FDES. The dotted lines separating the components indicate the continuous interactions among them. These interactions exist between and among all the components of the FDES. It should be noted that a two-dimensional diagram provides only a limited visualization of the complex and interrelated nature of the relationships between humans and the environment.

Figure 2.3
The components of the FDES

2.27. The FDES uses a multilevel approach. The first level of the structure defines the six fundamental components. Each individual FDES component is further broken down into its respective subcomponents (second level) and statistical topics (third level). The statistical topics represent the measurable aspects of the components of the FDES. The components, subcomponents, statistical topics and individual statistics of the FDES define the scope and boundaries of environment statistics. They provide an organizing structure for synthesizing and presenting the information in a comprehensive, consistent and coherent manner. Each level uses numbering conventions as shown below in Table 2.1. The final level contains the actual individual environment statistics.

Table 2.1
Hierarchical levels of the FDES

One digit	Two digits	Three digits	Four or five digits
Component	Subcomponent	Statistical topic	Statistics

2.28. The contents of each component of the FDES are organized based on three main factors. First, the contents are organized in accordance with the conceptual foundation described in Chapter 2, in which both environmental and human processes and activities modify environmental conditions, which in turn affect the human subsystem and trigger responses. Second, as a statistical tool to be applied by the environmental statistician, the content of the components of the FDES also considers specific practical concerns, such as the methods of data collection or compilation and the types and sources of data. Third, analytical consistency within subcomponents and between statistical topics is also a key characteristic of the content of each component.

2.29. Subcomponents have been selected using a holistic view of the constituent parts of the component; that is, the subcomponents seek to organize all possible themes that fall under the component. Statistical topics have been selected to further categorize and group the different aspects underlying each subcomponent.

2.30. While the FDES has been designed to be conceptually distinct at the component level, the contents of each component may overlap in some cases. Hence, the same statistics may often be used to describe more than one component. Their final assignment within the structure corresponds to both their most substantive content and nature and to the sources and methods of statistical production. This optimizes both conceptual and statistical soundness. Therefore, the breakdown of components into their subcomponents and topics is not intended to be fixed, mutually exclusive or exhaustive.

2.31. In line with the need to maintain the framework's flexibility and applicability, the levels can be adapted according to each country's requirements, priorities and circumstances. Some countries may need more or less detailed information, while others may wish to exclude some topics.

2.5. Components and subcomponents of the FDES

2.32. The main structure of the FDES (two-digit level) is presented in the table below. Chapter 3 provides a detailed description of the relevance and contents of the components, subcomponents and statistical topics of the FDES, as well as the most common statistics that are recommended to measure them.

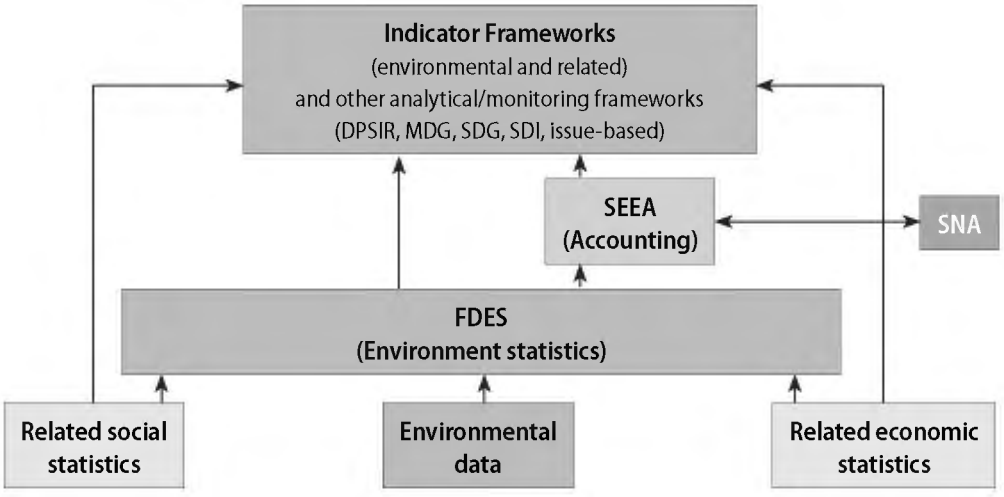
Table 2.2
Components and subcomponents of the FDES

Component 1: Environmental Conditions and Quality	Subcomponent 1.1: Physical Conditions Subcomponent 1.2: Land Cover, Ecosystems and Biodiversity Subcomponent 1.3: Environmental Quality
Component 2: Environmental Resources and their Use	Subcomponent 2.1: Mineral Resources Subcomponent 2.2: Energy Resources Subcomponent 2.3: Land Subcomponent 2.4: Soil Resources Subcomponent 2.5: Biological Resources Subcomponent 2.6: Water Resources
Component 3: Residuals	Subcomponent 3.1: Emissions to Air Subcomponent 3.2: Generation and Management of Wastewater Subcomponent 3.3: Generation and Management of Waste Subcomponent 3.4: Release of Chemical Substances
Component 4: Extreme Events and Disasters	Subcomponent 4.1: Natural Extreme Events and Disasters Subcomponent 4.2: Technological Disasters
Component 5: Human Settlements and Environmental Health	Subcomponent 5.1: Human Settlements Subcomponent 5.2: Environmental Health
Component 6: Environmental Protection, Management and Engagement	Subcomponent 6.1: Environmental Protection and Resource Management Expenditure Subcomponent 6.2: Environmental Governance and Regulation Subcomponent 6.3: Extreme Event Preparedness and Disaster Management Subcomponent 6.4: Environmental Information and Awareness

2.6. Relationship of the FDES with other frameworks

2.33. As a multipurpose statistical tool for the development of environment statistics, the FDES is closely related to and supports other systems and frameworks that are frequently used at the national and international levels. Figure 2.4 provides a simplified illustration of the relationship between environmental data, the FDES, the SEEA and indicator frameworks. The FDES is shown here as a tool to bring together and transform primary statistical and non-statistical data into environment statistics. These environment statistics can then be used to produce statistical series and indicators organized according to different analytical or policy frameworks. They may also be used in combination with economic statistics to produce environmental-economic accounts that link environment statistics with the SNA.

Figure 2.4
Relationship of the FDES to other frameworks, systems and indicator sets



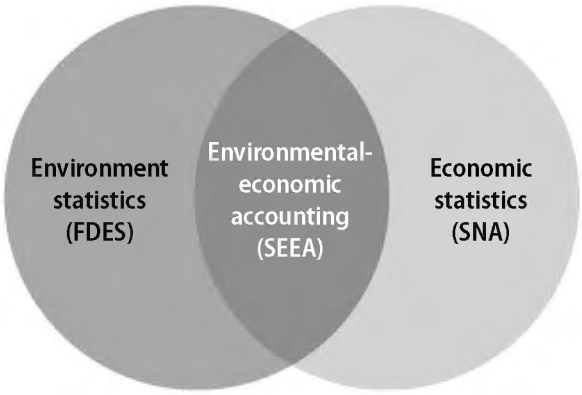
SEEA = System of Environmental-Economic Accounting
SNA = System of National Accounts

Relationship between the FDES and the SEEA

2.34. The SEEA-CF describes the interactions between the economy and the environment, and the stocks and changes in stocks of environmental assets. Central to the SEEA-CF is a systems approach to organizing environmental and economic information that covers, as completely as possible, the stocks and flows that are relevant to the analysis of environmental and economic issues. It applies the accounting concepts, structures, rules and principles of the SNA. In practice, environmental-economic accounting includes the physical and monetary statistics for the compilation of supply and use tables, functional accounts (such as the environmental protection expenditure accounts), and asset accounts for natural resources. The United Nations Statistical Commission at its forty-third session in 2012 adopted the SEEA-CF as the initial version of the international standard for environmental-economic accounting.

2.35. The FDES as an organizing framework for environment statistics has a wider scope than that of the SEEA-CF, as Figure 2.5 illustrates.

Figure 2.5
The FDES and the SEEA Central Framework



2.36. The SEEA-CF uses many environment statistics by combining them with economic statistics and reorganizing them according to national accounting principles. One of the objectives of the FDES as a multipurpose framework is to provide, to the extent possible, the environment statistics necessary for the development of environmental-economic accounts. As environmental-economic accounting is considered an important user of environment statistics, the concepts, terms and definitions used in the FDES and the SEEA were made as consistent as possible.

2.37. The statistics included in Component 2: Environmental Resources and their Use and Component 3: Residuals of the FDES are closely related to and support populating both the physical asset accounts and physical flow accounts. Component 6: Environmental Protection, Management and Engagement includes statistics relevant to the functional accounts of the SEEA-CF.

2.38. The SEEA Experimental Ecosystem Accounting is a companion to the SEEA-CF. It extends the accounting to the measurement of flows of services to society that ecosystems provide and to the measurement of ecosystem capital in terms of the capacity and changes in ecosystems' capacity to provide those services in physical terms. It describes the valuation of ecosystems insofar as it is consistent with the market valuation principles of the SNA. Component 1: Environmental Conditions and Quality of the FDES includes statistics that can feed into future ecosystem accounts.

2.39. The SEEA is based on the definitions and classifications applied in the SNA. The concepts of resident units and centre of economic interest are used to define the boundaries and, therefore, to determine which activities should be included in or excluded from the accounts. An institutional unit is resident within the economic territory of a country when it maintains the centre of economic interest in that territory—that is, when it engages, or intends to engage, in economic activities or transactions usually over at least one year. In the SEEA and in the SNA 2008,[24] all economic activities of resident institutional units are included in the accounts irrespective of whether they take place inside or outside the geographic territory of the country. On the other hand, economic activities of non-resident institutional units are not included in the accounts even if they take place within the geographic territory of the country. Using these concepts to define the boundary is different from the standard practice in environment statistics and thus in the FDES. Environment statistics typically uses the territorial principle, by which all relevant activities and environmental impacts within the geographic area of the country are included, irrespective of whether the institutional unit is resident or non-resident. The difference relates mainly to the treatment of international transport and tourism.

[24] European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank (2009). *System of National Accounts 2008*, available from http://unstats.un.org/unsd/nationalaccount/docs/SNA2008.pdf (accessed 4 August 2017).

The FDES and its relationship with the Driving force-Pressure-State-Impact-Response (DPSIR) framework

2.40. The Stress Response Environment Statistics System (S-RESS) framework was developed by Statistics Canada during the 1970s and 1980s and later adapted by the United Nations in the 1984 FDES and by the OECD. The Pressure-State-Response (PSR) and the DPSIR frameworks are adaptations of the S-RESS framework and are still in use today in many countries, as well as internationally by the United Nations Environment Programme (UNEP), OECD and the European Environment Agency (EEA) for assessment and reporting purposes and to categorize indicators.

2.41. The DPSIR is an analytical framework that is based on the causal relationship between its D-P-S-I-R components. Driving forces are the socioeconomic and sociocultural forces driving human activities, which increase or mitigate pressures on the environment. Pressures are the stresses that human activities place on the environment. State, or state of the environment, is the condition of the environment. Impacts are the effects of environmental degradation. Responses refer to the responses by society to the environmental situation.

2.42. It is often difficult, however, to distinguish human and natural stressors on the environment, and it is even more challenging to link a particular stressor to a specific impact. In the natural world, each process and state influences and is influenced, making it difficult to separate pressure, state and response. Nevertheless, the DPSIR framework facilitates consistent handling of information and avoids gaps in assessment and analysis. As such, it is useful for grouping and reporting existing data and indicators.

2.43. While adopting certain concepts of the DPSIR framework, the FDES does not apply its causal sequence as an organizing principle. However, the statistical topics of the FDES can be rearranged according to the logic of the DPSIR framework.

2.44. Table 2.3 summarizes key attributes of the six components of the FDES. This includes a general description, examples of the types of data that are included in each component, main sources and partners, and conceptual relationships between each component and other systems and frameworks. Geospatial data refer to statistics related to location or boundaries. Physical data refer to a variety of information that is measured in physical units, such as volume and area. Monetary data refer to information described in terms of monetary units, such as government expenditure on environmental protection. Qualitative data refer to descriptions that rely

primarily on qualitative characterizations, though sometimes including quantitative aspects, such as environmental engagement.

2.7. Main attributes of the components of the FDES

2.45. Table 2.3 provides a description of the six components and the related types of data, as well as main sources and institutions. It also includes a description of the relationship of each component to the DSPIR framework and the SEEA.

Table 2.3
Main attributes of the components of the FDES

	Description	Types of data	Main sources and institutions	Relation to DPSIR and the SEEA
Component 1: Environmental Conditions and Quality	Meteorological, hydrographical, geological, geographical, biological, physical and chemical conditions and characteristics of the environment that determine ecosystems and environmental quality	• Geospatial • Physical • Qualitative	• Monitoring systems • Remote sensing data • Environmental, meteorological, hydrological, geological and geographical authorities or institutions	• State and Impact element in DPSIR • Experimental ecosystem accounts of the SEEA
Component 2: Environmental Resources and their Use	Quantities of environmental resources and their changes and statistics on activities related to their use and management	• Physical • Geospatial	• Statistical surveys • Administrative records • Remote sensing • NSOs • Authorities and institutions such as mining, energy, agriculture, water and forest	• Driving force, Pressure and State elements in DPSIR • Asset and physical flow accounts of the SEEA-CF
Component 3: Residuals	Generation, management and discharge of residuals to air, water and soil	• Physical	• Statistical surveys • Administrative records • Monitoring systems	• Pressure and Response elements in DPSIR • Physical flow accounts of the SEEA-CF
Component 4: Extreme Events and Disasters	Occurrence and impact of natural extreme events and disasters, and technological disasters	• Physical • Monetary • Geospatial • Qualitative	• Administrative records • Remote sensing • Emergency and disaster authorities • Seismic, meteorological monitoring and research centres • Industrial complexes that work with hazardous substances and processes • Insurance companies	• Pressure, Impact and Response elements in DPSIR • Asset accounts of the SEEA-CF
Component 5: Human Settlements and Environmental Health	The built environment in which humans live, particularly with regard to population, housing, living conditions, basic services and environmental health	• Geospatial • Physical	• Statistical surveys • Administrative records • Remote sensing • NSOs • Housing and urban planning and oversight authorities • Cartographic authorities • Transport authorities • For health and administrative records, the health authority	Driving force, Pressure and Impact elements in DPSIR
Component 6: Environmental Protection, Management and Engagement	Environmental protection and resource management expenditure, environmental regulation, both direct and via market instruments, disaster preparedness, environmental perception, awareness and engagement of the society	• Monetary • Qualitative	• Statistical surveys • Administrative records • Remote sensing • NSOs • Entity producing government expenditure statistics • Statistical entity in charge of national or subnational surveys • Environmental authority and other sector authorities	• Response element in DPSIR • Environmental activity accounts and related flows of the SEEA-CF

Chapter 3

Components of the FDES and the Basic Set of Environment Statistics

3.1. The conceptual foundation, the six constituent components and the main structure of the FDES were introduced in Chapter 2. The objective of Chapter 3 is to explain in detail how the contents of the FDES are organized within its constituent components.

3.2. Environmental Conditions and Quality (Component 1) is at the centre of the FDES. The other five components have been established based on their relationship with the central component. Each component is broken down into subcomponents that in turn include relevant statistical topics. The statistical topics represent the measurable aspects of the components of the FDES, taking into consideration the types and sources of the data needed to describe them. The final level contains the actual individual environment statistics.

3.3. Chapter 3 is organized in six parts describing each of the components of the FDES. The description usually covers the most important aspects, including their relevance to environmental policy, scope and content, the type of data typically used or obtained in measurement, the most common sources of data, and the main institutional stakeholders needed to produce the underlying environment statistics. The relation to other frameworks and areas of statistics is also described, where applicable. A comprehensive set of environment statistics underlying the topics (the Basic Set of Environment Statistics) is presented after each component description.

3.4. This Basic Set of Environment Statistics is designed with enough flexibility to adapt to individual countries' environmental concerns, priorities and resources. The Basic Set contains the most important environment statistics in each topic, based on a progression of three tiers. Tier 1 constitutes the Core Set of Environment Statistics. A more detailed description of the development of the Basic Set, the description of the three tiers, and the statistics in the Core Set are found in Chapter 4. The full Basic Set of Environment Statistics is found in Annex A.

3.1. Component 1: Environmental Conditions and Quality

3.5. Component 1 includes statistics about the physical, biological and chemical characteristics of the environment and their changes over time. These fundamental background conditions are strongly interrelated and determine the types, extent, conditions and health of ecosystems. Many of these natural conditions change very slowly as a result of natural processes or human influence. Others may show immediate and dramatic effects. Importantly, changes in environmental conditions and quality are the result of combined and accumulated impacts of natural and human processes. Connecting the changes with individual activities or events is thus not a straightforward process.

3.6. The source of the data is usually remote sensing and monitoring by environmental, meteorological, hydrological, geological and geographical authorities or institutions. Due to

the nature of this field, the use of maps and cartographic information is the common way to present the relevant information, in addition to statistical tabulations.

3.7. Component 1 includes statistics relevant to the State and Impact elements of the DPSIR framework. It also provides basic statistics for the SEEA Experimental Ecosystem Accounting.

3.8. Component 1 contains three subcomponents:

i. Subcomponent 1.1: Physical Conditions;

ii. Subcomponent 1.2: Land Cover, Ecosystems and Biodiversity; and

iii. Subcomponent 1.3: Environmental Quality.

Subcomponent 1.1: Physical Conditions

3.9. Subcomponent 1.1: Physical Conditions, is designed to capture those physical aspects of the environment which change relatively slowly because of human influence. It contains statistics on meteorological, hydrographical, geological, geographical conditions and soil characteristics. While the other subcomponents are also part of the physical environment, their physical, biological or chemical characteristics can be influenced in the short to mid-term by human activities.

3.10. Statistics on these general physical conditions are important, as they help determine the scope of and influences on the environmental resources of a country. Without information on these baseline conditions, it is difficult for governments to judge the need for and efficacy of policies.

Topic 1.1.1: Atmosphere, climate and weather

3.11. This topic covers data on atmospheric, climatic and weather conditions across territories and over time. Weather information describes the atmosphere's behaviour over a given territory in the short term. It is recorded by countries through a network of monitoring stations. Climate is determined by long-term weather conditions over that territory. Relevant data usually include aspects such as temperature, precipitation, humidity, pressure, wind speed, solar radiation, ultraviolet (UV) radiation and the occurrence of El Niño and La Niña events.

3.12. In most countries atmospheric, weather and climate authorities monitor and record these types of environmental data over long periods using a network of monitoring stations scattered throughout the country. They usually produce data covering long time series of climate and atmospheric information with a very high level of detail. The data available in most countries are too dense and detailed for the purposes of environment statistics, so they must be processed (for example, synthesized and aggregated, with central tendencies and variances established with respect to both time and space) to produce environment statistics on weather and climate. Time and seasonal variability is crucial when recording and organizing these types of statistics. The territorial reference of the measurements is important because although the entire territory of a country cannot be monitored, the spatial configuration of the monitoring stations is usually relevant to local and subnational conditions and concerns.

3.13. Statistics on air quality are covered under Subcomponent 1.3: Environmental Quality.

Table 3.1.1.1
Statistics and related information for Topic 1.1.1

Component 1: Environmental Conditions and Quality			
Subcomponent 1.1: Physical Conditions			
Topic 1.1.1: Atmosphere, climate and weather			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Temperature		• National	• World Meteorological Organization (WMO)
1. **Monthly average**	Degrees	• Subnational	• Intergovernmental Panel on Climate Change (IPCC)
2. **Minimum monthly average**	Degrees		• National Oceanic and Atmospheric Administration (NOAA)/National Aeronautics and Space Administration (NASA)
3. **Maximum monthly average**	Degrees		
b. Precipitation (also in 2.6.1.a)			
1. **Annual average**	Height		
2. **Long-term annual average**	Height		
3. Monthly average	Height		
4. Minimum monthly value	Height		
5. Maximum monthly value	Height		
c. Relative humidity			
1. Minimum monthly value	Number		
2. Maximum monthly value	Number		
d. Pressure		• National	
1. *Minimum monthly value*	Pressure unit	• Subnational	
2. *Maximum monthly value*	Pressure unit	• By station	
e. Wind speed		• National	
1. *Minimum monthly value*	Speed	• Subnational	
2. *Maximum monthly value*	Speed		
f. Solar radiation			• WMO
1. *Average daily value*	Area, energy unit		• IPCC
2. *Average monthly value*	Area, energy unit		• NOAA /NASA
3. *Number of hours of sunshine*	Number	• National	
		• Subnational	
		• By month and per year	
g. UV radiation		• National	• World Health Organization (WHO)-UV Radiation Index
1. *Maximum daily value*	Area, energy unit	• Subnational	• WMO-UV Radiation
2. *Average daily value*	Area, energy unit		
3. *Maximum monthly value*	Area, energy unit		
4. *Average monthly value*	Area, energy unit		
h. Occurrence of El Niño/La Niña events, when relevant		• By location	
1. *Occurrence*	Number	• National	
2. *Time period*	Time period	• Subnational	

Topic 1.1.2: Hydrographical characteristics

3.14. This topic includes hydrographical information on the extent, location and characteristics of lakes, rivers and streams, artificial reservoirs, watersheds, seas, aquifers and glaciers. This information is best presented in map form. The main sources are hydrographical and hydrological monitoring and information systems that are usually managed by national geographical, hydrological institutions and water authorities. The data are usually produced for individual river basins or catchments, for use at national and subnational levels. Important exclusions from this topic include water-quality statistics (contained in Topic 1.3.2: Freshwater quality and Topic 1.3.3: Marine water quality) and water resources and their use (contained in Component 2: Environmental Resources and their Use).

Table 3.1.1.2
Statistics and related information for Topic 1.1.2

Component 1: Environmental Conditions and Quality			
Subcomponent 1.1: Physical Conditions			
Topic 1.1.2: Hydrographical characteristics			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Lakes		• By location • By watershed/river basin • National • Subnational	• United Nations Statistics Division (UNSD): International Recommendations for Water Statistics (IRWS) • UN-Water
1. Surface area	Area		
2. *Maximum depth*	Depth		
b. Rivers and streams			
1. Length	Length		
c. Artificial reservoirs			
1. *Surface area*	Area		
2. *Maximum depth*	Depth		
d. Watersheds			
1. **Description of main watersheds**	Area, description		
e. Seas		• By location • National, within coastal waters or Exclusive Economic Zone (EEZ)	
1. Coastal waters	Area		
2. Territorial sea	Area		
3. Exclusive Economic Zone (EEZ)	Area		
4. *Sea level*	Depth		
5. *Area of sea ice*	Area		
f. *Aquifers*	Depth, description	• By location • By salinity levels • By watershed • National • Subnational • Renewable • Non-renewable	
g. Glaciers	Area	• By location • National • Subnational	

Topic 1.1.3: Geological and geographical information

3.15. This topic includes general geological and topographic information on the extent and characteristics of the country's territory and relief. These characteristics typically change slowly over time; as such, the statistics produced are normally static. Because of their nature, these geological (e.g., bedrock, fault lines and volcanoes), geographical (e.g., territorial borders, area of country, elevation and length of marine coastline) data are often presented in map form. The main data sources are information systems operated by national geographical and geological institutions and authorities.

3.16. Statistics on stocks of mineral resources and their extraction are included in Component 2: Environmental Resources and their Use.

Table 3.1.1.3
Statistics and related information for Topic 1.1.3

Component 1: Environmental Conditions and Quality			
Subcomponent 1.1: Physical Conditions			
Topic 1.1.3: Geological and geographical information			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Geological, geographical and geomorphological conditions of terrestrial areas and islands		• National	• UNSD: Demographic Yearbook • Food and Agriculture Organization of the United Nations (FAO) • Center for International Earth Science Information Network (CIESIN)
1. Length of border	Length		
2. **Area of country or region**	Area, location		
3. Number of islands	Number	• By location • National	
4. Area of islands	Area		
5. *Main geomorphological characteristics of islands*	Description		
6. *Spatial distribution of land relief*	Description, location		
7. *Characteristics of landforms* (e.g., plains, hills, plateaus, dunes, volcanoes, mountains, seamounts)	Description, area, height		
8. *Area by rock types*	Area		
9. *Length of fault lines*	Length		
b. **Coastal waters** (including area of coral reefs and mangroves)	Area, description		
c. **Length of marine coastline**	Length		
d. **Coastal area**	Area		

Topic 1.1.4: Soil characteristics

3.17. Soil is a multifunctional part of the environment. It provides the physical base to support the production and cycling of biological resources, provides the foundation for buildings and infrastructure, constitutes the source of nutrients and water for agriculture and forestry systems, provides a habitat for diverse organisms, plays an essential role in carbon sequestration and fulfils a complex buffering role against environmental variability, ranging from dampening diurnal and seasonal change in temperature and water supply to the storage and binding of a range of chemical and biological agents. The main environmental concerns about soil pertain to its degradation through soil erosion or nutrient depletion, among other processes.

3.18. Statistics on soil characteristics are an important tool for policymakers, particularly in countries that rely heavily on agriculture and forestry to sustain livelihoods, and for which the quality and amount of soil resources are very relevant.

3.19. Soil characteristics can be measured by the area by soil types. Various soil types can be defined using information on different combinations of soil components and properties. Soil typologies can be found at the global level (from FAO[25] or the Harmonised World Soil Database).[26] Many countries have also produced a classification of their own soil types for national purposes.[27] Most soil classifications combine the physical properties (e.g., texture, structure, density, porosity, consistency, temperature and colour) and the type of organic matter (e.g., plant material, fungi, bacteria, protozoa, arthropods and earthworms) sheltered by the soil that may be alive or at different stages of decomposition.

3.20. Information on soil degradation and nutrient content for specific types of soil or specific locations should also be included in this topic. Statistics on degradation include measures of erosion, desertification, salinization, waterlogging, acidification and compaction of specific soil types in particular parts of the country. The nutrient content of soil is typically assessed using data on levels of nitrogen (N), phosphorous (P), calcium (Ca), magnesium (Mg), potassium (K) and zinc (Zn). Data for soil degradation types and extent, as well as nutrient content, are usually produced from scientific research and monitoring programmes. They can also come from estimation and modelling by research institutions and agricultural authorities.

[25] FAO has described 30 soil groups: acrisols, albeluvisols, alisols, andosols, anthrosols, arenosols, calcisols, cambisols, chernozems, cryosols, durisols, ferralsols, fluvisols, gleysols, gypsisols, histosols, kastanozems, leptosols, lixisols, luvisols, nitisols, phaeozems, planosols, plinthosols, podzols, regosols, solonchaks, solonetz, umbrisols and vertisols. Food and Agriculture Organization of the United Nations (1998). "World Reference Base for Soil Resources", available from www.fao.org/docrep/W8594E/w8594e03.htm#elements (accessed 4 August 2017).

[26] *Harmonised World Soil Database*, Version 1.2, February 2012, describes 28 major soil groupings that can be used to categorize and map soils at a broad global scale, available from http://webarchive.iiasa.ac.at/Research/LUC/External-World-soil-database/HWSD_Documentation.pdf (accessed 4 August 2017).

[27] For example, the United States Department of Agriculture soil taxonomy includes 12 soil orders: alfisol, andisols, aridisols, entisols, gelisols, histosols, inceptisols, mollisols, oxisols, spodosols, ultisols and vertisols, available from www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051232.pdf (accessed 4 August 2017).

3.21. Soil characteristics are measured through a series of inventory processes, known collectively as a soil survey. Typically, a soil survey produces data and maps by soil types, soil suitability for various purposes, hazard and degradation potential and, in some cases, maps of specific soil properties. Data and maps on soil typologies covering the national territory are produced primarily by scientific research institutions and by geological, geographical and, sometimes, agricultural authorities.

3.22. Soil pollution statistics are included under Topic 1.3.4: Soil pollution.

Table 3.1.1.4
Statistics and related information for Topic 1.1.4

Component 1: Environmental Conditions and Quality			
Subcomponent 1.1: Physical Conditions			
Topic 1.1.4: Soil characteristics			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Soil characterization		• By location • By soil type • National • Subnational	• FAO and the International Institute for Applied Systems Analysis (IIASA) Harmonized World Soil Database • International Soil Reference and Information Centre (ISRIC) World Data Centre for Soils • United Nations Convention to Combat Desertification (UNCCD) • FAO Global Assessment of Human-induced Soil Degradation (GLASOD)
1. **Area by soil types**	Area		
b. Soil degradation			
1. **Area affected by soil erosion**	Area		
2. **Area affected by desertification**	Area		
3. Area affected by salinization	Area		
4. Area affected by waterlogging	Area		
5. Area affected by acidification	Area		
6. *Area affected by compaction*	Area		
c. Nutrient content of soil, measured in levels of:		• By soil type • By nutrient • National • Subnational	
1. Nitrogen (N)	Concentration		
2. Phosphorous (P)	Concentration		
3. *Calcium (Ca)*	Concentration		
4. *Magnesium (Mg)*	Concentration		
5. *Potassium (K)*	Concentration		
6. *Zinc (Zn)*	Concentration		
7. *Other*	Concentration		

Subcomponent 1.2: Land Cover, Ecosystems and Biodiversity

3.23. This subcomponent organizes environment statistics on land cover, ecosystems and biodiversity, as well as their recordable changes over time and across locations. Land cover is defined by FAO as "the observed (bio) physical cover on the earth's surface."[28] Changes in land cover are the result of natural processes and changes in land use. Ecosystems can be broadly defined as a community of organisms, together with their physical environment, viewed as a system of interacting and interdependent relationships. Biodiversity is the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, including diversity within species, between species and of ecosystems.[29] It is also a measure of ecosystem health. Biodiversity is a fundamental characteristic of ecosystems, while variability among ecosystems is a fundamental driver of biodiversity.

3.24. Protected areas and species are included in this subcomponent because of their inherent role in maintaining biodiversity and ecosystem health. The main purpose of designating protected areas and species is to sustain valuable ecosystems and the biodiversity and survival of threatened or key species that exist in certain zones.

[28] Food and Agriculture Organization of the United Nations (2005). *Land Cover Classification System*, available from www.fao.org/docrep/008/y7220e/y7220e00.htm (accessed 4 August 2017).

[29] United Nations Convention on Biological Diversity, Rio de Janeiro, 5 June 1992, available from http://treaties.un.org/doc/Treaties/1992/06/19920605%2008-44%20PM/Ch_XXVII_08p.pdf (accessed 4 August 2017).

3.25. Land cover statistics can be used to systematically record the biophysical characteristics of land. They include the land area and also the area under inland water (e.g., rivers, lakes and ponds), coastal water bodies and inter-tidal areas, but not marine water.

3.26. Statistics related to ecosystems and biodiversity are critical given the increasing understanding of the role ecosystems play in human well-being and evidence of biodiversity loss across the planet. Maintaining biodiversity and ecosystem health is necessary to preserve the genetic and ecosystem inheritance of a country, as well as its ecological productivity. This also protects, subsequently, the productivity of ecosystems for the use of the economy and society, which depend heavily on the diversity of ecological systems for human livelihoods (e.g., production, distribution and consumption).

3.27. Because of the importance of forests worldwide, the most important aspects and statistics required to describe them are organized under a separate topic, Topic 1.2.3: Forests. As forests constitute particular ecosystem and land cover categories, their characteristics are also included within the other topics of this subcomponent. Presenting forests as a separate topic depends on their significance in a given country or area. Similarly, other land cover or ecosystem categories may be presented as separate topics depending on national priorities.

3.28. Statistics on biological resources (such as timber and fish) and their harvesting are contained in Component 2: Environmental Resources and their Use.

Topic 1.2.1: Land cover

3.29. This topic includes statistics on the extent, and the physical and spatial characteristics of land cover. The main source of land cover information is remote sensing data that maps the different categories of land cover.

3.30. The LCCS was developed by FAO.[30] The many combinations of land cover features that can be created using the LCCS approach apply to any type of land cover. An interim classification composed of 14 classes was developed in the SEEA-CF (included in Annex D)[31] following a comprehensive global consultation process. These 14 classes were generated using the LCCS approach and thus provide a comprehensive set of land cover types, all of which are mutually exclusive and unambiguous, with clear boundaries and systematic definitions. Furthermore, the identified classes are defined to be used as the basis for developing ecosystem statistics. The aim of the classification is to provide a common framework to compile and aggregate land cover information available at the national level and enabling its comparability at the international level, and to provide a structure to guide data collection and the creation of land cover databases for countries that are developing land cover statistics.

[30] Food and Agriculture Organization of the United Nations (2000). *Land Cover Classification System*, available from www.fao.org/docrep/003/x0596e/x0596e00.htm (accessed 4 August 2017).

[31] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2014). *System of Environmental-Economic Accounting 2012—Central Framework*, available from http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed 4 August 2017).

Table 3.1.2.1
Statistics and related information for Topic 1.2.1

Component 1: Environmental Conditions and Quality			
Subcomponent 1.2: Land Cover, Ecosystems and Biodiversity			
Topic 1.2.1: Land cover			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Area under land cover categories**	Area	• By location • By type of land cover (e.g., artificial surfaces, including urban and associated areas; herbaceous crops; woody crops; multiple or layered crops; grassland; tree-covered areas; mangroves; shrub-covered areas; shrubs and/or herbaceous vegetation, aquatic or regularly flooded; sparsely natural vegetated areas; terrestrial barren land; permanent snow and glaciers; inland water bodies; and coastal water bodies and inter-tidal areas)[a] • National • Subnational	• FAO Land Cover Classification System • System of Environmental-Economic Accounting (SEEA) Central Framework (2012) land cover categories • European Environment Agency (EEA)

[a] SEEA land cover categories, based on FAO Land Cover Classification System (http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf)

Topic 1.2.2: Ecosystems and biodiversity

3.31. This topic covers physical quantitative as well as qualitative information and statistics about a country's main ecosystems, including the extent, chemical and physical characteristics, and biological components (biodiversity) of the ecosystems. The extent and conditions of the ecosystems determine their capacity to produce ecosystem services.

3.32. In order to characterize the ecosystems of a country, in the absence of an internationally agreed ecosystem classification, national classifications may be used and fully described for statistical purposes. Alternatively, the country may follow and adapt other ecosystem categories used internationally, such as the Millennium Ecosystem Assessment reporting categories. The broadest reporting categories used in the Millennium Ecosystem Assessment [32] are forest, cultivated, dryland, coastal, marine, urban, polar, inland water, island and mountain. As recognized by the Millennium Ecosystem Assessment, these ecosystem reporting categories can and do overlap, so countries may wish to decide as to the exact composition, inclusions and exclusions of the main ecosystems in accordance with national or existing international definitions.

[32] Millennium Ecosystem Assessment (2005). *Ecosystems and Human Well-being: Synthesis*, Washington, D.C., Island Press, available from www.millenniumassessment.org/documents/document.356.aspx.pdf (accessed 4 August 2017).

3.33. Ecosystem categories are complicated to describe because of considerations of scale. Ecosystems may be grouped alternatively into biomes, biogeographical regions, habitats or river basins/sub-basins. A biome is a distinct community of plants, animals or fungi that occupy a distinct region. It is often referred to as an ecosystem. Depending on the country, ecosystems may be subdivided into small homogenous units (in practice, land cover units which are homogenous in terms of provisioning ecosystem services) and broader spatial and statistical units reflecting socioecological systems.

3.34. Sets of statistics and indicators may be produced for each ecosystem category to capture baselines and trends over time and space. These may be organized into the following categories:

i. Statistics on extent (location and size) and pattern, which describe the spatial area of ecosystems and how they intermingle across the landscape (e.g., area of wetlands, rivers and streams, the proximity of croplands to residences and habitat fragmentation);

ii. Statistics on chemical and physical characteristics, which report on nutrients, carbon, oxygen, contaminants and key physical trends (e.g., the amount of nitrogen

that major rivers deliver to the nation's coastal waters, soil nutrient depletion and cropland erosion);

iii. Statistics on biological components, which provide information on the diversity and conditions of plants, animals and living habitats (e.g., number of known species or species at risk of extinction); and

iv. Statistics on ecosystem goods and services, which describe the flows that humanity derives from ecosystems (e.g., amount of timber harvested).[33]

Statistics describing the extent, the chemical and physical characteristics and the biological components (biodiversity) of the ecosystems are included in this topic. Statistics describing the goods and services provided by ecosystems are included in Component 2 (Environmental Resources and their Use) and Component 3 (Residuals).

[33] H. John Heinz III Center for Science, Economics, and the Environment. *The State of the Nation's Ecosystems 2008: Measuring the Lands, Waters, and Living Resources of the United States*, (Washington, D.C.: Island Press, 2008).

3.35. Statistics on biodiversity include statistics on the diversity of flora and fauna species (the plant and animal life of a particular region or time, generally regarded as that which is naturally occurring and indigenous). Biota is defined as all animal and plant life of a particular region or time. Biotic (living) factors function with the abiotic (non-living) factors to form a complex unit such as an ecosystem. Typical themes include the number and population trends of known species of flora and fauna (terrestrial, freshwater and marine) and their vulnerability status category.

3.36. Human activities affect flora, fauna and biodiversity both directly and indirectly, resulting in changes that are reflected by statistics on the status of flora and fauna species. The IUCN Red List of Threatened Species categories and criteria[34] is based on the threat level. The main categories are extinct, extinct in the wild, threatened (critically endangered, endangered and vulnerable), near threatened and least concern.

[34] International Union for Conservation of Nature and Natural Resources, Species Survival Commission (2010). *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels (Version 4.0)*, available from http://s3.amazonaws.com/iucnredlist-newcms/staging/public/attachments/3101/reg_guidelines_en.pdf (accessed 4 August 2017).

3.37. Data on species populations are usually available on species of specific significance. Data are often obtained from expert and ad hoc scientific studies and assessments, as well as research conducted by NGOs and civil society. This can result in scattered and non-systematized data. When available and appropriate, displaying information through GIS can also be particularly useful.

3.38. Statistics on protected areas include physical and descriptive information and statistics on protected terrestrial and marine areas within the country. The IUCN Protected Area Management Categories[35] are based on the strictness of protection and serve as the classification for protected areas. The main categories are strict nature reserve, wilderness area, national park, natural monument or feature, habitat/species management area, protected landscape/seascape, and protected area with sustainable use of natural resources.

[35] International Union for Conservation of Nature and Natural Resources. *IUCN Protected Areas Categories System*, available from www.iucn.org/theme/protected-areas/about/categories (accessed 4 August 2017).

3.39. The administrative and legal measures taken to protect a species also reflect its vulnerability at the national or local level. Statistics on protected species are thus also relevant for this topic. Administrative records are the main source of data on protected areas and species. Data may also be found in secondary databases and reports on the status of ecosystems or the state of the environment. They usually fall under the responsibility of environmental authorities and are frequently produced for the national and subnational levels.

3.40. Although information on ecosystems and biodiversity is well developed and increasingly available from ecosystem science and other disciplines, it is not used frequently or systematically in the production of statistics. Developing meaningful statistics on ecosystems and biodiversity requires the collaboration of scientists and statisticians. Ongoing work on the SEEA Experimental Ecosystem Accounting, among other efforts, will improve this situation in the future.

Table 3.1.2.2
Statistics and related information for Topic 1.2.2

Component 1: Environmental Conditions and Quality			
Subcomponent 1.2: Land Cover, Ecosystems and Biodiversity			
Topic 1.2.2: Ecosystems and biodiversity			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. General ecosystem characteristics, extent and pattern		• By location • By ecosystem (e.g., forest, cultivated, dryland, coastal, marine, urban, polar, inland water, island, mountain)[b]	• Millennium Ecosystem Assessment • Convention on Biological Diversity (CBD) • UN Economic Commission for Europe (UNECE) Standard Statistical Classification of Flora, Fauna and Biotopes (1996) • Convention on Wetlands of International Importance, especially as Waterfowl Habitat (the Ramsar Convention)
1. **Area of ecosystems**	Area		
2. *Proximity of ecosystem to urban areas and cropland*	Distance		
b. Ecosystems' chemical and physical characteristics			
1. *Nutrients*	Concentration		
2. *Carbon*	Concentration		
3. *Pollutants*	Concentration		
c. Biodiversity		• By ecosystem (e.g., forest, cultivated, dryland, coastal, marine, urban, polar, inland water, island, mountain)[b] • By status category (e.g., extinct, extinct in the wild, threatened, near threatened, least concern) • By class (e.g., mammals, fishes, birds, reptiles) • National • Subnational	• Millennium Ecosystem Assessment • CBD • International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species • UNECE Standard Statistical Classification of Flora, Fauna and Biotopes (1996) • FAO FISHSTAT (Species population and number of invasive alien species)
1. **Known flora and fauna species**	Number		
2. Endemic flora and fauna species	Number		
3. Invasive alien flora and fauna species	Number		
4. Species population	Number		
5. *Habitat fragmentation*	Area, description, location, number		
d. Protected areas and species		• By location • By management category[c] • By ecosystem (e.g., forest, cultivated, dryland, coastal, marine, urban, polar, inland water, island, mountain)[b] • National • Subnational	• IUCN Protected Area Management Categories • UNSD: Millennium Development Goal (MDG) Indicator 7.6 Metadata
1. **Protected terrestrial and marine area** (also in 1.2.3.a)	Number, area		
2. Protected flora and fauna species	Number	• By species • By ecosystem (e.g., forest, cultivated, dryland, coastal, marine, urban, polar, inland water, island, mountain)[b] • By status category • National • Subnational	• IUCN Red List of Threatened Species • UNSD: MDG Indicator 7.7 Metadata

[b] Reporting categories used in the Millennium Ecosystem Assessment (www.millenniumassessment.org/documents/document.356.aspx.pdf)

[c] IUCN reporting categories: strict nature reserves, wilderness areas, national parks, natural monuments or features, habitat/species management areas, protected landscapes/seascapes and protected areas with sustainable use of natural resources (www.iucn.org/theme/protected-areas/about/categories)

Topic 1.2.3: Forests

3.41. Forests provide livelihoods for millions of people around the world. They offer timber, food, shelter, fuel and medicinal products, and also perform significant ecosystem functions such as hydrological regulation, soil protection and biodiversity protection, and act as carbon sinks. Therefore, it is crucial to understand the extent and characteristics of forests and to produce statistics about their diverse dimensions. The importance of forests is reflected in the MDGs (Indicator 7.1 Proportion of land area covered by forest).

3.42. Forest is defined by FAO as land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 per cent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. Complementarily, FAO defines other wooded land as land not classified as "Forest", spanning more than 0.5 hectares; with trees higher than 5 metres and a canopy cover of 5 to 10 per cent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 per cent. It does not include land that is predominantly under agricultural or urban land use.[36]

[36] Food and Agriculture Organization of the United Nations (2010). *Global Forest Resources Assessment 2010 Main Report*, available from www.fao.org/docrep/013/i1757e/i1757e.pdf (accessed 4 August 2017).

3.43. The most important statistics in this topic include forest area, which can be disaggregated by forest type (e.g., primary forest, other naturally generated forest and planted forest). Forest area can also be shown based on dominant tree species, age distribution, productivity, primary use of forest, areas under sustainable forest management and protected forests. Further statistics may include forest biomass and its carbon storage, and a characterization of forest ecosystems that exist in the country, including types, location, area and main species of flora and fauna living in the forest. Statistics on the forest area affected by fire may also be included. (See also Topic 1.2.2: Ecosystems and biodiversity.)

3.44. Data on forest area and its biophysical characteristics may be obtained from remote sensing, field surveys, forest inventories and forestry statistics from forest management agencies (e.g., agricultural and forestry authorities).

3.45. Statistics on changes in forest area due to economic activities and natural processes, and on timber and other forest resources and their use, are contained in Component 2: Environmental Resources and their Use.

Table 3.1.2.3
Statistics and related information for Topic 1.2.3

Component 1: Environmental Conditions and Quality			
Subcomponent 1.2: Land Cover, Ecosystems and Biodiversity			
Topic 1.2.3: Forests			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Forest area		• By forest type • National • Subnational • By dominant tree species • By ownership category	• FAO Global Forest Resources Assessment (FRA) • UN Forum on Forests (UNFF) Monitoring, Assessment and Reporting (MAR) • UNSD: MDG Indicator 7.1 Metadata • Montreal Process (Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests) • State of Europe's Forests (Forest Europe/UNECE-FAO Forestry and Timber Section)
1. **Total**	Area		
2. Natural	Area		
3. Planted	Area		
4. Protected forest area (also in 1.2.2.d)	Area		
5. Forest area affected by fire	Area		
b. Forest biomass			
1. Total	Volume		
2. *Carbon storage in living forest biomass*	Mass		

Subcomponent 1.3: Environmental Quality

3.46. This subcomponent organizes statistics on the concentration of pollutants in the air, freshwater and marine water, and on soil pollution and noise levels. Measurements of concentrations of substances in the environmental media reflect the combined and cumulative impact of human and natural processes. This pollution impacts both the human subsystem and ecosystems.

3.47. Policymakers, analysts and civil society require statistics on environmental quality to monitor and make evidence-based policies to maintain and improve environmental quality globally and in each country. Pollutant concentration statistics provide information on the quality of environmental media. The importance of pollutants may vary when considering the quality of the ecosystem or the health and well-being of humans and other living beings.

3.48. The spatial implications of pollutant concentration statistics are particularly important because of the fluidity of the environmental media (e.g., freshwater, marine water and air). Spatial information on impacts on ecosystems near a pollution source is particularly important. Air and water transport pollutants from one medium to another and from one geographic area to another. Transforming measurements of pollutants into statistics can be laborious because of spatial and temporal considerations. This underscores the need for collaboration between statistical offices and environmental agencies on the design (sampling pattern) of monitoring networks.

3.49. When national or local maximum allowable levels of pollutants exist in countries, these values should be compared with the actual measured pollutant levels. Statistics on frequency of occurrences or per cent of pollution events above maximum allowable levels are usually more important measures of environmental quality than national aggregates or averages. The number and area of locations where maximum allowable levels are exceeded can, however, be important at the national level.

3.50. Statistics on concentrations of pollutants are usually organized according to environmental media such as air, water and soil. Depending on the situation, countries monitor the concentrations of the most relevant pollutants for which statistical series can be produced.

3.51. It should be noted that the emissions of these pollutants are not included here but, rather, in Component 3: Residuals and are linked to the activities and processes that generate, manage and, finally, discharge them to the environment.

Topic 1.3.1: Air quality

3.52. This topic includes statistics on the ambient concentration of the most important air pollutants, including suspended solid particles, gases and other relevant pollutants that can have a negative effect on human and ecosystem health.

3.53. Air quality is measured at monitoring stations. Data availability varies according to the country's circumstances. Where monitoring programmes and stations exist, the data produced require further processing for transformation into environment statistics. Based on their location and purpose, monitoring stations may be impact, regional or background stations. Impact stations are situated near major sources of pollution and measure the direct impact on local air quality. Regional stations are not affected directly by pollution sources. They measure how the pollution is transported and changes through space and time. Background stations are usually located in places that are not directly affected by human activities and provide data on natural conditions. Changes in background concentrations are usually slow and reflect the combined impact of human and natural processes. The UNECE Standard Statistical Classification of Ambient Air Quality (1990) lists the most important substances, parameters and variables recommended for measurement at impact, regional and background monitoring stations (see

Annex D: Classifications and environment statistics). Further information is also available in the WHO Air Quality Guidelines.[37,38]

3.54. National monitoring of air quality is usually limited to urban settlements where polluting activities and the affected population are concentrated. Air quality in urban settlements is also relevant to Component 5: Human Settlements and Environmental Health. Air quality monitoring is also conducted frequently in ecosystems or habitats of outstanding value or of high vulnerability. Statistics based on these measurements may be used to describe certain aspects of ecosystem health.

3.55. The statistics pertaining to concentration of gases in the atmosphere that are climate change drivers under this topic also include global concentrations of the two main GHGs which are carbon dioxide (CO_2) and methane (CH_4).

[37] World Health Organization (2006). *Air Quality Guidelines—Global Update 2005, Particulate matter, ozone, nitrogen dioxide and sulfur dioxide*, available from www.euro.who.int/__data/assets/pdf_file/0005/78638/E90038.pdf?ua=1 (accessed 4 August 2017).

Table 3.1.3.1
Statistics and related information for Topic 1.3.1

Component 1: Environmental Conditions and Quality			
Subcomponent 1.3: Environmental Quality			
Topic 1.3.1: Air quality			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)			
a. Local air quality		• By point measurement • Subnational • Daily maximum • Monthly maximum and average • Yearly maximum and average	• WHO Air Quality Guidelines—Global Update 2005, Particulate matter, ozone, nitrogen dioxide and sulfur dioxide • WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global Update 2005, Summary of risk assessment • UNECE Standard Statistical Classification of Ambient Air Quality (1990)
1. **Concentration level of particulate matter (PM_{10})**	Concentration		
2. **Concentration level of particulate matter ($PM_{2.5}$)**	Concentration		
3. **Concentration level of tropospheric ozone (O_3)**	Concentration		
4. **Concentration level of carbon monoxide (CO)**	Concentration		
5. **Concentration level of sulphur dioxide (SO_2)**	Concentration		
6. **Concentration levels of nitrogen oxides (NO_x)**	Concentration		
7. Concentration levels of heavy metals	Concentration		
8. Concentration levels of non-methane volatile organic compounds (NMVOCs)	Concentration		
9. *Concentration levels of dioxins*	Concentration		
10. *Concentration levels of furans*	Concentration		
11. Concentration levels of other pollutants	Concentration		
12. Number of days when maximum allowable levels were exceeded per year	Number	By pollutant	
b. Global atmospheric concentrations of greenhouse gases		Global	WMO
1. Global atmospheric concentration level of carbon dioxide (CO_2)	Concentration		
2. Global atmospheric concentration level of methane (CH_4)	Concentration		

Topic 1.3.2: Freshwater quality

3.56. Without sufficient quantities of good quality freshwater, ecosystems and humans cannot survive. Precipitation, aquifers, lakes, rivers, coastal zones and oceans are all interconnected in the water cycle, so the choice of where to measure or monitor pollutants and which pollutants to monitor will depend on local and national priorities, ecosystem characteristics and resources available. Identification of the pollutants that are most relevant for monitoring depends on several factors. These include the immediate and subsequent water uses that are important to humans and the nature of the pollutants found in water bodies and watersheds that affect the country's biocapacities and local ecological equilibriums.

3.57. The quality of freshwater can be described based on concentrations of nutrients and chlorophyll, organic matter, pathogens, metals and organic contaminants, and by physical and chemical characteristics in surface water and groundwater. Pollutants found in groundwater are important but systematic measurements are often difficult.

[38] World Health Organization (2006). *Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide, Global Update 2005, Summary of risk assessment*, available from http://whqlibdoc.who.int/hq/2006/WHO_SDE_PHE_OEH_06.02_eng.pdf?ua=1 (accessed 4 August 2017).

3.58. The fluidity of this medium presents a challenge with regard to selecting the most important spatial locations and relevant frequency for monitoring stations and programmes. This can cause complications with regard to spatial and temporal aggregation when producing data sets. For example, the significance of pollutant concentrations can vary widely at different points in a water body depending on multiple factors, including where and when the highest concentrations of pollutants are discharged into the body. Seasonal variations in the volume of freshwater can also affect the concentrations of pollutants.

3.59. The quality and quantity of freshwater are highly inter-related. Highly polluted water may not be usable, thereby reducing the actual usable quantity of water significantly. In addition, the costs of treating polluted water may be high.

3.60. Data for water quality statistics are produced primarily by monitoring stations. Monitoring programmes are usually developed when a policy or quality norm is set up for specific locations that show the most problematic signs of pollution. Most monitoring stations and regular monitoring programmes are aimed at measuring specific pollutants. The data from these monitoring stations require further processing to produce environment statistics on the water quality of specific locations. Typically, the resulting environment statistics will be produced and be relevant for specific local areas or parts of rivers and lakes, but are not representative at the national level.

3.61. The UNECE Standard Statistical Classification of Surface Freshwater Quality for the Maintenance of Aquatic Life (1992) lists the most important substances, parameters and statistics needed to assess freshwater quality (see Annex D: Classifications and environment statistics).

Table 3.1.3.2
Statistics and related information for Topic 1.3.2

Component 1: Environmental Conditions and Quality			
Subcomponent 1.3: Environmental Quality			
Topic 1.3.2: Freshwater quality			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Nutrients and chlorophyll		• By water body • By watershed/river basin • By surface or groundwater • By point measurement • By type of water resource	• UNECE Standard Statistical Classification of Freshwater Quality for the Maintenance of Aquatic Life (1992) • UN Environment Programme (UNEP) Global Environment Monitoring System—Water (GEMS-Water) • WHO
1. **Concentration level of nitrogen**	Concentration		
2. **Concentration level of phosphorous**	Concentration		
3. Concentration level of chlorophyll A	Concentration		
b. Organic matter			
1. **Biochemical oxygen demand (BOD)**	Concentration		
2. Chemical oxygen demand (COD)	Concentration		
c. Pathogens			
1. **Concentration levels of faecal coliforms**	Concentration		
d. Metals (e.g., mercury, lead, nickel, arsenic, cadmium)			
1. Concentration levels in sediment and freshwater	Concentration		
2. Concentration levels in freshwater organisms	Concentration		
e. Organic contaminants (e.g., PCBs, DDT, pesticides, furans, dioxins, phenols, radioactive waste)			• UNECE Standard Statistical Classification of Freshwater Quality for the Maintenance of Aquatic Life (1992) • UNEP GEMS-Water • Stockholm Convention
1. Concentration levels in sediment and freshwater	Concentration		
2. Concentration levels in freshwater organisms	Concentration		
f. Physical and chemical characteristics			• UNECE Standard Statistical Classification of Freshwater Quality for the Maintenance of Aquatic Life (1992) • UNEP GEMS-Water
1. pH/acidity/alkalinity	Level		
2. Temperature	Degrees		
3. *Total suspended solids (TSS)*	Concentration		
4. Salinity	Concentration		
5. Dissolved oxygen (DO)	Concentration		
g. Plastic waste and other freshwater debris			
1. Amount of plastic waste and other debris	Area, mass		

Topic 1.3.3: Marine water quality

3.62. Oceans cover about 70 per cent of the earth's surface. They play a critical role in regulating weather and atmospheric processes, absorb 30 per cent of emitted CO_2, are a fundamental part of the water cycle and are home to species and varied ecosystems worldwide. Oceans also provide important ecosystem services for humans, with food at the forefront. Oceans are under tremendous anthropogenic pressure, including both chemical and physical contamination and over-exploitation. Marine water and ecosystems have been increasingly polluted in the last century, with critical impacts on biodiversity. Degradation is accompanied by depletion of aquatic resources based on human exploitation.

3.63. Relevant statistics about marine and coastal water quality and pollutant concentrations may include, but are not limited to, nutrients and chlorophyll, organic matter, pathogens, metals, organic contaminants, physical and chemical characteristics, and coral bleaching.

3.64. The most commonly monitored marine pollutants and associated phenomena, such as eutrophication and red tide, can be analysed as relevant in local, national or supranational terms, based on the type of pollution and effect.

3.65. Data sources for marine water quality statistics are typically either national or international monitoring stations, associated with scientific research or compliance with policy objectives and targets. Monitoring programmes are usually constructed when scientific interest in research exists and/or when policy or quality norms are established for specific areas that show the most problematic signs of marine pollution. The data from these monitoring stations require further processing to produce environment statistics on the water quality of specific locations.

3.66. Spatial and temporal considerations are very important when constructing statistics on this topic. For instance, with regard to oceanic and marine water pollutant concentrations, most monitoring stations and water regular quality monitoring programmes focus on surface marine water and coastline zones. There is a lack of deep ocean monitoring. Given the fluidity of the oceans' waters, waves, tides and continued movement determining location, depth and appropriate time periods for measurement applicable to each relevant pollutant is a complex task.

3.67. The UNECE Standard Statistical Classification of Marine Water Quality (1992) lists the most important pollutants, parameters and statistics needed to assess marine water quality. There are many important marine environment and marine water quality statistics which a country may track. Examples include concentrations of bio-pollutants, heavy metals, persistent toxins and radioactive substances, as well as the area affected by coral bleaching. Producing statistics on the concentrations and effects of pollutants and waste in marine water bodies is of the greatest importance to both ecosystems and human health (see Annex D: Classifications and environment statistics).

Table 3.1.3.3
Statistics and related information for Topic 1.3.3

Component 1: Environmental Conditions and Quality			
Subcomponent 1.3: Environmental Quality			
Topic 1.3.3: Marine water quality			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Nutrients and chlorophyll		• By coastal zone, delta, estuary or other local marine environment • Subnational • National • Supranational • By point measurement • By water resource	• UNECE Standard Statistical Classification of Marine Water Quality (1992) • NOAA/NASA • UNEP Regional Seas Programme
1. **Concentration level of nitrogen**	Concentration		
2. **Concentration level of phosphorous**	Concentration		
3. Concentration level of chlorophyll A	Concentration		
b. Organic matter			
1. **Biochemical oxygen demand (BOD)**	Concentration		
2. Chemical oxygen demand (COD)	Concentration		
c. Pathogens			
1. Concentration levels of faecal coliforms in recreational marine waters	Concentration		
d. Metals (e.g., mercury, lead, nickel, arsenic, cadmium)			
1. Concentration levels in sediment and marine water	Concentration		
2. Concentration levels in marine organisms	Concentration		
e. Organic contaminants (e.g., PCBs, DDT, pesticides, furans, dioxins, phenols, radioactive waste)			• UNECE Standard Statistical Classification of Marine Water Quality (1992) • NOAA/NASA • UNEP Regional Seas Programme • Stockholm Convention
1. *Concentration levels in sediment and marine water*	Concentration		
2. *Concentration levels in marine organisms*	Concentration		
f. Physical and chemical characteristics			• UNECE Standard Statistical Classification of Marine Water Quality (1992) • NOAA/NASA • UNEP Regional Seas Programme
1. *pH/acidity/alkalinity*	Level		
2. Temperature	Degrees		
3. *Total suspended solids (TSS)*	Concentration		
4. *Salinity*	Concentration		
5. Dissolved oxygen (DO)	Concentration		
6. *Density*	Density		
g. Coral bleaching			
1. **Area affected by coral bleaching**	Area		
h. Plastic waste and other marine debris		• By coastal zone, delta, estuary or other local marine environment • By location • Subnational • National • Supranational • By point measurement	• UNECE Standard Statistical Classification of Marine Water Quality (1992) • NOAA/NASA • UNEP Regional Seas Programme
1. *Amount of plastic waste and other debris in marine waters*	Area, mass		
i. Red tide			
1. *Occurrence*	Number		
2. *Impacted area*	Area		
3. *Duration*	Duration		
j. Oil pollution			
1. *Area of oil slicks*	Area		
2. *Amount of tar balls*	Area, diameter, number		

Topic 1.3.4: Soil pollution

3.68. Soil pollution is typically caused by chemicals and other residuals disposed of by humans. The most common sources of soil contamination include leakage from underground storage tanks and pipelines, the use of pesticides in agriculture and forestry, the percolation of polluted waters, oil and fuel dumping, direct discharges of wastewater and industrial residuals to the soil, and deposition from air pollution.

3.69. Some of the most commonly measured soil pollutants include petroleum hydrocarbons (e.g., oil residuals and solvents), pesticides and heavy metals.

3.70. Data for soil pollution are produced primarily by monitoring stations and are related to those specific locations. The data from these monitoring stations require further processing to produce environment statistics on the soil quality of specific locations. The resulting environment statistics should be produced and be relevant for the specific local areas where the most problematic soil pollution conditions exist. Owing to local variations in soil quality, it will be very difficult to develop figures that are representative at national level.

3.71. Soil pollution directly affects human and environmental health and land productivity based on factors including pollutant concentration, depth of contact with biota and density of humans in polluted areas. However, soil pollution is rarely monitored. It is usually documented and measured after major pollution events that require clean-up or intervention. Thus, the data available for statistical purposes are usually limited and not systematic.

3.72. Statistics on soil pollution also cover statistics on contaminated sites. The term "contaminated site" refers to a well-defined area where the presence of soil pollution has been confirmed, and this presents a potential risk to humans, water, ecosystems or other receptors. The term "potentially contaminated site" refers to sites where unacceptable soil contamination is suspected but not verified and detailed investigations need to be carried out to verify whether there is unacceptable risk of adverse impacts on receptors.[39] Relevant statistics include the number and area of contaminated, potentially contaminated, remediated and other sites.

[39] European Commission, Joint Research Centre Scientific and Technical Reports (2011). "Soil Protection Activities and Soil Quality Monitoring in South Eastern Europe", available from http://eusoils.jrc.ec.europa.eu/ESDB_Archive/eusoils_docs/other/EUR24889.pdf (accessed 4 August 2017).

Table 3.1.3.4
Statistics and related information for Topic 1.3.4

Component 1: Environmental Conditions and Quality			
Subcomponent 1.3: Environmental Quality			
Topic 1.3.4: Soil pollution			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Sites affected by pollution		• By location • Subnational • By type of pollutant • By source	
1. Contaminated sites	Area, number		
2. Potentially contaminated sites	Area, number		
3. Remediated sites	Area, number		
4. Other sites	Area, number		

Topic 1.3.5: Noise

3.73. Noise pollution exists not only in the most populated or busiest cities, but also wherever human activities are conducted, such as adjacent to highways, near airports and marine ports and around manufacturing, metal processing and mining establishments and construction sites. Noise pollution negatively affects the welfare and health of humans and also affects ecosystems.

3.74. Noise pollution is typically measured using calibrated instruments in specific spatially located stations. This approach is usually used when noise abatement and control policies or programmes are in place. These monitoring stations, operated by the relevant national or local environmental authority, typically produce data that require further processing to be converted into statistics on noise levels attributed to various causes and of specific origin. The resulting statistics, e.g., on noise levels and intensity, are produced for and are relevant to the specific local areas where the most problematic noise pollution conditions exist. They are not representative of the national territory.

3.75. Statistics on noise levels in urban settlements are also relevant to Component 5: Human Settlements and Environmental Health.

Table 3.1.3.5
Statistics and related information for Topic 1.3.5

Component 1: Environmental Conditions and Quality			
Subcomponent 1.3: Environmental Quality			
Topic 1.3.5: Noise			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Noise levels from specific sources	Level	• By source	• WHO
b. Noise levels in specific locations	Level	• By location • Subnational	

3.2. Component 2: Environmental Resources and Their Use

3.76. Component 2 is closely related to the asset and physical flow accounts of the SEEA-CF[40] on which the text, terms and definitions are based, where relevant. Environmental resources (or assets, as they are referred to in the SEEA-CF) are the naturally occurring[41] living and non-living components of the earth, together constituting the biophysical environment, which may provide benefits to humanity. Environmental resources include natural resources, such as subsoil resources (mineral and energy), soil resources, biological resources and water resources, and land. They may be naturally renewable (e.g., fish, timber or water) or non-renewable (e.g., minerals).

3.77. Environmental resources are important inputs in production and consumption. They contribute to providing shelter, food, health care, infrastructure, communications, transportation, defence and virtually every other aspect of human activity. Consequently, policymakers need statistics documenting their availability and quality over time to make informed decisions. Such statistics are also needed to avoid shortage or restriction of use, ensure availability for new and emerging applications, determine import dependence and other risks and, in general, enable continued use over time. Data on the availability of environmental resources and their use are important to ensure sustainable management of current and future use by the human subsystem.

3.78. In Component 2, statistics on environmental resources and their use focus on measuring stocks and changes in stocks of these resources and their use for production and consumption. Changes in the stocks of environmental resources include additions and reductions, from both anthropogenic and natural activities. In the case of non-renewable resources, continued extraction usually leads eventually to the depletion of the resource. For renewable resources, if extraction (e.g., abstraction, removal and harvesting) exceeds natural regeneration and human-made replenishment, the resource is depleted. Depletion, in physical terms, is the decrease in the quantity of the stock of a natural resource over an accounting period that is due to the

[40] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2014). *System of Environmental-Economic Accounting 2012—Central Framework*, available from http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed 4 August 2017).

[41] "Naturally occurring" includes both wild and cultivated biological resources as those which are cultivated, although managed by human intervention, grow as part of a natural process.

extraction of the natural resource by economic units occurring at a level greater than that of regeneration.

3.79. Statistics regarding the most important human activities related to the use of environmental resources help identify the possibilities for policy intervention. The activities that directly extract, abstract, harvest or restructure individual environmental resources are included under Component 2. These activities have additional impacts on the environment beyond the direct use of individual environmental resources. Examples of analyses that bring together all environmental impacts of the individual activities are discussed and presented in Chapter 5.

3.80. Statistics on the generation, management and discharge of residuals related to the use of environmental resources are covered in Component 3: Residuals.

3.81. The use of products originating from environmental resources in the economy and by households can be captured in physical and monetary supply and use tables originating from national accounts and also from sectoral statistics. The SEEA-CF links environmental resources after their extraction from the environment to their use as products in the economy and to the SNA.

3.82. Component 2 contains six subcomponents that correspond to the main categories of environmental resources:

i. Subcomponent 2.1: Mineral Resources;

ii. Subcomponent 2.2: Energy Resources;

iii. Subcomponent 2.3: Land;

iv. Subcomponent 2.4: Soil Resources;

v. Subcomponent 2.5: Biological Resources; and

vi. Subcomponent 2.6: Water Resources.

Subcomponent 2.1: Mineral Resources

Topic 2.1.1: Stocks and changes of mineral resources

3.83. Minerals are elements or compounds composed of a concentration of naturally occurring solid, liquid or gaseous materials in or on the earth's crust. Minerals include metal ores (including precious metals and rare earths); non-metallic minerals such as coal, oil, gas, stone, sand and clay; chemical and fertilizer minerals; salt; and various other minerals such as gemstones, abrasive minerals, graphite, asphalt, natural solid bitumen, quartz and mica.

3.84. Stocks of mineral resources are defined as the amount of known deposits of non-metallic and metallic mineral resources. Classes of known mineral deposits include commercially recoverable deposits; potential commercially recoverable deposits; and non-commercial and other known deposits. While stocks and changes in the stocks are measured in the same way for all minerals, mineral resources used for the production of energy (e.g., fossil fuels such as oil, coal and natural gas), due to their significance, are discussed in the FDES separately (under Topic 2.2.1: Stocks and changes of energy resources).

3.85. Mineral resources are not renewable so their depletion reduces their availability in the environment over time. The scale of their extraction can determine the amount of stress placed on the environment. Statistics on their stocks are required to assist in the sustainable management of these resources.

3.86. Mineral resources considered in this subcomponent are extracted from the environment typically through mining and quarrying. These activities fall in ISIC Rev. 4 under Section B—Mining and quarrying. Extraction involves methods such as underground or surface mining. Extraction of mineral resources reflects the quantity of the resource physically removed from the deposit during a period of time (usually one year). The difference between the opening and closing stocks of mineral resources for a particular year result largely from extraction. However, new discoveries, reappraisals and reclassifications of stocks, as well as catastrophic losses, can also influence the difference between opening and closing stocks.

3.87. Main sources of statistics about stocks of mineral resources are geological surveys and inventories, as well as economic statistics on mining and quarrying. The institutional data collection partners will be the mining authorities at the national and subnational levels. Data are also available from governing commercial bodies such as gemstone and metallic mineral bourses and manufacturers' associations.

Table 3.2.1.1
Statistics and related information for Topic 2.1.1

Component 2: Environmental Resources and their Use			
Subcomponent 2.1: Mineral Resources			
Topic 2.1.1: Stocks and changes of mineral resources			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Mineral resources		• By mineral (e.g., metal ores including precious metals, and rare earths, coal, oil, gas, stone, sand and clay, chemical and fertilizer minerals, salt, gemstones, abrasive minerals, graphite, asphalt, natural solid bitumen, quartz, mica) • National • Subnational	• United Nations Framework Classification for Energy and Mineral Resources (UNFC 2009) • SEEA Central Framework (2012) asset and physical flow accounts • International Standard Industrial Classification of All Economic Activities (ISIC) Rev. 4, Section B, Divisions 05-09
1. **Stocks of commercially recoverable resources**	Mass, volume		
2. New discoveries	Mass, volume		
3. *Upward reappraisals*	Mass, volume		
4. *Upward reclassifications*	Mass, volume		
5. **Extraction**	Mass, volume		
6. *Catastrophic losses*	Mass, volume		
7. *Downward reappraisals*	Mass, volume		
8. *Downward reclassifications*	Mass, volume		
9. Stocks of potentially commercially recoverable resources	Mass, volume		
10. *Stocks of non-commercial and other known resources*	Mass, volume		

Topic 2.1.2: Production and trade of minerals

3.88. Mining and quarrying contribute substantially to the value of goods and services produced by many countries. The outputs are minerals such as metal ores (iron and non-ferrous), stone, sand and clay, chemical and fertilizer minerals, and other minerals such as gemstones and abrasive minerals (classified under Section 1, Divisions 14-16 of the CPC Ver.2). Statistics on the amounts of minerals extracted or produced, and their imports and exports are important to measure the pressure on these resources. They may be linked to economic statistics to understand their significance in the national economy.

3.89. Industrial commodity statistics, sectoral statistics on mining and quarrying, and trade statistics provide statistics about the production and trade of minerals. Activities involved in the production of minerals are captured under the relevant ISIC Rev. 4 categories in Section B—Mining and quarrying. Main partners for primary activity data include the ministry responsible for mining and NSOs.

3.90. Production and trade of minerals that are energy sources are discussed under Topic 2.2.2: Production, trade and consumption of energy.

Table 3.2.1.2
Statistics and related information for Topic 2.1.2

Component 2: Environmental Resources and their Use			
Subcomponent 2.1: Mineral Resources			
Topic 2.1.2: Production and trade of minerals			
Statistics and related information			
(**Bold text—Core Set/Tier 1;** regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Production of minerals	Mass, volume	• By mineral (e.g., metal ores including precious metals and rare earths, coal, oil, gas, stone, sand and clay, chemical and fertilizer minerals, salt, gemstones, abrasive minerals, graphite, asphalt, natural solid bitumen, quartz, mica) • National • Subnational	Harmonized Commodity Description and Coding Systems (HS) 2012, Section V, Chapters 25 and 26, and Section VI Chapter 28
b. Imports of minerals	Currency, mass, volume		
c. Exports of minerals	Currency, mass, volume		

Subcomponent 2.2: Energy Resources

Topic 2.2.1: Stocks and changes of energy resources

3.91. Energy can be produced from non-renewable or renewable sources. Non-renewable energy resources are the minerals used for energy production. These environmental resources cannot be renewed in any human timescale, so their extraction and use in the economy depletes the resource, limiting its availability for future generations. Statistics on the magnitude of their stocks through time are required to assist in the sustainable management of these resources.

3.92. Stocks of non-renewable energy resources are defined as the amount of known deposits of mineral energy resources. They include fossil fuels (e.g., natural gas, crude oil and natural gas liquids, oil shale, natural bitumen and extra heavy oil, coal and lignite), peat, uranium and thorium ores. Classes of known mineral energy deposits include commercially recoverable deposits, potential commercially recoverable deposits, and non-commercial and other known deposits.

3.93. Extraction of non-renewable energy resources reflects the quantity of the resource physically removed from the deposit during a period of time (usually one year). The difference between the opening and closing stocks of energy resources for a particular year result largely from extraction. New discoveries, reappraisals and reclassifications of stocks, as well as catastrophic losses, can also influence the difference between opening and closing stocks.

3.94. Main sources of statistics about stocks of non-renewable energy resources are geological surveys and inventories, while the institutional data collection partners are the mining and energy authorities at the national and subnational levels. Statistics about extraction of non-renewable energy resources can be obtained from economic statistics on mining, as well as energy statistics.

3.95. Energy from renewable sources is captured from sources that replenish themselves. Renewable energy includes solar (photovoltaic and thermal), hydroelectric, geothermal, tidal action, wave action, marine (non-tidal currents, temperature differences and salinity gradients), wind and biomass energy. All are replenished naturally, although their flow may be limited.

3.96. Stocks of renewable energy resources are not subject to depletion in the same manner as non-renewable energy resources. Additionally, their stocks are difficult to define accurately, except for biomass. Even so, it would make sense to measure only those resources with slow replenishment rates (such as wood). Furthermore, biomass may have both energy and non-energy uses, which makes it difficult to distinguish between energy resources and non-energy

resources. Thus, stocks of renewable energy resources are not included in the FDES. However, the consumption of renewable energy resources can be measured in terms of energy produced (e.g., hydroelectric power, solar energy generation and wind energy production) and is included in the FDES under Topic 2.2.2: Production, trade and consumption of energy.

Table 3.2.2.1
Statistics and related information for Topic 2.2.1

Component 2: Environmental Resources and their Use			
Subcomponent 2.2: Energy Resources			
Topic 2.2.1:Stocks and changes of energy resources			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Energy resources		• By resource (e.g., natural gas, crude oil and natural gas liquids, oil shale, and extra heavy oil (includes oil extracted from oil sands), coal and lignite, peat, non-metallic minerals except for coal or peat, uranium and thorium ores) • National • Subnational	• UNSD: International Recommendations for Energy Statistics (IRES) • International Energy Agency (IEA) Energy Statistics Manual • SEEA Central Framework (2012) asset and physical flow accounts • UNFC 2009 • ISIC Rev. 4, Section B, Divisions 05-09 • HS 2012, Section V, Chapter 27
1. **Stocks of commercially recoverable resources**	Mass, volume		
2. New discoveries	Mass, volume		
3. *Upward reappraisals*	Mass, volume		
4. *Upward reclassifications*	Mass, volume		
5. **Extraction**	Mass, volume		
6. *Catastrophic losses*	Mass, volume		
7. *Downward reappraisals*	Mass, volume		
8. *Downward reclassifications*	Mass, volume		
9. Stocks of potentially commercially recoverable resources	Mass, volume		
10. *Stocks of non-commercial and other known resources*	Mass, volume		

Topic 2.2.2: Production, trade and consumption of energy

3.97. Energy production refers to the capture, extraction or manufacture of fuels or other energy products in forms which are ready for general consumption. Energy products are produced in a number of ways, depending on the energy source. Energy production, transformation, distribution and consumption are processes characterized by different efficiency rates, which cause distinct environmental impacts (including land use change, air pollution, GHG emissions and waste). Therefore, producing statistics to describe these activities is key to informing environmental sustainability policy.

3.98. Total energy production originates from sources that can be classified as non-renewable or renewable. These constitute key environment statistics that can assist when analysing the sustainability of the energy mix at the national level.

3.99. Energy production includes the production of primary and secondary energy. Primary energy refers to energy sources as found in their natural state, as opposed to derived or secondary energy, which is the result of the transformation of primary sources. Energy imports and exports refer to the amount of fuels, electricity and heat obtained from or supplied to other countries. Total energy supply is intended to show flows that represent energy entering the national territory for the first time, energy removed from the national territory and stock changes. It represents the amount of energy available on the national territory during the reference period. Final energy consumption refers to the consumption of primary and secondary energy by households and through economic activities.

3.100. Statistics on the production, trade and consumption of energy can be obtained from energy statistics, foreign trade statistics and energy balances that are available from national energy authorities or NSOs in most countries. The most important statistics on energy production reflect the different types of non-renewable and renewable energy sources and the production of primary and secondary energy, including the amount of electricity produced. Both total

production of primary and secondary energy can be disaggregated by energy resource used or fuel, as produced regularly for national energy balances. Statistics on energy consumption should be broken down by economic activity (based on ISIC) and households. Energy consumption by certain sectors (e.g., international transport) or population groups (tourists) may also be estimated for specific analytic purposes.

3.101. The production of energy from non-renewable and renewable sources is captured under the economic activities ISIC Rev. 4, Section B, Divisions 05 Mining of coal and lignite and 06 Extraction of crude petroleum and natural gas; Section C, Division 19 Manufacture of coke and refined petroleum products; and Section D, Division 35 Electricity, gas, steam and air conditioning supply. Energy products resulting from extraction and transformation activities can be classified according to the Standard International Energy Product Classification (SIEC) included in the IRES.[42]

[42] United Nations Statistics Division (2011). *International Recommendations for Energy Statistics* (draft version), available from https://unstats.un.org/unsd/energy/ires/IRES_edited2.pdf (accessed 4 August 2017).

Table 3.2.2.2
Statistics and related information for Topic 2.2.2

Component 2: Environmental Resources and their Use			
Subcomponent 2.2: Energy Resources			
Topic 2.2.2: Production, trade and consumption of energy			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Production of energy		• By non-renewable resource (e.g., petroleum, natural gas, coal, nuclear fuels, non-sustainable firewood, waste, other non-renewables) • By renewable resource (e.g., solar, hydroelectric, geothermal, tidal action, wave action, marine, wind, biomass) • National • Subnational	• UNSD: IRES • IEA Energy Statistics Manual • Joint Wood Energy Enquiry (UNECE-FAO Forestry and Timber Section)
1. **Total production**	Energy unit, mass, volume		
2. **Production from non-renewable sources**	Energy unit, mass, volume		
3. **Production from renewable sources**	Energy unit, mass, volume		
4. **Primary energy production**	Energy unit, mass, volume	• By primary energy resource (e.g., petroleum, natural gas, coal, hydroenergy, geothermal, nuclear fuels, cane products, other primary) • By secondary energy product (e.g., electricity, liquefied petroleum gas, gasoline/alcohol, kerosene, diesel oil, fuel oil, coke, charcoal, gases, other secondary) • National • Subnational	
5. Imports of energy	Energy unit, mass, volume		
6. Exports of energy	Energy unit, mass, volume		
7. **Secondary energy production**	Energy unit, mass, volume		
b. **Total energy supply**	Energy unit, mass, volume	• By energy product	
c. **Final consumption of energy**	Energy unit, mass, volume	• By households • By ISIC economic activity • By tourists • National • Subnational	

Subcomponent 2.3: Land

3.102. Land is a unique environmental resource that delineates the space in which economic activities and environmental processes take place and within which environmental resources and economic assets are located. The two primary aspects are land cover (see also Topic 1.2.1: Land cover) and land use. They are closely related; while land cover describes the biophysical aspects of land, land use refers to the functional aspects of land. Changes in land cover can be the result of natural processes and of land use changes. Generally, the total area of a country remains unchanged from one period to the next.[43] Hence, changes in the stocks of land comprise changes within and between stocks in different classes of land cover and land use (land restructuring).

[43] That is, unless there are geopolitical changes, border corrections, natural events or catastrophes, or land reclamation.

3.103. The total area of a country is the area enclosed by its inland borders and, if applicable, the sea.[44] The land area of a country is the total area minus inland waters. While inland waters (e.g., rivers, lakes and ponds) are included in land use, marine water areas may be included only in a broader concept of land use. Certain types of land use analyses may include coastal waters (internal waters) or even Exclusive Economic Zones (EEZs).

[44] The boundaries between land and sea vary considerably across countries based on a country's geographical features. The conventions that determine country area, particularly the definition of baselines, focus on the boundary between land and sea and have been agreed internationally in the United Nations Convention on the Law of the Sea (UNCLOS). Text of the United Nations Convention on the Law of the Sea, available from www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf (accessed 4 August 2017).

Topic 2.3.1: Land use

3.104. Land use reflects both the activities undertaken and the institutional arrangements put in place for a given area for the purposes of economic production, or the maintenance and restoration of environmental functions. Land being "used" means the existence of some kind of human activity or management. Consequently, there are areas of land that are "not in use" by human activities. These areas are important from an ecological point of view. Land use statistics cover both land in use and land not in use. Statistics on land use are usually obtained through the combination of field surveys and remote sensing (mostly satellite images). Land use data may also be obtained from administrative land registers where available.

3.105. A reference framework for the interim classification of land use is provided in the SEEA-CF[45] as agreed after a comprehensive global consultation process. The development of the land use classification included in the SEEA-CF, led by the FAO, has been based on practices already in use in major international and national land use databases, adjusted to address the needs which have arisen during this global consultation process. The aim of the land use classification presented in the SEEA-CF is twofold: (i) to provide a reference framework for the compilation and aggregation of data at the international level and (ii) to provide guidance to countries in establishing a land use classification scheme. For more information, see Annex D: Classifications and environment statistics.

[45] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2014). *System of Environmental-Economic Accounting 2012—Central Framework*, available from http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed 4 August 2017).

3.106. This topic also includes statistics on land use pertaining to specific agricultural and forest management methods, in particular, land under organic farming, irrigation, agroforestry, sustainable forest management and different ownership categories. These statistics are important because they describe how the use and management of land and biological resources impact the environment.

3.107. Changes in land use can be reflected by statistics on changes within and between the different land use classes. Changes in land use will redistribute the area of the country among the land use categories. If presented in matrix form, the information will show how an increase or decrease in one category contributes to a decrease or increase in other land use categories. Land cover statistics can also be presented in a similar fashion.

3.108. Cross-combination of land use and land cover categories show the kind of human activities are carried out in the various land cover areas. Changes in land use frequently result in changes of land cover. However, land in different land cover categories will also increase or decrease owing to managed or natural expansion or regression. Statistics on land cover and its changes also provide information on the extent of different ecosystems (see also Topic 1.2.2: Ecosystems and biodiversity).

Table 3.2.3.1
Statistics and related information for Topic 2.3.1

Component 2: Environmental Resources and their Use			
Subcomponent 2.3: Land			
Topic 2.3.1: Land use			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Area under land use categories**	Area	• By type of land use (e.g., agriculture; forestry; land used for aquaculture; use of built-up and related areas; land used for maintenance and restoration of environmental functions; other uses of land not elsewhere classified; land not in use; inland waters used for aquaculture or holding facilities; inland waters used for maintenance and restoration of environmental functions; other uses of inland waters not elsewhere classified; inland water not in use; coastal waters (including area of coral reefs and mangroves); Exclusive Economic Zone (EEZ)) • National • Subnational	• FAO • UNECE Standard Classification of Land Use (1989) • SEEA Central Framework (2012) Annex 1
b. Other aspects of land use		• National • Subnational	
1. *Area of land under organic farming*	Area		• FAO Inter-departmental Working Group on Organic Agriculture
2. Area of land under irrigation	Area		
3. Area of land under sustainable forest management	Area		• Forest Stewardship Council
4. *Area of land under agroforestry*	Area		
c. Land ownership	Area	• By ownership category • National • Subnational	• FAO

Topic 2.3.2: Use of forest land

3.109. Changes in forest area in the different categories result from economic activities (afforestation or deforestation), reclassifications among the categories, or natural processes (expansion or regression). FAO defines afforestation as the establishment of forest through planting and/or deliberate seeding on land that, until then, was not classified as forest.[46] It implies a transformation from non-forest to forest. FAO defines deforestation, in turn, as the conversion of forest to another land use or the long-term reduction of the tree canopy cover below the minimum 10 per cent threshold.[47] Reforestation, which is the re-establishment of forest through planting and/or deliberate seeding on land classified as forest,[48] is also included here.

3.110. Not all forest land is used primarily to produce wood. The primary designated functions of forests are production, protection of soil and water, conservation of biodiversity, social services, multiple use and other. To better understand the uses of forest land, statistics on forest land should be broken down according to its primary designated function.

[46] Food and Agriculture Organization of the United Nations (2010). "Global Forest Resources Assessment 2010 Main Report", available from www.fao.org/docrep/013/i1757e/i1757e.pdf (accessed 4 August 2017)

[47] FAO states, "Deforestation implies the long-term or permanent loss of forest cover and implies transformation into another land use. Such a loss can only be caused and maintained by a continued human-induced or natural perturbation. Deforestation includes areas of forest converted to agriculture, pasture, water reservoirs and urban areas. The term specifically excludes areas where the trees have been removed as a result of harvesting or logging, and where the forest is expected to regenerate naturally or with the aid of silvicultural measures. (*continued on next page*)

Table 3.2.3.2
Statistics and related information for Topic 2.3.2

Component 2: Environmental Resources and their Use			
Subcomponent 2.3: Land			
Topic 2.3.2: Use of forest land			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Use of forest land		• By forest type • National • Subnational • By dominant tree species	• FAO FRA • UNFF MAR • UNSD: MDG Indicator 7.1 Metadata • Montreal Process (Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests) • State of Europe's Forests (Forest Europe/UNECE-FAO Forestry and Timber Section)
1. **Area deforested**	Area		
2. Area reforested	Area		
3. Area afforested	Area		
4. *Natural growth*	Area		
b. Forest area by primary designated function	Area	• Production • Protection of soil and water • Conservation of biodiversity • Social services • Multiple use • Other	• FAO FRA

(*Footnote 47 continued*) Unless logging is followed by the clearing of the remaining logged-over forest for the introduction of alternative land uses, or the maintenance of the clearings through continued disturbance, forests commonly regenerate, although often to a different, secondary condition. In areas of shifting agriculture, forest, forest fallow and agricultural lands appear in a dynamic pattern where deforestation and the return of forest occur frequently in small patches. To simplify reporting of such areas, the net change over a larger area is typically used. Deforestation also includes areas where, for example, the impact of disturbance, overutilization or changing environmental conditions affects the forest to an extent that it cannot sustain a tree cover above the 10 percent threshold." Food and Agriculture Organization of the United Nations (2000). "Global Forest Resources Assessment 2000 Main Report", available from ftp://ftp.fao.org/docrep/fao/003/Y1997E/FRA%202000%20Main%20report.pdf (accessed 4 August 2017).

Subcomponent 2.4: Soil Resources

Topic 2.4.1: Soil resources

3.111. Soil resources comprise the top layers (horizons) of soil that form a biological system. Accounting for soil resources can provide information on the area and volume of soil resources lost due to erosion or degradation, or made unavailable by changes in land cover and other sources. Accounting for soil resources in terms of their types, nutrient content, carbon content and other characteristics is relevant for a more detailed examination of the health of soil systems and of the connections between soil resources and production in agriculture and forestry.

3.112. Additions to the stock of the volume of soil resources may originate from soil formation and deposition or from upward reappraisals and reclassifications. Reduction in the stock may result from extraction, soil erosion, catastrophic losses, and downward reappraisals and reclassifications. The changing volume of soil must be measured to assess the extent of soil erosion and the impact of natural disasters, and to assess soil depletion due to economic activities. The flows of individual elements in the soils, such as carbon and nutrients (nitrogen, phosphorous and potassium), can be recorded as part of material flow accounting and nutrient balances.

3.113. The relevant statistics cover the stocks of soil resources and their changes (additions and reductions) in terms of area and volume, by soil type. Statistics related to the area and changes in the area under soil types are covered under Topic 1.1.4: Soil characteristics. Changes in the volume of soil resources and other aspects of accounting for soil resources are included conceptually in the FDES but the development of the necessary statistics is subject to further research. For more information, see SEEA-CF, paras. 5.318-5.342, Accounting for Soil Resources.[49]

Table 3.2.4.1
Statistics and related information for Topic 2.4.1

Component 2: Environmental Resources and their Use			
Subcomponent 2.4: Soil Resources			
Topic 2.4.1: Soil resources			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
Further research is needed to develop the necessary statistics in this topic.			

Subcomponent 2.5: Biological Resources

3.114. Biological resources are renewable resources capable of regeneration through natural (non-managed or managed) processes. Biological resources include timber and aquatic resources and a range of other animal and plant resources (such as livestock, orchards, crops and wild animals), fungi and bacteria.[50] Biological resources form an important part of biodiversity and ecosystems. If harvesting and other losses exceed natural or managed regeneration or replenishment, biological resources become depleted.

3.115. Biological resources can be natural (non-cultivated) or cultivated. Natural biological resources consist of animals, birds, fish and plants that yield both once-only and repeat products for which natural growth and/or regeneration is not under the direct control, responsibility and management of institutional units.[51]

3.116. Cultivated biological resources cover animal resources yielding repeat products and tree, crop and plant resources yielding repeat products whose natural growth and regeneration are under the direct control, responsibility and management of an institutional unit.[52] They may impact the environment differently than natural ones. This is quite evident in the case of mono-cultivated, intensive crops that use irrigation and increasing amounts of fertilizers and pesticides.

Topic 2.5.1: Timber resources

3.117. Timber resources can be natural or cultivated and are important environmental resources in many countries. They provide inputs for construction and the production of furniture, cardboard, cellulose, paper and other products, and are also a fuel source. Timber resources are defined by the volume of trees, living and dead, which can still be used for timber or fuel. This includes all trees regardless of diameter or tops of stems. The general proxy that should be considered for determining the volume of timber resources is the volume that is commercially usable.

3.118. Stocks of timber resources increase due to natural growth, new plantations or growth derived from management of plantations and are measured as the gross annual increase. Timber resources may also change due to the increase of forest land or changes in management practices (reclassification). Stocks decrease due to timber removals, natural losses and catastrophic losses. The volume of timber removals can be disaggregated according to the type of forestry product (e.g., industrial roundwood and fuelwood) or by tree species. Stock changes should be estimated separately for natural and cultivated timber resources.

3.119. From a resource accounting perspective, SEEA-CF defines afforestation as the increase in the stock of forest[53] and other wooded land[54] either due to the establishment of new forest on land that was previously not classified as forest land, or as a result of silvicultural measures such as planting and seeding. In turn, SEEA-CF defines deforestation as the decrease in the stock of forest and other wooded land due to the complete loss of tree cover and transfer of forest land to

[48] Food and Agriculture Organization of the United Nations (2010). "Global Forest Resources Assessment 2010 Main Report", available from www.fao.org/docrep/013/i1757e/i1757e.pdf (accessed 4 August 2017).

[49] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2014). *System of Environmental-Economic Accounting 2012—Central Framework*, available from http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed 4 August 2017).

[50] Ibid.

[51] Ibid.

[52] Ibid.

[53] As defined in Topic 1.2.3: Forests.

[54] Ibid.

other uses (e.g., use as agricultural land, land under buildings, roads, etc.) or to no identifiable use. From a general forest perspective, FAO definitions may be found in Topic 1.2.3: Forests.

3.120. The most important economic activity responsible for the extraction, harvesting and management of timber resources is forestry and logging (ISIC Rev. 4, Section A, Division 02). This division includes: growing of standing timber; planting, replanting, transplanting, thinning and conserving of forests and timber tracts; growing of coppice, pulpwood and fire wood; operation of forest tree nurseries; producing round wood; gathering and producing fire wood; and production of charcoal in the forest (using traditional methods). These activities may be carried out in natural or planted forests.

3.121. Forestry activities may also include the application of fertilizers and pest control. Statistics on fertilizer and pesticide use in forestry are very important to assess their impact on the environment.

3.122. The use of timber products in the economy and by households can be captured in physical and monetary supply and use tables originating from national accounts and from forestry, manufacturing, energy and trade statistics. The SEEA-CF links timber resources to their use in the economy and to the SNA.

Table 3.2.5.1
Statistics and related information for Topic 2.5.1

Component 2: Environmental Resources and their Use			
Subcomponent 2.5: Biological Resources			
Topic 2.5.1: Timber resources			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Timber resources		• By type (e.g., natural or planted) • National • Subnational	• SEEA Central Framework (2012) • FAO FRA • State of Europe's Forests (Forest Europe/UNECE-FAO Forestry and Timber Section) • UNECE/FAO Joint Working Party on Forest Statistics, Economics and Management • ISIC Rev. 4, Section A, Division 02 • FAOSTAT database
1. **Stocks of timber resources**	Volume		
2. Natural growth	Volume		
3. Fellings	Volume		
4. Removals	Volume		
5. *Felling residues*	Volume		
6. *Natural losses*	Volume		
7. *Catastrophic losses*	Volume		
8. *Reclassifications*	Volume		
b. Amount used of:		• National • Subnational	
1. Fertilizers (also in 3.4.1.a)	Area, mass, volume		
2. Pesticides (also in 3.4.1.b)	Area, mass, volume		
c. Forest production	Volume	• By type of product (e.g., timber, industrial roundwood, fuelwood, pulp, chips) • National • Subnational	• Central Product Classification (CPC) • Joint Forest Sector Questionnaire (UNECE/FAO/Eurostat International Tropical Timber Organization [ITTO]) • FAO/ITTO/UNECE/Eurostat Inter-secretariat Working Group on Forest Sector Statistics • UNECE Timber Committee • UNECE/FAO Joint Working Party on Forest Statistics, Economics and Management • ISIC Rev. 4, Section A, Division 02 • FAOSTAT database
d. Fuelwood production	Volume	• National	• FAO/ITTO/UNECE/Eurostat Inter-secretariat Working Group on Forest Sector Statistics • State of Europe's Forests (Forest Europe/UNECE-FAO Forestry and Timber Section) • HS 2012, Sections IX and X • FAOSTAT database
e. Imports of forest products	Currency, mass, volume	• By type of product	
f. Exports of forest products	Currency, mass, volume		

Topic 2.5.2: Aquatic resources

3.123. Aquatic resources comprise fish, crustaceans, molluscs, shellfish, aquatic mammals and other aquatic organisms that are considered to live within the boundaries of the EEZ of a country throughout their life cycles, including both coastal and inland fisheries. Migrating and straddling fish stocks are considered to belong to a given country during the period when those stocks inhabit its EEZ.

3.124. Aquatic resources are harvested for commercial reasons and as part of recreational and subsistence fishing activities. The abundance and health of natural aquatic resources in inland and marine waters are also increasingly affected by water pollution and habitat degradation. The dual impacts of excessive exploitation levels and habitat degradation result in the loss, or reduction of the goods, functions and services provided by the aquatic ecosystems, including the loss of biodiversity and genetic resources. The unsustainable extraction of marine resources is caused partly by illegal, unreported and unregulated (IUU) fishing.

3.125. Stocks of aquatic resources are difficult to measure in inland and marine waters, although certain estimation methodologies may be considered for this purpose. Aquaculture stocks can be estimated more frequently.

3.126. Aquatic resources may be either cultivated or natural biological resources. Aquatic resources produced within aquaculture facilities (for breeding or for harvest) are considered cultivated biological resources. All other aquatic resources harvested as part of capture production processes are considered natural biological resources. Changes in the stocks of aquatic resources are the result of growth in stocks, total removals and, natural and catastrophic losses. Stock changes should be estimated separately for natural and cultivated resources, the most important aquatic groups/species, and marine and freshwater groups/species.

3.127. Aquaculture is the farming of aquatic organisms, including fish, molluscs, crustaceans and aquatic plants. Farming implies some form of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. Farming also implies individual or corporate ownership of the stock being cultivated.[55] Aquaculture activities may also include the application of colourants, pellets, antibiotics, fungicides, hormones and other substances. Statistics on these aspects of aquaculture are very important to assess their impact on the environment.

3.128. The FAO International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) is commonly used for statistics on aquatic resources.[56] The FAO has also developed a set of catch concepts for the different stages of the catch, depending on the inclusion or exclusion of by-catch and by-product.[57] The measurement of discarded catch is an important component in order to understand fully the linkages between economic activity and the impact on aquatic resources.

3.129. The most important economic activity related to the extraction, harvesting and management of aquatic resources is fishing and aquaculture (ISIC Rev. 4, Section A, Division 03). This division includes capture fishery and aquaculture, covering the use of fishery resources from marine, brackish or freshwater environments, with the goal of capturing or gathering fish, crustaceans, molluscs and other marine organisms and products (e.g., aquatic plants, pearls and sponges).

3.130. The use of aquatic products in the economy and by households can be captured in physical and monetary supply and use tables originating from national accounts. The SEEA-CF links aquatic resources to their use in the economy and to the SNA.

[55] Food and Agriculture Organization of the United Nations (1997). "Rural Aquaculture: Overview and Framework for Country Reviews", available from www.fao.org/docrep/003/x6941e/x6941e04.htm (accessed 4 August 2017).

[56] Food and Agriculture Organization of the United Nations. "International Standard Statistical Classification of Aquatic Animals and Plants", available from ftp://ftp.fao.org/fi/document/cwp/handbook/annex/AnnexS2listISSCAAP2000.pdf (accessed 4 August 2017).

[57] Food and Agriculture Organization of the United Nations. Coordinating Working Party on Fishery Statistics, "Handbook of Fishery Statistical Standards", available from ftp://ftp.fao.org/FI/DOCUMENT/cwp/handbook/annex/AnnexB1CatchConcepts.pdf (accessed 4 August 2017).

Table 3.2.5.2
Statistics and related information for Topic 2.5.2

Component 2: Environmental Resources and their Use			
Subcomponent 2.5: Biological Resources			
Topic 2.5.2: Aquatic resources			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Fish capture production**	Mass	• By relevant freshwater and marine species • National • Subnational	• FAO International Standard Statistical Classification of Aquatic Animals and Plants (ISSCAAP) • ISIC Rev. 4, Section A, Division 03 • The United Nations Convention on the Law of the Sea (UNCLOS) • UNSD: MDG Indicator 7.4 Metadata • HS 2012, Section I, Chapter 03 • SEEA Central Framework (2012)
b. **Aquaculture production**	Mass		
c. Imports of fish and fishery products	Currency, mass, volume	• By relevant freshwater and marine species • By type of product • By species	
d. Exports of fish and fishery products	Currency, mass, volume		
e. Amount used of:		• By type of water (i.e., marine or freshwater) • National • Subnational	
1. *Pellets* (also in 3.4.1.c)	Mass, volume		
2. *Hormones* (also in 3.4.1.d)	Mass, volume		
3. *Colourants* (also in 3.4.1.e)	Mass, volume		
4. *Antibiotics* (also in 3.4.1.f)	Mass, volume		
5. *Fungicides*	Mass, volume		
f. Aquatic resources		• By relevant freshwater and marine species • By type (e.g., natural or cultivated) • National • Subnational	
1. Stocks of aquatic resources	Mass		
2. *Additions to aquatic resources*	Mass		
3. *Reductions in aquatic resources*	Mass		

Topic 2.5.3: Crops

3.131. Crops refer to plants or agricultural produce grown for food or other economic purposes, such as clothes or livestock fodder (ISIC Rev. 4, Section A, Division 01). In its race to improve crop production, modern large-scale agriculture has increased the use of anthropogenic inputs in the form of labour, irrigation, chemical fertilizers, pesticides and new or modified genetic material. On the other hand, small-scale agriculture, which may be less resource intensive, may be more environmentally friendly.

3.132. In terms of environment statistics, both the area used for cultivated crops and yields are important. Furthermore, crop production methods, which can have different environmental consequences, are highly relevant. Monoculture, the practice of growing one type of crop intensively over an area, can benefit farmers because of its uniform growing requirements and standardized planting, maintenance and pest control. Overall, monoculture and resource-intensive farming have increased crop yield, greatly reducing the amount of land needed for crop production. However, in recent decades, the rise of monocultures has also led to widespread environmental sustainability concerns, including soil nutrient loss, widespread pest invasions and biodiversity loss. Organic production is growing in importance, benefiting both the environment and human health, but it still constitutes a small proportion of crops worldwide.

3.133. The application of biotechnology in the agriculture sector has led to the increased use of genetically modified organisms (GMOs) and products derived from them. GMOs are organisms produced through techniques in which the genetic material has been altered in a way that does not occur naturally by mating and/or natural recombination".[58] These organisms may include genetically modified seeds and grain, plant tubers, spores, plant t0issue and cells. Measuring their use is an important aspect of environment statistics because of their relevance in maintaining genetic variability, possible effect on non-target organisms and implication in the evolution of pest resistance and loss of biodiversity. Maintaining genetic variability is also interconnected with genetic resources, which should not be confused with GMOs. Genetic

[58] Food and Agriculture Organization of the United Nations (2002). "Codex Alimentarius. Joint FAO/WHO Food Standards Programme", available from www.fao.org/docrep/005/y2772e/y2772e04.htm (accessed 4 August 2017).

resources are defined as the genetic material of plants, animals or microorganisms containing functional units of heredity that are of actual or potential value as a resource for future generations of humanity.[59] Although statistics on genetic resources are not collected, they are accounted for through the Nagoya Protocol, which ensures the conservation and sustainable use of genetic resources.

3.134. For environment statistics, this topic covers statistics about the area used for and the production of main crop types, annual and perennial crops, different planting methods, monoculture and resource-intensive farming systems, the use of GMOs, and organic farming. Area harvested is especially important when measuring sown or planted areas (gross) versus harvested areas (net).[60] Fertilizers play a key role in the yield and quantity of crops produced, as well as in the environmental effects of agriculture. Therefore, the amount of natural fertilizers, such as manure or compost, and chemical fertilizers are also relevant. Because of their effect on biodiversity, invasive pests and pollution, statistics on the use of pesticides (e.g., fungicides, herbicides, insecticides and rodenticides) are also considered essential to environment statistics. With the significant growth of modern intensive farming practices and genetically modified crops, constructing these statistics can be particularly relevant to some countries. Finally, imports and exports of crops can also be an important measure of total production, apparent national consumption and, possibly, the associated pressure on the environment. The main institution providing data, besides the NSO, is usually the agricultural authority.

[59] Convention on Biological Diversity (1992). "Article 2. Use of terms", available from www.cbd.int/convention/articles/default.shtml?a=cbd-02 (accessed 4 August 2017).

[60] Food and Agriculture Organization of the United Nations (2011). "Crops Statistics—Concepts, definitions and classifications", available from www.fao.org/fileadmin/templates/ess/ess_test_folder/documents/Production_trade/definitions/Crops_statistics_concepts_definitions_classifications.doc (accessed 4 August 2017).

Table 3.2.5.3
Statistics and related information for Topic 2.5.3

Component 2: Environmental Resources and their Use			
Subcomponent 2.5: Biological Resources			
Topic 2.5.3: Crops			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Main annual and perennial crops		• By crop • By size • National • Subnational	• FAO Indicative Crop Classification (for 2010 round of agricultural censuses) • FAO/WHO Specifications for Pesticides (2010) • FAO Specifications for Commonly Used Fertilizers (2009) • ISIC Rev. 4, Section A, Division 1 • FAOSTAT database • HS 2012, Section II
1. **Area planted**	Area		
2. **Area harvested**	Area		
3. **Amount produced**	Mass		
4. *Amount of organic production*	Mass		
5. *Amount of genetically modified crops produced*	Mass		
b. Amount used of:		• By type of fertilizer • By type of pesticide • By crop • National • Subnational	
1. **Natural fertilizers** (e.g., manure, compost, lime) (also in 3.4.1.a)	Area, mass, volume		
2. **Chemical fertilizers** (also in 3.4.1.a)	Area, mass, volume		
3. **Pesticides** (also in 3.4.1.b)	Area, mass, volume		
4. Genetically modified seeds	Mass	• By crop • National • Subnational	
c. Monoculture/resource-intensive farming systems		• By crop • By size • National • Subnational	
1. Area being used for production	Area		
2. Amount produced	Mass		
3. *Amount of genetically modified crops produced*	Mass		
d. Imports of crops	Currency, mass		
e. Exports of crops	Currency, mass		

Topic 2.5.4: Livestock

3.135. Livestock are animal species that are raised by humans for commercial purposes, consumption or labour (ISIC Rev. 4, Section A, Division 01). Usually raised in agricultural settings, typical livestock species include cows, poultry, pigs, goats and sheep. Rising incomes and growing populations, especially in the developing world, have led to higher demands for livestock products, including milk, eggs and meat, thus driving growth in the livestock sector.[61] Nonetheless, livestock rearing is associated with multiple environmental effects. Livestock production contributes to GHG emissions. Animal husbandry (grazing and production of feedstock) occupies a large percentage of land, directly or indirectly. Clearing land for pasture and feed crops has led to widespread deforestation and biodiversity loss and overgrazing leads to erosion and compaction. Furthermore, livestock production accounts for large amounts of water use and constitutes a source of water pollution from hormone use and other chemicals, as well as from the inadequate handling of manure.

[61] Food and Agriculture Organization of the United Nations (2006). "Livestock impacts on the environment".

3.136. A limited number of genetically modified animals, animal substances, tissues and micro-organisms have been introduced in the production of livestock and fish to date. The goal is to add economic value by introducing specific substances or tissue modifications. This could produce unintended environmental effects relating to the place of introduction or the nature of expression of GMOs.

3.137. Despite these prevalent environmental implications, however, livestock contributes to the livelihoods of millions of the world's poor, providing an income source, and sometimes the only source, for many. Therefore, measuring livestock impacts and driving efficiency in the production line is vital.

3.138. Environmentally relevant statistics on livestock include the number and characteristics of live animals, as well as antibiotics and hormones used for them. Furthermore, imports and exports of livestock are also a good measure of national livestock quantity and, possibly, of pressure on the environment.

3.139. The main provider of data for livestock statistics is usually the agricultural authority or the NSO.

Table 3.2.5.4
Statistics and related information for Topic 2.5.4

Component 2: Environmental Resources and their Use			
Subcomponent 2.5: Biological Resources			
Topic 2.5.4: Livestock			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
a. Livestock		• By type of animal • National • Subnational	• FAOSTAT database • ISIC Rev. 4, Section A, Division 01 • HS 2012, Section I, Chapter 01
1. **Number of live animals**	Number		
2. Number of animals slaughtered	Number		
b. Amount used of:			
1. Antibiotics (also in 3.4.1.f)	Mass		
2. Hormones (also in 3.4.1.d)	Mass		
c. Imports of livestock	Currency, number		
d. Exports of livestock	Currency, number		

Topic 2.5.5: Other non-cultivated biological resources

3.140. A range of naturally occurring biological resources provides inputs to the economy and forms an important part of biodiversity. They may include wild berries, fungi, bacteria, fruits, sap and other plant resources that are harvested (ISIC Rev. 4, Section A, class 0230), as well as wild animals that are trapped or killed for production, consumption and trade (ISIC Rev. 4, Section A, class 0170). This topic excludes timber and aquatic resources, as they are included in Topics 2.5.1 and 2.5.2, respectively.

3.141. Environmentally relevant statistics on this topic focus on the use and management of these resources as this can affect biodiversity. The conservation of key habitats and landscapes and the species within them is key to prevent further biodiversity loss. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) states that the trade of wild species needs to be managed at national and international levels to prevent over-exploitation.[62] Trade that is detrimental to the survival of a species and does not allow the species to live in a consistent level in its ecosystem has to be managed and measured. This can involve measuring imports and exports of such species for trade, the number of wild animals killed or trapped for food or sale, permits issued to hunt and trap wild animals, and animal kills allowed by permits.

3.142. The main provider of data and the institutional partners for these statistics include the environmental, natural resources and wildlife authorities, and the government agency responsible for hunting.

[62] Convention on International Trade in Endangered Species of Wild Fauna and Flora (2008). "Non-detriment findings", available from https://cites.unia.es/cites/file.php/1/files/guide-CITES-NDFs-en.pdf (accessed 4 August 2017).

Table 3.2.5.5
Statistics and related information for Topic 2.5.5

Component 2: Environmental Resources and their Use				
Subcomponent 2.5: Biological Resources				
Topic 2.5.5: Other non-cultivated biological resources				
Statistics and related information				
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)		Category of measurement	Potential aggregations and scales	Methodological guidance
a.	Permits for regulated hunting and trapping of wild animals		• By type of animal	• ISIC Rev. 4, Section A, Class 0170
	1. Number of permits issued per year	Number	• By species	
	2. Number of animal kills allowed by permits	Number		
b.	Imports of endangered species	Currency, number		• Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
c.	Exports of endangered species	Currency, number		
d.	*Reported wild animals killed or trapped for food or sale*	Number		• ISIC Rev. 4, Section A, Class 0170
e.	*Trade in wildlife and captive-bred species*	Description, mass, number	• By status category • National • Subnational	• CITES
f.	*Non-wood forest products and other plants*	Mass, volume	• By type of product • National • Subnational	• ISIC Rev. 4, Section A, Class 0230

Subcomponent 2.6: Water Resources

3.143. Management of water resources, in terms of quantities, distribution and quality, is one of the world's most important priorities today. Policymakers need statistics on water resources, their abstraction, use and returns for many reasons, including to estimate the amount of available water resources; monitor abstraction from key water bodies to prevent overutilization; ensure equitable usage of abstracted water; and track the volume of water returned to the environment.

3.144. The IRWS[63] provides the definitions and groupings for the purposes of statistics on water resources and their use.

Topic 2.6.1: Water resources

3.145. Water resources consist of freshwater and brackish water, regardless of their quality, in inland water bodies, including surface water, groundwater and soil water. Inland water stocks are the volume of water contained in surface water and groundwater bodies and in the soil at a point in time. Water resources are also measured in terms of flows to and out of the inland water resources during a period of time. Surface water comprises all water that flows over or is stored on the ground's surface, regardless of its salinity levels. Surface water includes water in artificial reservoirs, lakes, rivers and streams, snow, ice and glaciers. Groundwater comprises water that collects in porous layers of underground formations known as aquifers. A country's renewable water resources are generated by precipitation and inflows of water from neighbouring territories and reduced by evapotranspiration.

3.146. Statistics on water resources include the volume of water generated within the country or territory as the result of precipitation, the volume of water lost to evapotranspiration, the inflow of water from neighbouring territories, and the outflow of water to neighbouring territories or the sea. The statistics are sourced from hydrometeorological and hydrological monitoring, measurements and models. Statistics on the quality of water in water bodies are discussed under Topic 1.3.2: Freshwater quality and Topic 1.3.3: Marine water quality.

[63] United Nations Statistics Division (2012). *International Recommendations for Water Statistics*, available from http://unstats.un.org/unsd/envaccounting/irws/irwswebversion.pdf (accessed 18 August 2017).

Table 3.2.6.1
Statistics and related information for Topic 2.6.1

Component 2: Environmental Resources and their Use			
Subcomponent 2.6: Water Resources			
Topic 2.6.1: Water resources			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Inflow of water to inland water resources		• National	• UNSD: IRWS
1. **Precipitation** (also in 1.1.1.b)	Volume	• Subnational	• UNECE Standard Statistical Classification of Water Use (1989)
2. **Inflow from neighbouring territories**	Volume	• By territory of origin and destination	• UNSD: MDG Indicator 7.5 Metadata
3. *Inflow subject to treaties*	Volume		• FAO AQUASTAT
b. Outflow of water from inland water resources			• SEEA Central Framework (2012) asset accounts
1. **Evapotranspiration**	Volume		• SEEA Water
2. Outflow to neighbouring territories	Volume		• UNSD: Environment Statistics Section—Water Questionnaire
3. Outflow subject to treaties	Volume		
4. Outflow to the sea	Volume		
c. Inland water stocks		• National	
1. Surface water stocks in artificial reservoirs	Volume	• Subnational	
2. Surface water stocks in lakes	Volume		
3. *Surface water stocks in rivers and streams*	Volume		
4. *Surface water stocks in wetlands*	Volume		
5. *Surface water stocks in snow, ice and glaciers*	Volume		
6. Groundwater stocks	Volume		

Topic 2.6.2: Abstraction, use and returns of water

3.147. Abstraction, use and returns of water are the flows of water between the environment and the human subsystem and within the human subsystem. Water abstraction is the amount of water that is removed from any source, either permanently or temporarily, in a given period of time. Water is abstracted from surface water and groundwater resources by economic activities and households. It can be abstracted for own use or for distribution to other users. Statistics on water abstraction should be disaggregated according to the source of the water (surface or groundwater) and by abstractor (economic activity or households). Water abstraction usually refers to the off-stream use of water. The most important off-stream uses for which water is abstracted are (i) water supply to human settlements, (ii) water for agriculture, (iii) water for industries and (iv) water for cooling in thermoelectricity generation.

3.148. In-stream water use refers to the use of water without moving it from its source or to the use when water is immediately returned with little or no alteration. The most important in-stream water uses are (i) water for hydroelectricity generation, (ii) water for the operation of navigation locks and (iii) water for freshwater aquaculture.

3.149. Water managers also use the category of in situ water use. The most important in situ water use is ecological use, that is, water used as a habitat for living organisms. Human in situ water uses include navigation, fishing, recreation, tourism and waste loading (pollution dilution).

3.150. As with off-stream uses, all human in-stream and in situ water uses have significant effects with regard to the ecological use of the same water resources. In-stream and in situ activities are usually measured in terms of the intensity of the use. In-stream and in situ activities that use water are covered under Topic 2.5.2: Aquatic resources and their use; Topic 2.2.2: Production, trade and consumption of energy; Topic 3.2.3: Discharge of wastewater to the environment; and Topic 3.3.2: Management of waste. Statistics on water transport and recreation are not included in the FDES but can be used to indicate the pressures these activities place on water resources.

3.151. After abstraction and distribution, water is used in the economy in production and consumption activities. Water can be recycled and reused several times before it is returned to the environment. Water use should be disaggregated according to economic activity and household use. Water use by tourists may also be captured to measure tourism's environmental impact. The most significant water uses (e.g., irrigation in agriculture, hydropower generation and cooling) should be specified. Significant water loss may occur during transport, so these data should be captured here as well. Statistics on water use can be obtained from statistical surveys of primary users, household surveys and administrative records of the water supply industry.

3.152. A large part of the water used in economic activities and by households is returned to the environment after or without treatment. The volume of returned water should be disaggregated by recipient (e.g., surface water, groundwater, soil and sea). Statistics on the generation, treatment and pollutant content of wastewater are discussed under Subcomponent 3.2: Generation and Management of Wastewater.

3.153. All economic activities and households can abstract, use and return water to the environment. The most important activities, in terms of the volume of water abstracted, are agriculture (irrigation and livestock), the generation of electricity (hydropower and cooling) and the water collection, treatment and supply industry (ISIC Rev. 4, Section E, Division 36), which includes the collection (abstraction), treatment and distribution of water for household and industrial needs. Collection of water from various sources, as well as distribution by various means, is also included. Division 37 Sewerage accounts for a significant amount of water returned to the environment.

Table 3.2.6.2
Statistics and related information for Topic 2.6.2

Component 2: Environmental Resources and their Use				
Subcomponent 2.6: Water Resources				
Topic 2.6.2: Abstraction, use and returns of water				
Statistics and related information				
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)		Category of measurement	Potential aggregations and scales	Methodological guidance
a.	**Total water abstraction**	Volume	• By type of source • National • Subnational	• UNSD: IRWS • UNECE Standard Statistical Classification of Water Use (1989) • FAO AQUASTAT • SEEA Central Framework (2012) • SEEA Water • UNSD: Environment Statistics Section—Water Questionnaire
b.	**Water abstraction from surface water**	Volume		
c.	Water abstraction from groundwater			
	1. **From renewable groundwater resources**	Volume		
	2. **From non-renewable groundwater resources**	Volume		
d.	Water abstracted for own use	Volume	• By ISIC economic activity • National • Subnational	
e.	Water abstracted for distribution	Volume		
f.	Desalinated water	Volume	• National • Subnational	
g.	Reused water	Volume		
h.	Water use	Volume	• By ISIC economic activity • By tourists • National • Subnational	
i.	*Rainwater collection*	Volume	• National • Subnational	
j.	*Water abstraction from the sea*	Volume		
k.	Losses during transport	Volume	• By ISIC economic activity • National • Subnational	
l.	*Exports of water*	Volume	• National • Subnational	
m.	*Imports of water*	Volume		
n.	*Returns of water*	Volume	• By ISIC economic activity • By destination (e.g., inland water, land, sea, ocean) • National • Subnational	

3.3. Component 3: Residuals

3.154. Component 3 is closely related to the physical flow accounts (flows from the economy to the environment) of the SEEA-CF on which the terms and definitions are based, where relevant.[64] This component contains statistics on the amount and characteristics of residuals generated by human production and consumption processes, their management, and their final release to the environment. Residuals are flows of solid, liquid and gaseous materials, and energy, that are discarded, discharged or emitted by establishments and households through processes of production, consumption or accumulation. Residuals may be discarded, discharged or emitted directly to the environment or be captured, collected, treated, recycled or reused. The FDES covers the main groups of residuals that are emissions of substances to air, water or soil, wastewater and waste, and the release of residuals from the application of chemical substances (dissipative uses of products in the SEEA-CF).

3.155. Emissions, wastewater, waste and residuals from the application of chemicals can have different impacts and effects on human and ecosystem health. They will be absorbed, or will persist and concentrate differently, based on their nature, scale and a combination of local environmental dynamics (e.g., wind, currents, as well as characteristics of land, air and water masses). The substances are sometimes released or disposed of with little or no treatment, but, increasingly, emissions are treated to reduce pollutants before they are released into the environment. These treatment and management processes, and their infrastructure, are also included in this component.

[64] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2014). *System of Environmental-Economic Accounting 2012—Central Framework*, available from http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed 4 August 2017).

3.156. Emissions are substances released to the environment by establishments and households as a result of production, consumption and accumulation processes. Emissions can be released to air, water (as part of wastewater) and soil. Generally, emissions are analysed by the type of receiving environment (air, water or soil) and type of substance.

3.157. Wastewater is discarded water that is no longer required by the owner or user. Wastewater usually (but not always) carries pollution from the processes in which the water was used (emissions to water). Water discharged into sewers, received by water treatment plants and discharged to the environment is all considered wastewater regardless of its quality. It also includes reused water, which is wastewater supplied to a user for further use with or without prior treatment.

3.158. Waste covers discarded materials that are no longer required by the owner or user. It includes materials in solid or liquid state but excludes wastewater and emissions to air, water or soil.

3.159. A special category of residuals results from the dissipative uses of products, which cover products that are deliberately released to the environment as part of production processes. Examples are the application of chemicals such as fertilizers and pesticides, part of which may be absorbed in the production process while the rest will remain in the environment and may cause pollution.

3.160. The SEEA-CF also accounts for residuals in terms of dissipative losses, natural resource residuals and losses. Dissipative losses are material residues that are an indirect result of production and consumption activity. For more detailed discussion see the SEEA-CF, paras. 3.97-3.103.

3.161. Statistics on residuals must be broken down according to the economic activity that generated them, based on ISIC. Special attention should be paid to estimating residuals generated by international transport and tourism in order to calculate SEEA physical flow accounts.

3.162. Residuals have an impact on environmental quality that can be measured in terms of their concentrations in those media covered in Subcomponent 1.3: Environmental Quality.

3.163. Component 3 contains four subcomponents:

i. Subcomponent 3.1: Emissions to Air;

ii. Subcomponent 3.2: Generation and Management of Wastewater;

iii. Subcomponent 3.3: Generation and Management of Waste; and

iv. Subcomponent 3.4: Release of Chemical Substances.

Subcomponent 3.1: Emissions to Air

3.164. Air pollution can be caused by natural as well as anthropogenic factors. The FDES focuses on the emission of pollutants from anthropogenic factors that are socioeconomic processes. Emissions to air are gaseous and particulate substances released to the atmosphere by establishments and households as a result of production, consumption and accumulation processes. The statistical description of such emissions covers their sources and the quantities emitted by substance.

3.165. Policymakers, analysts and civil society need statistics on emissions to air to monitor the amount and type of emissions over time and across locations. These statistics can be used for evidence-based policymaking, particularly with regard to environmental regulations (e.g., maximum allowable emission levels versus actual levels). They can also be used to model where the greatest impacts on humans from air pollution may occur. These statistics are also required to monitor adherence to any MEAs, particularly the Kyoto and Montreal protocols, to which the country may be a party.

3.166. Air emissions may be measured directly or estimated on the basis of fuel and other material input data and process-specific emission factors. This information is usually produced in the form of emission inventories, available primarily from environmental ministries or environmental protection authorities. Emissions to air can be distinguished by the type of source (e.g., stationary or mobile, point or diffuse), by process, and by economic activity based on ISIC.

3.167. The groups of chemicals relevant to statistics on emissions to air include sulphur compounds, oxidized nitrogen compounds and oxidants, reduced nitrogen compounds, inorganic carbon compounds, halogen and inorganic halogen compounds, volatile organic compounds, heavy metals and different fractions of particulate matter (PM). The UNECE Standard Statistical Classification of Ambient Air Quality (1990) lists the substances, parameters and variables needed for statistics on air emissions.

Topic 3.1.1: Emissions of greenhouse gases (GHGs)

3.168. GHG emissions constitute a special category of air emissions. GHG emission inventories are compiled based on the guidelines developed by the IPCC, under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC). The source categories of GHG emissions are based on processes. The categories of sinks for GHG emissions are also included. GHGs include both direct and indirect GHGs. The most important direct GHGs are carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), and the most important indirect GHGs are sulphur dioxide (SO_2), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NM-VOCs).

3.169. While the IPCC guidelines prescribe process-based source categories, sources must be broken down by economic activity based on ISIC, to ensure consistency with and linkages to economic statistics. GHGs from international transport and tourism must be estimated to produce emission accounts. Air emissions generated by tourists may also be estimated to measure the environmental impacts of tourism.

Table 3.3.1.1
Statistics and related information for Topic 3.1.1

Component 3: Residuals			
Subcomponent 3.1: Emissions to Air			
Topic 3.1.1: Emissions of greenhouse gases			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Total emissions of direct greenhouse gases (GHGs), by gas:		• By ISIC economic activity • By tourists • National • Subnational • By IPCC source categories	• IPCC Emission Factor Database • UN Framework Convention on Climate Change (UNFCCC) Reporting Guidelines • UNECE Standard Statistical Classification of Ambient Air Quality (1990) • UNSD: MDG Indicator 7.2 Metadata • WHO
1. **Carbon dioxide (CO_2)**	Mass		
2. **Methane (CH_4)**	Mass		
3. **Nitrous oxide (N_2O)**	Mass		
4. Perfluorocarbons (PFCs)	Mass		
5. Hydrofluorocarbons (HFCs)	Mass		
6. Sulphur hexafluoride (SF_6)	Mass		
b. Total emissions of indirect greenhouse gases (GHGs), by gas:			
1. **Sulphur dioxide (SO_2)**	Mass		
2. **Nitrogen oxides (NO_x)**	Mass		
3. Non-methane volatile organic compounds (NM-VOCs)	Mass		
4. Other	Mass		

Topic 3.1.2: Consumption of ozone depleting substances (ODSs)

3.170. ODS is another important category of emissions that is actively monitored by the Montreal Protocol. Reported statistics worldwide have shown this protocol to be very effective in phasing out the use of these substances. Examples of ODSs include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons, methyl chloroform, carbon tetrachloride and methyl bromide. However, as emissions of these substances are difficult to measure directly, countries report on the apparent consumption of ODSs.

Table 3.3.1.2
Statistics and related information for Topic 3.1.2

Component 3: Residuals			
Subcomponent 3.1: Emissions to Air			
Topic 3.1.2: Consumption of ozone depleting substances			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Consumption of ozone depleting substances (ODSs), by substance:		• By ISIC economic activity • By tourists • National • Subnational • By IPCC source categories	• UNEP Ozone Secretariat • IPCC Emission Factor Database • UNECE Standard Statistical Classification of Ambient Air Quality (1990) • UNSD: MDG Indicator 7.3 Metadata • WHO
1. Chlorofluorocarbons (CFCs)	Mass		
2. Hydrochlorofluorocarbons (HCFCs)	Mass		
3. Halons	Mass		
4. Methyl chloroform	Mass		
5. Carbon tetrachloride	Mass		
6. Methyl bromide	Mass		
7. Other	Mass		

Topic 3.1.3: Emissions of other substances

3.171. Other environmentally important polluting substances are emitted to air beyond GHGs and ODSs. The most important are the different fractions of PM, which is an air pollutant consisting of mixed solid (i.e., dust) and liquid particles suspended in the air. PM eventually concentrates in the air and is measured to establish pollution levels (for instance as $PM_{2.5}$ and PM_{10}, see Topic 1.3.1: Air Quality). Furthermore, the particulate material contains different chemical elements and compounds that can be harmful beyond the potential impact of dust. For example, PM can contain chemical constituents such as sulphates, nitrates and ammonium. PM can be formed by suspension of soil and dust or from gaseous precursors such as SO_2, NO_x, ammonia and NM-VOCs. Other potentially harmful emissions include heavy metals (such as cadmium, lead and mercury) and other substances that are linked to environmental and health problems. Countries may wish to measure or estimate a variety of other emissions, based on national circumstances and priorities.

Table 3.3.1.3
Statistics and related information for Topic 3.1.3

Component 3: Residuals			
Subcomponent 3.1: Emissions to Air			
Topic 3.1.3: Emissions of other substances			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Emissions of other substances:		• By ISIC economic activity • By tourists • National • Subnational • By IPCC source categories	• UNECE Standard Statistical Classification of Ambient Air Quality (1990) • European Monitoring and Evaluation Programme (EMEP) under the Convention on Long-range Transboundary Air Pollution
1. Particulate matter (PM)	Mass		
2. Heavy metals	Mass		
3. *Other*	Mass		

Subcomponent 3.2: Generation and Management of Wastewater

3.172. This subcomponent contains statistics on the generation, management and discharge of wastewater, as well as the pollutant content of wastewater (emissions of substances to water). Policymakers, analysts and civil society need statistics on wastewater to properly manage this potentially harmful by-product of the human subsystem. Without statistics on the generation, management and discharge of wastewater, it is difficult to assess and possibly intervene with regard to wastewater volume and pollution levels. Other policy relevant wastewater statistics include a disaggregation by economic activity of responsibility for its generation, whether the wastewater is being treated and what is being emitted to the country's water bodies.

3.173. Administrative records and in some cases estimation outputs are the most commonly used type of statistical source. Countries usually report their wastewater and discharges to water based on statistics from the final treatment or collecting institution(s), or when no wastewater treatment is in place, by estimating from the water used by different activities (e.g., households, industries) using technological coefficients. The main institutional partner will be the water and wastewater authorities or institutions in charge of water supply, collection, treatment and/or final discharge of wastewater to the environment (e.g., water regulating bodies, water authorities, municipalities, water utilities and wastewater treatment plants).

Topic 3.2.1: Generation and pollutant content of wastewater

3.174. This topic includes statistics on the volume of water that is no longer required and is thus discarded by the user and statistics on the amount of pollutants contained in wastewater (emissions to water) before any collection or treatment. Statistics on the generation of wastewater and emissions to water should be broken down by the economic activity and households that generate them. The amount of wastewater generated by tourists can also be estimated to measure the environmental impact of tourism. Wastewater generation is usually estimated based on the volume of water used. The pollutant content of wastewater (emissions to water) can usually be obtained from monitoring at the place of generation or from estimates based on technological parameters.

Table 3.3.2.1
Statistics and related information for Topic 3.2.1

Component 3: Residuals			
Subcomponent 3.2: Generation and Management of Wastewater			
Topic 3.2.1: Generation and pollutant content of wastewater			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Volume of wastewater generated**	Volume	• By ISIC economic activity • By tourists • National • Subnational	• UNSD: IRWS • ISIC Rev. 4, Section E, Divisions 35-37 • SEEA Water • UNSD: Environment Statistics Section—Water Questionnaire
b. Pollutant content of wastewater	Mass	• By pollutant or pollution parameter (e.g., biochemical oxygen demand (BOD), chemical oxygen demand (COD), nitrogen, phosphorous, total suspended solids (TSS)) • By ISIC economic activity • National • Subnational	

Topic 3.2.2: Collection and treatment of wastewater

3.175. Wastewater may be discharged directly to the environment by the generator or may be collected in sewerage systems and treated in wastewater treatment plants (urban, industrial or other). This topic can include statistics describing (i) volumes of wastewater collected and transported to its final place of discharge or treatment facilities, (ii) volume of wastewater treated by type of treatment (primary, secondary and tertiary), (iii) physical infrastructure related to wastewater collection and treatment (e.g., number of treatment plants and capacities of plants), (iv) pollutant content extracted in the treatment facilities and (v) other relevant information.

3.176. Establishments that collect and treat wastewater are grouped under ISIC Rev.4, Section E, Division 37 Sewerage.

Table 3.3.2.2
Statistics and related information for Topic 3.2.2

Component 3: Residuals			
Subcomponent 3.2: Generation and Management of Wastewater			
Topic 3.2.2: Collection and treatment of wastewater			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Volume of wastewater collected**	Volume	• National • Subnational	• UNSD: IRWS • ISIC Rev. 4, Section E, Division 35 and 36
b. **Volume of wastewater treated**	Volume	• By treatment type (e.g., primary, secondary, tertiary) • National • Subnational	• UNSD: Environment Statistics Section—Water Questionnaire
c. Total urban wastewater treatment capacity			
1. Number of plants	Number		
2. Capacity of plants	Volume		
d. Total industrial wastewater treatment capacity			
1. Number of plants	Number		
2. Capacity of plants	Volume		

Topic 3.2.3: Discharge of wastewater to the environment

3.177. This topic captures information at the stage of final discharge of wastewater to the environment. It includes (i) volume of wastewater discharged to the environment without treatment; (ii) volume of wastewater discharged to the environment after treatment, by type of treatment (primary, secondary and tertiary) and type of treatment facility (public, private, municipal, industrial); and (iii) effluent quality.

3.178. Statistics on the volume of wastewater discharged after treatment can be obtained from administrative records of the treatment plants. Statistics on the volume of wastewater released without treatment can be obtained from economic units and records of sewerage companies or estimated on the basis of water use. The volume of discharged wastewater should also be disaggregated by recipient water body.

3.179. In addition to the volume of wastewater returned to the environment, it is also important to measure or estimate the volumes of different pollutants emitted with the wastewater or otherwise released to water bodies. Emissions to water are the substances released to water resources by establishments and households as a result of production, consumption and accumulation processes. Emissions to water should be disaggregated according to the releasing economic activities and should cover the most important substances.

Table 3.3.2.3
Statistics and related information for Topic 3.2.3

Component 3: Residuals			
Subcomponent 3.2: Generation and Management of Wastewater			
Topic 3.2.3: Discharge of wastewater to the environment			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Wastewater discharge		• By treatment type (e.g., primary, secondary, tertiary) • By recipient (e.g., surface water, groundwater, wetland, sea, land) • By ISIC economic activity • National • Subnational • By source (point/non-point source)	• UNSD: IRWS • ISIC Rev. 4, Section E, Division 35 and 36 • UNSD: Environment Statistics Section—Water Questionnaire
1. **Total volume of wastewater discharged to the environment after treatment**	Volume		
2. **Total volume of wastewater discharged to the environment without treatment**	Volume		
b. Pollutant content of discharged wastewater	Mass	• By pollutant or pollution parameter (e.g., BOD, COD, nitrogen, phosphorous) • National • Subnational • Net emission by ISIC economic activity • By source (point/non-point source)	

Subcomponent 3.3: Generation and Management of Waste

3.180. This subcomponent includes statistics on the amount and characteristics of waste, defined as discarded material for which the owner or user has no further use, generated by human activities in the course of production and consumption processes. To reduce the amount of waste generated and increase the share of waste that is recycled and reused as material or energy source are central to sustainable consumption and production and natural resource management. The final disposal of waste in the environment, even if in a controlled manner, creates pollution and occupies considerable land areas.

3.181. Relevant statistics cover the amount of waste generated by different sources that are economic activities (by ISIC categories) and households. Waste can also be classified based on its material content or other characteristics. Waste is usually collected at the place of generation and transported to treatment facilities (for recycling and reuse or to reduce its amount or hazardousness before final disposal) and to disposal facilities (for final disposal).

3.182. Policymakers, particularly local governments, require statistics on waste in order to assess how its generation changes over time. This in turn assists in planning for present and future waste management in terms of transportation and facilities required. Statistics on waste are also needed to develop strategies to encourage waste reduction, reuse and recycling.

Topic 3.3.1: Generation of waste

3.183. This topic includes statistics describing the amount of waste generated before any collection or treatment, by waste type, and by generator (by economic activity (by ISIC) and households). The waste lists that countries and international organizations use for waste statistics are usually based either on the generating process or the material content of the waste, or on the combination of the two. In many cases, the origin of the waste (the economic activity) generally determines the material content of the waste.

3.184. Ideally, statistics on the amount and type of waste generated should be reported by the establishments (economic units) that generate it. However, in practice these statistics are usu-

ally estimated from the records of the economic units engaged in waste collection, treatment and disposal. The broad waste categories frequently used in waste statistics, such as municipal, industrial and hazardous waste, combine many waste materials into categories based on the similarity of their collection, treatment and disposal. The amount of waste generated can be estimated with high reliability when the waste management system is well developed and covers all waste.

3.185. Hazardous waste is a special group of waste that, due to its toxic or other hazardous character, requires special management and is controlled by law in many countries. The Basel Convention, an MEA, focuses on the control of transboundary movements of hazardous waste across international borders and establishes criteria for the environmentally sound management of such waste. Reporting needs under this convention include the generation of hazardous waste, as well as the imports and exports of hazardous waste covered in Topic 3.3.2: Management of Waste. For additional information, see Annex C: Multilateral Environmental Agreements.

3.186. Depending on their priorities and availability of resources, rather than estimate the total amount of waste generation, countries may prefer to focus on certain waste types that are important to them. Such types of waste may be selected either because they are recyclable or reusable and thus constitute a resource (e.g., paper, glass or metal waste), or because their volume or hazard level creates a specific problem for treatment and disposal. An important aspect of data collection on waste (by type of waste) is food waste. Approximately one-third of food produced globally is lost or wasted.[65] This represents a large portion of the environmental costs of agriculture production. Countries may also wish to estimate the amount of waste generated by specific sectors or population groups, such as tourists.

[65] Food and Agriculture Organization of the United Nations (2011). *Global food losses and food waste: extent, causes and prevention*, available from www.fao.org/docrep/014/mb060e/mb060e00.pdf (accessed 4 August 2017).

Table 3.3.3.1
Statistics and related information for Topic 3.3.1

Component 3: Residuals			
Subcomponent 3.3: Generation and Management of Waste			
Topic 3.3.1: Generation of waste			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Amount of waste generated by source**	Mass	• By ISIC economic activity • By households • By tourists • National • Subnational	• European Commission: European List of Waste, pursuant to European Waste Framework Directive • Eurostat: Environmental Data Centre on Waste • Eurostat: European Waste Classification for Statistics (EWC-Stat), version 4 (Waste categories) • Basel Convention: Waste categories and hazardous characteristics • Eurostat: Manual on Waste Statistics • Eurostat: Guidance on classification of waste according to EWC-Stat categories • SEEA Central Framework (2012) • UNSD: Environment Statistics Section—Waste Questionnaire
b. Amount of waste generated by waste category	Mass	• By waste category (e.g., chemical waste, municipal waste, food waste, combustion waste) • National • Subnational	
c. **Amount of hazardous waste generated**	Mass	• By ISIC economic activity • National • Subnational	

Topic 3.3.2: Management of waste

3.187. This topic includes statistics on (i) the amount of waste collected and transported to treatment facilities or final disposal (ii) the amount of waste treated and disposed of by type of treatment and disposal (e.g., reuse, recycling, composting, incineration, landfilling, other) (iii) the physical infrastructure for waste treatment and disposal, including the number and capacity of treatment and disposal plants and (iv) other relevant information.

3.188. Relevant statistics will come from the records of the economic units engaged in waste management that fall under ISIC Rev. 4, Section E, Division 38 Waste collection, treatment and disposal activities; materials recovery. Waste collection systems, and treatment and disposal facilities may be operated by public or private companies that provide the service for the waste generator and keep records of the relevant transactions. However, some industrial establishments may perform part or all of these activities themselves.

Table 3.3.3.2
Statistics and related information for Topic 3.3.2

Component 3: Residuals			
Subcomponent 3.3: Generation and Management of Waste			
Topic 3.3.2: Management of waste			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Municipal waste		• By type of treatment and disposal (e.g., reuse, recycling, composting, incineration, landfilling, other) • By type of waste, when possible • National • Subnational	• Eurostat: Environmental Data Centre on Waste • Eurostat metadata: Organisation for Economic Co-operation and Development (OECD)/Eurostat definition of municipal waste • UNSD: Environment Statistics Section—Waste Questionnaire • Basel Convention: Waste categories and hazardous characteristics • Eurostat: EWC-Stat, version 4 (Waste categories) • European Commission: European Waste Framework Directive (Waste treatment operations) • Eurostat: Manual on Waste Statistics • Eurostat: Guidance on classification of waste according to EWC-Stat categories • Rotterdam Convention
1. **Total municipal waste collected**	Mass		
2. **Amount of municipal waste treated by type of treatment and disposal**	Mass		
3. **Number of municipal waste treatment and disposal facilities**	Number		
4. Capacity of municipal waste treatment and disposal facilities	Volume		
b. Hazardous waste			
1. **Total hazardous waste collected**	Mass		
2. **Amount of hazardous waste treated by type of treatment and disposal**	Mass		
3. **Number of hazardous waste treatment and disposal facilities**	Number		
4. Capacity of hazardous waste treatment and disposal facilities	Volume		
c. Other/industrial waste			
1. Total other/industrial waste collected	Mass		
2. Amount of other/industrial waste treated by type of treatment and disposal	Mass		
3. Number of other/industrial treatment and disposal facilities	Number		
4. Capacity of other/industrial waste treatment and disposal facilities	Volume		
d. **Amount of recycled waste**	Mass	• By specific waste streams (e.g., e-waste, packaging waste, end of life vehicles) • By waste category • National • Subnational	
e. Imports of waste	Mass	• By waste category (e.g., chemical waste, municipal waste, combustion waste)	
f. Exports of waste	Mass		
g. Imports of hazardous waste	Mass		
h. Exports of hazardous waste	Mass		

Subcomponent 3.4: Release of Chemical Substances

Topic 3.4.1: Release of chemical substances

3.189. This topic deals with chemical fertilizers to enrich soils and pesticide use in protecting plants and animals from disease. Other chemicals accelerate the growth of biota and preserve and enhance the quality, size and appearance of biological products. Environmental effects are generated by the diffusion of chemicals through cycling systems and build-up of contaminants in water, land and living organisms (through the food chain). Statistics under this topic include the amount of natural and chemical fertilizers, pesticides and other chemicals (hormones and pellets) used by type of active ingredients (see also Subcomponent 2.5: Biological Resources), the area under application and the method employed. These statistics serve as a proxy or the basis for estimating the chemicals that remain in the environment and affect environmental quality.

3.190. The Stockholm Convention on Persistent Organic Pollutants (POPs) aims to eliminate or restrict the production and use of POPs. POPs are a group of chemicals possessing the following characteristics: they are highly toxic to humans and wildlife (harmfulness), they can last for many years in the environment before degrading into less dangerous forms (persistence), they bio-accumulate in the food chain (bio-accumulation), and they are transported over large distances through air and water and can be found worldwide (long-range transport).[66] The Stockholm Convention identified an initial 12 chemicals or chemical groups for priority action, including aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, PCBs, polychlorinated dioxins and polychlorinated furans. Additional substances were added in 2009. For additional information, see Annex C: Multilateral Environmental Agreements.

[66] United Nations Environment Programme. "Persistent Organic Pollutants", available from http://drustage.unep.org/chemicalsandwaste/what-we-do/science-and-risk/persistent-organic-pollutants-pops/ (accessed 4 August 2017).

Table 3.3.4.1
Statistics and related information for Topic 3.4.1

Component 3: Residuals			
Subcomponent 3.4: Release of Chemical Substances			
Topic 3.4.1: Release of chemical substances			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Total amount of fertilizers used		• National • Subnational • By ISIC economic activity (forestry, agriculture) • By type of fertilizer • By type of pesticide	• FAOSTAT database • Stockholm Convention
1. Natural fertilizers (also in 2.5.1.b and 2.5.3.b)	Area, mass, volume		
2. Chemical fertilizers (also in 2.5.1.b and 2.5.3.b)	Area, mass, volume		
b. Total amount of pesticides used (also in 2.5.1.b and 2.5.3.b)	Area, mass, volume		
c. *Total amount of pellets used* (also in 2.5.2.e)	Mass, volume	• National • Subnational • By ISIC economic activity (aquaculture)	• Stockholm Convention
d. *Total amount of hormones used* (also in 2.5.2.e and 2.5.4.b)	Mass, volume	• National • Subnational • By ISIC economic activity (aquaculture, livestock production)	
e. *Total amount of colourants used* (also in 2.5.2.e)	Mass, volume	• National • Subnational • By ISIC economic activity (aquaculture)	
f. *Total amount of antibiotics used* (also in 2.5.2.e and 2.5.4.b)	Mass, volume	• National • Subnational • By ISIC economic activity (aquaculture, livestock production)	

3.4. Component 4: Extreme Events and Disasters

3.191. This component organizes statistics on the occurrence of extreme events and disasters and their impacts on human well-being and the infrastructure of the human subsystem.

3.192. The most common data providers are national and subnational authorities responsible for disaster management and assistance, emergency management and response agencies, insurance companies, optical and radar satellite operators for satellite information, and seismic monitoring and research centres.

3.193. Component 4 contains the following two subcomponents:

i. Subcomponent 4.1: Natural Extreme Events and Disasters; and

ii. Subcomponent 4.2: Technological Disasters.

Subcomponent 4.1: Natural Extreme Events and Disasters

3.194. This subcomponent organizes statistics on the frequency and intensity of extreme events and disasters deriving from natural phenomena, as well as their impact on human lives and habitats and the environment as a whole. Statistics on natural extreme events and disasters are important to policymakers, analysts and civil society not only to assess the impact of an ongoing disaster, but also to monitor the frequency, intensity and impact of disasters over time.

3.195. An extreme event is one that is rare within its statistical reference distribution at a particular location. An extreme event is normally as rare as or rarer than the 10th or 90th percentile. A disaster is often described as a result of exposure to an extreme event. The Centre for Research on the Epidemiology of Disasters (CRED) defines a disaster as an "unforeseen and often sudden event that causes great damage, destruction and human suffering."[67] It often exceeds local response capacities and requires external assistance at the national or international level. For inclusion in this subcomponent, a disaster should be categorized using the same criteria as the CRED Emergency Events Database (EM-DAT). It must thus meet at least one of the following criteria:

i. Ten (10) or more people reported killed;

ii. One hundred (100) or more people reported affected;

iii. Declaration of a state of emergency; or

iv. Call for international assistance.

For more information on the full classification of CRED, see Annex D: Classifications and environment statistics.

3.196. Natural extreme events and disasters impact human lives, habitats and ecosystems in ways depending on their intensity, the extent to which the human habitat is prepared and the environmental conditions prevailing in the territories, particularly those where humans live. Thus, the general social, living and infrastructural conditions of a given human habitat can worsen or mitigate the impacts and effects of natural disasters.

3.197. In recent decades, increased extreme events have led to more frequent, more intense and more destructive and deadly natural disasters. Climate change has been associated with the increasing frequency and severity of extreme weather events. It has resulted in increased global temperatures, rising sea levels, increased storms and precipitation, droughts, floods, tropical cyclones, hurricanes, tornadoes and other climatic disruptions in many places around the world. As the occurrence and intensity of natural extreme events and disasters have increased globally, countries have faced greater social and economic impacts.

[67] Centre for Research on the Epidemiology of Disasters EM-DAT (2009). "Emergency Events Database", available from www.emdat.be (accessed 4 August 2017).

3.198. The statistics organized under this component will take into account the entire sequence associated with both the occurrence and impact of each individual event, including type, statistics on the disaster's impact, including people affected and the assessment of economic loss. Statistics relating to the indirect health problems associated with natural disasters is covered in Subcomponent 5.2: Environmental Health. Statistics related to disaster preparedness can be found under Topic 6.3.1: Preparedness for Natural Extreme Events and Disasters.

Topic 4.1.1: Occurrence of natural extreme events and disasters

3.199. The types of statistics included in this topic may be, but are not limited to, the type of natural disaster, location, magnitude, date of occurrence and duration.

Table 3.4.1.1
Statistics and related information for Topic 4.1.1

Component 4: Extreme Events and Disasters			
Subcomponent 4.1: Natural Extreme Events and Disasters			
Topic 4.1.1: Occurrence of natural extreme events and disasters			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Occurrence of natural extreme events and disasters		• By event • National • Subnational	• Centre for Research on the Epidemiology of Disasters Emergency Events Database (CRED EM-DAT) • UN Economic Commission for Latin America and the Caribbean (UNECLAC) Handbook for Estimating the Socio-economic and Environmental Effects of Disasters • The United Nations Office for Disaster Risk Reduction (UNISDR)
1. **Type of natural extreme event and disaster** (geophysical, meteorological, hydrological, climatological, biological)	Description		
2. **Location**	Location		
3. Magnitude (where applicable)	Intensity		
4. Date of occurrence	Date		
5. Duration	Time period		

Topic 4.1.2: Impact of natural extreme events and disasters

3.200. This topic should include information on the impact of a natural extreme event or disaster. Impact can be measured in a number of ways. Common dimensions include the number of people killed, injured, homeless and affected, as well as economic loss. Economic loss may refer to damage to buildings and other economic assets, number of transportation networks affected, economic disruption or loss of revenue to commercial services, and utility disruption. Physical loss or damage refers to the magnitude of the impact of the event or disaster on the quantity and quality of land, crops, livestock, aquaculture and biomass. The specific impact of each natural disaster on the integrity of the local ecosystem may also be reported on, where statistics exist. In addition, the external assistance received for disaster relief may also be measured.

3.201. The United Nations Economic Commission for Latin America and the Caribbean (UNECLAC) has developed a handbook, *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters*,[68] which may be useful to other countries and regions. It evaluates the overall impact of disasters associated with natural events and includes a methodology for evaluating it. This analysis of disaster impact in terms of damage and losses makes it possible to estimate the impact of disasters on economic growth, the population's living conditions and environmental conditions in the region.

3.202. UNECLAC published the third edition of the *Handbook for Disaster Assessment*[69] in February 2014. This edition strengthens the methodology for estimating both the effects and the impacts of disasters, improving its consistency by clearly differentiating concepts of losses and additional costs. It also systematizes the linkages among different economic sectors. The document also addresses cross-cutting themes such as gender and the environment.

[68] United Nations Economic Commission for Latin America and the Caribbean (2003). *Handbook for Estimating the Socio-economic and Environmental Effects of Disasters*. LC/MEX/G.5 UNECLAC Mexico Office, available from www.cepal.org/es/publicaciones/5502-guia-metodologica-desarrollar-indicadores-ambientales-desarrollo-sostenible (accessed 4 August 2017).

[69] United Nations Economic Commission for Latin America and the Caribbean (2014). *Handbook for Disaster Assessment*. LC/L.3691, available from www.cepal.org/cgi-bin/getProd.asp?xml=/publicaciones/xml/4/52674/P52674.xml&xsl=/publicaciones/ficha.xsl&base=/publicaciones/top_publicaciones.xsl (accessed 4 August 2017).

Table 3.4.1.2
Statistics and related information for Topic 4.1.2

Component 4: Extreme Events and Disasters			
Subcomponent 4.1: Natural Extreme Events and Disasters			
Topic 4.1.2: Impact of natural extreme events and disasters			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. People affected by natural extreme events and disasters		• By event • National • Subnational	• Centre for Research on the Epidemiology of Disasters Emergency Events Database (CRED EM-DAT) • UN Economic Commission for Latin America and the Caribbean (UNECLAC) Handbook for Estimating the Socio-economic and Environmental Effects of Disasters • The United Nations Office for Disaster Risk Reduction (UNISDR)
1. **Number of people killed**	Number		
2. Number of people injured	Number		
3. Number of people homeless	Number		
4. Number of people affected	Number		
b. **Economic losses due to natural extreme events and disasters** (e.g., damage to buildings, transportation networks, loss of revenue for businesses, utility disruption)	Currency	• By event • By ISIC economic activity • National • Subnational • By direct and indirect damage	
c. Physical losses/damages due to natural extreme events and disasters (e.g., area and amount of crops, livestock, aquaculture, biomass)	Area, description, number		
d. Effects of natural extreme events and disasters on integrity of ecosystems		• By event • By ecosystem • National • Subnational	
1. *Area affected by natural disasters*	Area		
2. *Loss of vegetation cover*	Area		
3. *Area of watershed affected*	Area		
4. *Other*	Description		
e. *External assistance received*	Currency	• By event • National	

Subcomponent 4.2: Technological Disasters

3.203. This subcomponent organizes statistics on technological disasters. These disasters may arise as a result of human intent, negligence or error, or faulty or failed technological applications. This subcomponent groups information on the occurrence and impact of such disasters on human lives, habitats, the environment, and on disaster preparedness for such types of disasters.

3.204. Policymakers, analysts and civil society require statistics on technological disasters to understand who is ultimately responsible and what the immediate and potential impact may be, and to assess and mitigate future risks. To date, records of global technological disasters show increasing frequency and impact on humans, the infrastructure and the environment. This further reinforces the relevance and necessity of statistics on these issues for policymaking and analysis.

3.205. CRED recognizes three types of technological disasters.[70] These are industrial accidents, which cover accidents associated with chemical spill, collapse, explosion, fire, gas leak, poisoning, radiation and other; transport accidents, which cover accidents associated with air, road, rail, and water; and miscellaneous accidents, which cover accidents associated with collapse, explosion, fire and other disasters of varied origin. All these types of disasters can impact large areas and affect both human safety and the environment in both the short and long term.

[70] Centre for Research on the Epidemiology of Disasters EM-DAT. "Classification", available from www.emdat.be/classification (accessed 4 August 2017).

Topic 4.2.1: Occurrence of technological disasters

3.206. This topic organizes information on the frequency and nature of disasters that arise as a result of human intent, negligence or error, or from faulty or failed technological applications. Nuclear meltdowns and pipeline or tanker leaks that result in significant harm to the environment, including potentially significant consequent impacts on humans, are prime examples.

3.207. Technological disasters impact human lives, habitats and ecosystems in various ways, depending on the nature and intensity of the disaster. Their effects may be short term or of significant or unknown duration. In the case of technological disasters, there is sometimes no precedent for a given disaster. The full impact of such disasters cannot always be fully anticipated or measured.

3.208. This topic should include information on the identification and characterization of different types of events, including information on type of disaster, location, date of occurrence and duration. Additionally, where relevant because of repeated episodes, the frequency of technological disasters can also be critical in guiding policy-making and the development of deterrents.

3.209. Information on environmental media that are impacted is included under Subcomponent 1.3: Environmental Quality, covering air, water, soil and noise, as relevant.

3.210. For inclusion in this subcomponent, a technological disaster should be categorized using the same criteria as the CRED EM-DAT (see text in Subcomponent 4.1 for criteria).

Table 3.4.2.1
Statistics and related information for Topic 4.2.1

Component 4: Extreme Events and Disasters			
Subcomponent 4.2: Technological Disasters			
Topic 4.2.1: Occurrence of technological disasters			
Statistics and related information			
(**Bold text—Core Set/Tier 1;** regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Occurrence of technological disasters		• By event • By ISIC economic activity • National • Subnational	• CRED EM-DAT • UNECLAC: Handbook for Estimating the Socio-economic and Environmental Effects of Disasters
1. Type of technological disaster (industrial, transportation, miscellaneous)	Description		
2. *Location*	Location		
3. *Date of occurrence*	Date		
4. *Duration*	Time period		

Topic 4.2.2: Impact of technological disasters

3.211. This topic includes specific impacts on humans and damage to the economy and ecosystems arising from technological disasters. These impacts may include radiation-related conditions and diseases or other health impacts, property damage, loss of livelihood, services and housing, social and economic disruption, and environmental damage. The statistics in this topic include the number of people killed, injured, rendered homeless or affected, and economic loss. When available, estimates of the loss of work days and economic cost in monetary terms (e.g., loss of wages or costs of treatment) may be included here. Economic loss may refer to damage to buildings and other economic assets, number of transportation networks affected, economic disruption or loss of revenue to commercial services, and utility disruption. Physical loss or damage refers to the magnitude of the impact of the event or disaster on the quantity and quality of land, crops, livestock, aquaculture and biomass. The specific impact of each technological disaster on the integrity of the local ecosystem may also be reported on, where statistics exist. In addition, the external assistance received for disaster relief may also be measured.

3.212. As to data availability, economic impact assessments are often carried out by central banks and ministries of economic development. Additionally, large technological disasters are often the subject of one-time research projects by research or academic institutions assessing their impact. Insurance companies can also provide reliable appraisals of the impact.

3.213. Statistics on the environmental media that are impacted by technological disasters are included in Subcomponent 1.3: Environmental Quality, under the relevant heading (e.g., air, water or soil). Statistics on the health impact of technological disasters can also be found in Topic 5.2.5: Toxic substance- and nuclear radiation-related diseases and conditions.

Table 3.4.2.2
Statistics and related information for Topic 4.2.2

Component 4: Extreme Events and Disasters			
Subcomponent 4.2: Technological Disasters			
Topic 4.2.2: Impact of technological disasters			
Statistics and related information (**Bold text—Core Set/Tier 1;** regular text—Tier 2; *italicized text—Tier 3*)	**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
a. People affected by technological disasters		• By event	• CRED EM-DAT
1. Number of people killed	Number	• National	• UNECLAC: Handbook for Estimating the Socio-economic and Environmental Effects of Disasters
2. *Number of people injured*	Number	• Subnational	
3. *Number of people homeless*	Number		
4. *Number of people affected*	Number		
b. Economic losses due to technological disasters (e.g., damage to buildings, transportation networks, loss of revenue for businesses, utility disruption)	Currency	• By event • By ISIC economic activity • National • Subnational • By direct and indirect damage	
c. Physical losses/damages due to technological disasters (e.g., area and amount of crops, livestock, aquaculture, biomass)	Area, description, number		
d. Effects of technological disasters on integrity of ecosystems		• By event	
1. *Area affected by technological disasters*	Area	• National	
2. *Loss of vegetation cover*	Area	• Subnational	
3. *Area of watershed affected*	Area		
4. *Other* (e.g., for oil spills: volume of oil released into the environment, impact on ecosystem)	Description		
e. *External assistance received*	Currency	• By event • National	

3.5. Component 5: Human Settlements and Environmental Health

3.214. This component contains statistics on the environment in which humans live and work, particularly with regard to living conditions and environmental health. These statistics are important for the management and improvement of conditions related to human settlements, shelter conditions, safe water, sanitation and health, particularly in the context of rapid urbanization, increasing pollution, environmental degradation, disasters, extreme events and climate change.

3.215. Human settlements vary from tiny villages to large metropolitan agglomerations. Housing types also vary widely from slums to houses that meet local building codes. Increasing concentrations of humans in modern urban settlements pose special challenges to humans as well as to the physical environments in which these settlements are located. Air, water or soil pollution due to activities in human settlements causes continuous environmental change that can have damaging effects on agriculture, water resources, the energy sector and human health. The capacity or the resilience of the environment to cope with the environmental impacts caused by human habitation can influence both the health of the human settlements and the natural environment with which it is associated.

3.216. The well-being and health risks associated with the environment (and those posed by extreme events and disasters) can be mitigated substantially by the prevailing conditions and characteristics of human settlements. Several factors can mitigate or increase the effect of environmental and settlement-related risks on human well-being. These factors include the appropriate infrastructure that can provide water and sanitation, adequate waste disposal, wise land use planning, clean and safe transportation, safe building design and other measures of good housing, and ecosystem health. These conditions can improve a given human settlement, human well-being and health. Conversely, vulnerable human settlements are often more impacted by the changing environment and recover more slowly from pollution, environmental degradation, and extreme events and disasters.

3.217. Component 5 contains two subcomponents:

i. Subcomponent 5.1: Human Settlements; and

ii. Subcomponent 5.2: Environmental Health.

Subcomponent 5.1: Human Settlements

3.218. This subcomponent includes relevant statistics on basic services and infrastructure of human settlements. Human settlements refer to the totality of the human community, whether people live in large cities, towns or villages. They encompass the human population that resides in a settlement, the physical elements (e.g., shelter and infrastructure), services (e.g., water, sanitation, waste removal, energy and transport), and the exposure of humans to potentially deleterious environmental conditions.

3.219. Policymakers, analysts and civil society need statistics on human settlements for information on how humans live and work in these settlements, how they transform the landscape and the supporting ecosystems and, in turn, how this affects human well-being and health. The extent of human settlements, their ecological footprint (which is closely related to prevailing production and consumption patterns), the supporting and nearby environmental conditions and quality, and human access to infrastructure and services, all affect humans and the environment in a cyclical and iterative way.

3.220. The type of sources needed to document the status of and changes in human settlements include censuses, surveys, administrative records and remote sensing. The NSO's institutional partners include housing and urban planning authorities, health and transportation authorities, and research institutions. Presenting the statistics spatially using maps and geospatial statistics adds important value to the information produced.

3.221. The first topic in this subcomponent covers urban and rural population statistics, providing information on locations where humans construct and maintain their settlements in any given country. The next two topics cover access to water, sanitation, waste removal and energy, and housing conditions with a direct bearing on human well-being and health. The fourth topic includes complementary information describing how the spatial location of populations around sources of pollution exposes them to possible health effects. Finally, the fifth topic organizes information about additional urban environmental concerns such as transport, green spaces, and urban planning and zoning.

Topic 5.1.1: Urban and rural population

3.222. Humans live primarily in rural or urban communities, building their shelters and institutions, while using environmental resources to satisfy human needs. Depending on the carrying capacity of ecosystems, human settlements and their use of environmental resources will affect environmental conditions, as well as human well-being and health.

3.223. Statistics on the location of human settlements may be found in traditional demographic statistics and, increasingly, in geospatial information sources. There is a significant potential to use georeferenced population data in the field of environment statistics. They may be used as a reference and in combination with other environment statistics to construct indicators. For instance, in combination with housing, water and sanitation statistics, they can provide telling determinants of the environmental sustainability of human settlements and environmental health.

3.224. The main statistics pertaining to this topic are rural, urban and total population, including population density. When possible, these statistics should include geospatial information regarding specific geographic distributions in the country. Data on this topic are available widely in most countries. The main sources are censuses and household surveys. These statistics are generally produced by NSOs, usually in the demographic or social domains.

Table 3.5.1.1
Statistics and related information for Topic 5.1.1

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.1: Human Settlements			
Topic 5.1.1: Urban and rural population			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Population living in urban areas	Number	• Urban	• UN Population Division
b. Population living in rural areas	Number	• Rural	• UN Population Fund (UNFPA)
c. Total urban area	Area		
d. Total rural area	Area		
e. Population living in coastal areas	Number		

Topic 5.1.2: Access to selected basic services

3.225. This topic includes information about access to water, sanitation, waste removal services and energy in urban and rural areas. Access to these basic services can have a positive effect on human health and well-being, thereby contributing to improved environmental quality.

3.226. Relevant statistics on this topic include the population using an improved drinking water source and the population using an improved sanitation facility. MDG indicator 7.8 metadata defines an improved drinking water source as one of the following: piped water into dwelling, plot or yard; public tap or standpipe; borehole or tube well; protected dug well; protected spring; rainwater collection and bottled water (if a secondary available source is also improved).[71] The population using an improved drinking water source (at a national, urban and rural level) can be measured and the proportion of the total population can be obtained. Additionally, statistics on the price of water supplied, for example, through pipes or a vendor, as well as the population supplied by water supply industry, should also be collected.

3.227. MDG indicator 7.9 metadata defines an improved sanitation facility as one that hygienically separates human excreta from human contact. It includes flush/pour flush toilets or latrines connected to a sewer, septic tank, or pit, ventilated improved pit latrines, pit latrines with a slab or platform of any material which covers the pit entirely, except for the drop hole and composting toilets/latrines.[72] The population using an improved sanitation facility (at a national, urban and rural level) can be measured, and the proportion of the total population can be obtained.[73] Collection of data on this topic is therefore relevant and useful for monitoring progress towards achieving the MDGs and is required as numerators for MDG indicators 7.8 and 7.9.

[71] United Nations Statistics Division. "Millennium Development Goals Indicators. Indicator 7.8 Proportion of population using an improved drinking water source", available from http://unstats.un.org/unsd/mdg/Metadata.aspx?IndicatorId=0&SeriesId=665 (accessed 4 August 2017).

[72] United Nations Statistics Division. "Millennium Development Goals Indicators. Indicator 7.9 Proportion of population using an improved sanitation facility", available from http://mdgs.un.org/unsd/mdg/Metadata.aspx?IndicatorId=31 (accessed 4 August 2017).

[73] The Millennium Development Goal indicator 7.9 is the proportion of population using an improved sanitation facility. This is defined as the percentage of the population (national, urban and rural) with access to an improved sanitation facility with respect to the total population (national, urban and rural).

3.228. Polluted wastewater should be collected and treated before its discharge to the environment to reduce harmful environment effects. Statistics on the population's access to wastewater collecting systems and wastewater treatment are an important part of statistics on human settlements. Access to wastewater collecting systems does not necessarily mean that the wastewater is treated.

3.229. The generation of large amounts of waste during the normal functioning of households and economic activities in human settlements is also a very important environmental quality and human health concern, particularly in highly dense urban areas. Statistics about the population served by municipal waste collection are therefore considered important information about the population's access to basic services.

3.230. The last group of statistics under this topic refers to households with access to electricity and its price. Access to electricity is a measure of modern energy services. This term also encompasses access to clean cooking facilities, which include clean cooking fuels and stoves, advanced biomass cook stoves and biogas systems.

3.231. Institutional partners for this topic include NSOs, development, planning, energy and health ministries, utility providers and other agencies. In some countries, the municipal authorities in charge of providing some or all of these services produce the related statistics. In some instances, other partners may include agencies responsible for cartography or GIS data. Main data sources include administrative records, population censuses and household surveys that collect the relevant household data on water, sanitation, waste removal and energy.

Table 3.5.1.2
Statistics and related information for Topic 5.1.2

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.1: Human Settlements			
Topic 5.1.2: Access to selected basic services			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. **Population using an improved drinking water source**	Number	• Urban • Rural • National • Subnational	• UNSD: MDG Indicator 7.8 and 7.9 Metadata • UN-Water • UNSD: Environment Statistics Section—Water and Waste Questionnaire • WHO/(United Nations Children's Fund (UNICEF) Joint Monitoring Programme for Water Supply and Sanitation
b. **Population using an improved sanitation facility**	Number		
c. **Population served by municipal waste collection**	Number		
d. *Population connected to wastewater collecting system*	Number	• By treatment type (e.g., primary, secondary, tertiary) • National • Subnational	• UNSD: IRWS • ISIC Rev. 4, Section E, Division 35-37 • UNSD: Environment Statistics Section—Water Questionnaire
e. **Population connected to wastewater treatment**	Number		
f. **Population supplied by water supply industry**	Number	• National • Subnational	
g. Price of water	Currency	• By source (e.g., piped, vendor)	
h. Population with access to electricity	Number		
i. Price of electricity	Currency		

Topic 5.1.3: Housing conditions

3.232. This topic includes information on the sufficiency of housing in terms of the following characteristics: population access to an adequate dwelling; the characteristics of the houses in which both rural and urban population live, including the quality of the houses (e.g., building materials) and location in a safe or a hazard-prone area. Housing access and conditions have

a direct effect on human well-being and health, and these data serve as critical measures of those attributes.

3.233. Housing condition statistics need to be described according to national conditions and priorities. Income distribution directly influences access to housing, the quality of homes accessible to different social groups, and their location. The poorest members of the population usually live in poorly built, unsafe and less sanitary housing, which renders them more vulnerable to disasters and adverse health impacts.

3.234. Depending on the country, common statistics describing the quality and location of houses in either safe or hazard-prone areas include the urban population living in slums, area of slums, population living in informal settlements, homeless population, and the number of dwellings with adequate building materials as defined by national or local standards. Additionally, statistics on hazard-prone areas and the population living in hazard-prone areas are commonly used when available.

3.235. Poor or inadequate housing conditions in urban areas may be addressed using the concept of "slums" and statistics on the area and proportion of urban population living in them. MDG indicator 7.10 defines the urban population living in slum households as a group of individuals living under the same roof lacking one or more of the following conditions: access to improved water; access to improved sanitation; sufficient living area; durability of housing; or security of tenure. However, information on secure tenure is not available for most countries, so only the first four indicators are usually used to define slum households.[74]

[74] United Nations Statistics Division. "Millennium Development Goals Indicators, Indicator 7.10 Proportion of urban population living in slums", available from http://mdgs.un.org/unsd/mdg/Metadata.aspx?IndicatorId=32 (accessed 4 August 2017).

3.236. Data sources for this topic include censuses and household surveys. Typically, the NSO's partners include the urban planning and housing authorities responsible for zoning, construction methods and regulation of building materials used for local homes and buildings.

Table 3.5.1.3
Statistics and related information for Topic 5.1.3

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.1: Human Settlements			
Topic 5.1.3: Housing conditions			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Urban population living in slums	Number		• UN Habitat
b. Area of slums	Area		• UNSD: MDG Indicator 7.10 Metadata
c. Population living in hazard-prone areas	Number	• Urban	
d. Hazard-prone areas	Area	• Rural	
e. *Population living in informal settlements*	Number	• National	
f. *Homeless population*	Number	• Subnational	
g. *Number of dwellings with adequacy of building materials defined by national or local standards*	Number		

Topic 5.1.4: Exposure to ambient pollution

3.237. This topic includes spatially described statistics on human populations exposed to different levels of air and noise pollution. This topic overlays pollutant emission and exposure data onto geographic and demographic data to create a more detailed understanding of the location of populations currently exposed to pollutants and those most at risk of future exposure. Location-specific geospatial information on ambient pollutant levels is extremely important for environmental protection and environmental health policies, particularly in larger cities. Statistics for this topic include the number of people exposed to air or noise pollutants in main

cities. Data are obtained from NSOs through censuses and surveys (for demographic statistics), environmental authorities (for point pollution emissions), and geographic or cartographic authorities.

Table 3.5.1.4
Statistics and related information for Topic 5.1.4

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.1: Human Settlements			
Topic 5.1.4: Exposure to ambient pollution			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Population exposed to air pollution in main cities	Number	By pollutant (e.g., SO_2, NO_x, O_3)	WHO
b. *Population exposed to noise pollution in main cities*	Number		

Topic 5.1.5: Environmental concerns specific to urban settlements

3.238. A growing proportion of the world's population, currently more than half, live in urban areas. This topic is intended to organize issues of specific relevance to this part of the population. Depending on national and local conditions and priorities, additional environmentally relevant urban concerns should be included here. Such issues may include, but are not limited to, the extent of urban sprawl, the availability of green spaces for urban residents, the prevailing types of transportation in and between urban areas, and the existence and effectiveness of urban planning and zoning.

3.239. With regard to transportation, statistics may include the number of private, public and commercial vehicles by engine type, as well as the extent of roadway infrastructure. Most importantly, from the environment statistics perspective, additional statistics should include the number of passengers transported by public transportation systems and the number of passengers transported annually by hybrid and electric modes of transportation.

3.240. Data sources for this topic include administrative records and remote sensing. The NSO's typical partners include municipal authorities, urban planning and housing authorities responsible for zoning, transport authorities and urban research centres.

Table 3.5.1.5
Statistics and related information for Topic 5.1.5

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.1: Human Settlements			
Topic 5.1.5: Environmental concerns specific to urban settlements			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Extent of urban sprawl	Area		• UN Habitat
b. Available green spaces	Area		• WHO
c. **Number of private and public vehicles**	Number	By type of engine or type of fuel	• UNEP Urban Environment Unit
d. Population using public modes of transportation	Number		
e. *Population using hybrid and electric modes of transportation*	Number		
f. Extent of roadways	Length		
g. *Existence of urban planning and zoning regulations and instruments in main cities*	Description		
h. *Effectiveness of urban planning and zoning regulations and instruments in main cities*	Description		

Subcomponent 5.2: Environmental Health

3.241. The impacts of changes in environmental conditions and pollution on human health are multiple and vary from country to country. The WHO is the leading global institution documenting the relationship between health and the environment. Its publications include a considerable volume of critical global statistics on environmental health.[75]

3.242. Environmental health focuses on how environmental factors and processes impact and change human health. It can be defined as an interdisciplinary field that focuses on analysing the relationship between public health and the environment. From the health perspective, WHO states that "environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments [...]".[76]

3.243. Common measures of health problems within human populations include statistics on morbidity (incidence and prevalence)[77] and mortality associated with specific types of diseases and conditions that are heavily influenced by environmental factors. Estimates of premature death, the loss of work days and estimation of the economic cost in monetary terms (e.g., loss of wages or costs of treatment) may also be included in environmental health statistics when available.

3.244. Associated environment statistics, such as emissions of pollutants to the environment, may be found in Component 3: Residuals, while statistics on pollution concentration in air, water and soil may be found in Subcomponent 1.3: Environmental Quality.

3.245. The main provider of data on morbidity (incidence and prevalence) and mortality due to environmentally related diseases and conditions is usually a country's sanitary or health authority. Other partners may include regulatory agencies and environmental protection agencies.

3.246. Primary epidemiological data can be selected and processed further for transformation into the environmental health statistics that constitute this subcomponent. The resulting statistics are usually produced using national and subnational data. They include descriptive epidemiological data that can usually be updated yearly.

3.247. The WHO is making remarkable progress in developing methodologies needed to estimate the attributable fraction[78] and burden of disease attributable to the environment.[79] It has also formulated comprehensive indicators and indexes such as DALY (disability-adjusted life year),[80] which is a summary measure of population health problems combining morbidity and premature death associated with different factors related to the modifiable environment.[81] However, caution must be exercised when producing these types of environmental health statistics because health and environmental problems are multifaceted and complex. Attributing the proportion of disease cases to a specific environmental or non-environmental factor is a challenging process associated with a degree of uncertainty.

Topic 5.2.1: Airborne diseases and conditions

3.248. This topic includes all airborne diseases and conditions that are caused or worsened by exposure to unhealthy levels of pollutants (such as PM, SO_2 or O_3), usually found in urban settlements and, in particular, in cities with weaker air quality regulations and/or enforcement capabilities. Airborne diseases and conditions include, but are not limited to, upper and lower respiratory disease, obstructive pulmonary disease, asthma, allergic rhinitis, lung cancer, ischaemic heart disease and stroke. This topic includes health statistics on morbidity (such as incidence and prevalence) and mortality of these diseases or conditions, as well as measurement of the associated impact on the labour force and economic costs. Where available, the attributable fraction and burden of diseases, premature deaths and DALYs associated with pollution are to be included in this topic.

75 Including (i) World Health Organization (2010). *10 Facts on Preventing Disease through Healthy Environments*, available from www.who.int/features/factfiles/environmental-disease-burden/en/ (accessed 4 August 2017); (ii) World Health Organization (2013). Fact Sheet 266, "Climate Change and Health", available from www.who.int/mediacentre/factsheets/fs266/en/index.html (accessed 4 August 2017); and (iii) World Health Organization (2009). *The Resilience of Water Supply and Sanitation in the Face of Climate Change*, "Summary and Policy Implications Vision 2030", available from www.who.int/water_sanitation_health/publications/9789241598422_cdrom/en/ (accessed 4 August 2017).

76 World Health Organization (2014). "Health topics—Environmental health", available from www.who.int/topics/environmental_health/en (accessed 4 August 2017).

77 Statistics on morbidity may include both its incidence and prevalence within the total population. Incidence generally refers to the rate of occurrence of new cases of disease (number of new cases in a specified population per unit of time), while prevalence is the proportion of the population with the disease at a given point in time. Therefore, incidence is the measure of speed, while prevalence is just a proportion—the number of individuals with the disease divided by the size of the source population.

78 The attributable fraction is the proportion of all health problems or deaths in the community that can be attributed to the (environmental) risk factor. This can be estimated by the proportional reduction in the number of health problems or deaths as a result of reducing the (environmental) risk factor. World Health Organization (2006). *Preventing Disease through Healthy Environments: Towards an estimate of the environmental burden of disease*, p. 25, available from www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf (accessed 4 August 2017).

Table 3.5.2.1
Statistics and related information for Topic 5.2.1

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.2: Environmental Health			
Topic 5.2.1: Airborne diseases and conditions			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Airborne diseases and conditions		• By disease or condition • National • Subnational • Urban • Rural • By gender • By age group • By time period	WHO
1. Incidence	Number		
2. Prevalence	Number		
3. Mortality	Number		
4. *Loss of work days*	Number		
5. *Estimates of economic cost in monetary terms*	Currency		

Topic 5.2.2: Water-related diseases and conditions

3.249. This topic includes all water-related diseases and conditions that result from micro-organisms and chemicals in the water that humans drink. Water-related diseases and conditions are still significant public health problems in developing countries. They include, but are not limited to, diseases caused by biological contamination, such as gastroenteritis infections caused by bacteria, viruses and protozoa, and water-borne parasite infections. This topic may also include diseases and health problems associated with the organic or inorganic chemical contamination of water (e.g., from arsenic, cadmium, chromium or copper) as prolonged exposure to these chemicals can provoke health problems including increased risk of cancer, organ damage and malfunction, and increased blood cholesterol and blood pressure. Where available, this topic includes health statistics such as morbidity (incidence and prevalence) and mortality of these diseases or conditions, as well as measures of the associated impact on the labour force and on the economic costs. When possible, the attributable fraction and burden of diseases, premature deaths and DALYs associated with water-related factors are to be included in this topic.

Table 3.5.2.2
Statistics and related information for Topic 5.2.2

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.2: Environmental Health			
Topic 5.2.2: Water-related diseases and conditions			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Water-related diseases and conditions		• By disease or condition • National • Subnational • Urban • Rural • By gender • By age group • By time period	WHO
1. **Incidence**	Number		
2. **Prevalence**	Number		
3. **Mortality**	Number		
4. *Loss of work days*	Number		
5. *Estimates of economic cost in monetary terms*	Currency		

[79] The burden of disease attributable to the environment includes: number of deaths, death rate, number of DALYs, DALYs rate, the percentage of total deaths attributable to the environment and the percentage of total DALYs attributable to the environment. WHO Indicator and Measurement Registry (IMR, version 1.6.0), Indicator: "Mortality and burden of disease attributable to the environment", available from http://apps.who.int/gho/indicatorregistry/App_Main/view_indicator.aspx?iid=2393 (accessed 4 August 2017).

[80] World Health Organization (2014). "Metrics: Disability-Adjusted Life Year (DALY)", available from www.who.int/healthinfo/global_burden_disease/metrics_daly/en/ (accessed 4 August 2017).

[81] World Health Organization's definition of the modifiable environment aims to cover those parts of the environment that can be modified by environmental management, so as to reduce its impact on human health. World Health Organization (2006): *Preventing Disease through Healthy Environments. Towards an estimate of the environmental burden of disease*, p. 22, available from www.who.int/quantifying_ehimpacts/publications/preventingdisease.pdf (accessed 4 August 2017). The modifiable environment includes: air, soil and water pollution with chemicals or biological agents; ultraviolet and ionizing radiation; built environment; noise, electromagnetic fields; occupational risks, agricultural methods and irrigation schemes; anthropogenic climate changes and ecosystem degradation; and individual behaviours related to the environment (hand-washing, food contamination with unsafe water or dirty hands). WHO Indicator and Measurement Registry (IMR, version 1.6.0), Indicator: "Mortality and burden of disease attributable to the environment", available from http://apps.who.int/gho/indicatorregistry/App_Main/view_indicator.aspx?iid=2393 (accessed 4 August 2017).

Topic 5.2.3: Vector-borne diseases

3.250. This topic includes vector-borne diseases that are transmitted by organisms (e.g., insects and arachnids) that carry viruses, bacteria, protozoa and other pathogens. Common vector-borne diseases include, but are not limited to, malaria, dengue fever, yellow fever and Lyme disease. Some vector-borne diseases are directly affected by climate change, specifically by the change in rain patterns and floods. This topic includes health statistics such as morbidity (incidence and prevalence) and mortality of these diseases or conditions, as well as measures of the associated impact on the labour force and on the economic costs. Where available, the attributable fraction and burden of diseases, premature deaths and DALYs associated with vector-borne environmental factors are to be included in this topic.

Table 3.5.2.3
Statistics and related information for Topic 5.2.3

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.2: Environmental Health			
Topic 5.2.3: Vector-borne diseases			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Vector-borne diseases		• By disease or condition • National • Subnational • Urban • Rural • By gender • By age group • By time period	WHO
1. **Incidence**	Number		
2. **Prevalence**	Number		
3. **Mortality**	Number		
4. *Loss of work days*	Number		
5. *Estimates of economic cost in monetary terms*	Currency		

Topic 5.2.4: Health problems associated with excessive UV radiation exposure

3.251. Although exposure to UV radiation in small amounts is beneficial for humans, prolonged exposure to such radiation can be harmful and may lead to negative health effects on the skin, eye and immune system. This topic includes statistics on the incidence and prevalence of melanoma and other skin cancers, and the incidence and prevalence of cataracts associated with excessive and prolonged UV radiation exposure. In addition, this topic includes statistics on loss of work days and economic costs in monetary terms. Where available, the attributable fraction and burden of diseases, premature deaths and DALYs associated with excessive UV radiation exposure is to be included in this topic.

Table 3.5.2.4
Statistics and related information for Topic 5.2.4

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.2: Environmental Health			
Topic 5.2.4: Health problems associated with excessive UV radiation exposure			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Problems associated with excessive UV radiation exposure		• By disease or condition • National • Subnational • Urban • Rural • By gender • By age group • By time period	WHO
1. *Incidence*	Number		
2. *Prevalence*	Number		
3. *Loss of work days*	Number		
4. *Estimates of economic cost in monetary terms*	Currency		

Topic 5.2.5: Toxic substance- and nuclear radiation-related diseases and conditions

3.252. This topic includes diseases and conditions associated with exposure to toxic substances, residuals and/or waste that result from localized emissions. Toxic substances include toxic pesticides (e.g., pesticides that have teratogenic, carcinogenic, tumorigenic and/or mutagenic effects), and toxic industrial chemicals (e.g., lead, arsenic, mercury and nickel, among others). Toxic substance-related diseases and health problems include, but are not limited to, chronic illnesses of the respiratory system (such as pneumonia, upper and lower respiratory diseases, asthma and chronic obstructive pulmonary diseases), cancer, infertility, and congenital anomalies or malformations.

3.253. Exposure to toxic substances is usually the result of poor environmental management in the chemical industry, energy production, mining, agriculture and waste management, and stakeholders' lack of information. The resulting diseases and conditions included under this topic may be caused by exposure to the toxins through air, water, food, soil or a combination of these elements. In this respect, the resulting health problems in this topic cannot be categorized as primarily or solely attributable to a specific medium such as air or water.

3.254. This topic also includes diseases and conditions associated with exposure to nuclear radiation. The related diseases and health conditions may be acute or chronic. They include, but are not limited to, thermal burns from infrared heat radiation, beta and gamma burns from beta and gamma radiation, radiation sickness or "atomic disease", leukaemia, lung cancer, thyroid cancer and cancer of other organs, sterility and congenital anomalies or malformations, premature aging, cataracts, and increased vulnerability to disease and emotional disorders.

3.255. Exposure to nuclear radiation could occur from a nuclear explosion or an accident involving a nuclear reactor. In such situations, radioactive material is emitted to surrounding air, water and soil of human settlements and ecosystems. The effects of exposure to humans can range from immediate and mechanical injuries to long-term and delayed effects on organs and tissues. Caution must be exercised in assessing the public heath burden due to exposure to radiation since some health problems, such as cancer, may also be caused by other factors.

3.256. This topic includes statistics about morbidity (incidence and prevalence) due to toxic substance-related or radiation-related diseases and conditions, as well as measurement of the associated impact on the labour force and on the economic costs. Where available, the attributable fraction and burden of diseases, premature deaths and DALYs associated with toxic substances and radiation is to be included in this topic. These statistics are also relevant in Topic 4.2.2: Impact of technological disasters.

3.257. The main provider of epidemiological data is usually a country's sanitation or health authority. Other institutions may include nuclear regulatory agencies and environmental protection agencies.

Table 3.5.2.5
Statistics and related information for Topic 5.2.5

Component 5: Human Settlements and Environmental Health			
Subcomponent 5.2: Environmental Health			
Topic 5.2.5: Toxic substance-and nuclear radiation-related diseases and conditions			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Toxic substance-and nuclear radiation-related diseases and conditions		• By category of toxic substance • By disease or condition	WHO
1. Incidence	Number	• National • Subnational • Urban • Rural • By gender • By age group	
2. Prevalence	Number		
3. *Loss of work days*	Number		
4. *Estimates of economic cost in monetary terms*	Currency		

3.6. Component 6: Environmental Protection, Management and Engagement

3.258. A country's engagement in the protection and management of the environment and, therefore, the resources it dedicates to that task, is related to information, awareness and social demand. It is also related to the country's ability to finance environmental protection activities and participate in international efforts directed at these activities. International stewardship, national political engagement, civil society participation, and effective policies and programmes have a role to play in mutually reinforcing each other.

3.259. This component organizes information on environmental protection and resource management expenditure to improve the environment and maintain ecosystem health. Statistics on environmental governance, institutional strength, enforcement of regulations and extreme event preparedness are also considered. This component also includes information on a wide variety of programmes and actions to increase awareness, including environmental information and education, as well as private and community activities aimed at diminishing environmental impacts and improving the quality of local environments.

3.260. Component 6 is organized into four subcomponents:

i. Subcomponent 6.1: Environmental Protection and Resource Management Expenditure;
ii. Subcomponent 6.2: Environmental Governance and Regulation;
iii. Subcomponent 6.3: Extreme Event Preparedness and Disaster Management; and
iv. Subcomponent 6.4: Environmental Information and Awareness.

Subcomponent 6.1: Environmental Protection and Resource Management Expenditure

3.261. This subcomponent is closely related to the environmental activity accounts of the SEEA-CF and is based on the CEA.[82] Expenditure on environmental protection and resource management may be used as one measure of public and private engagement in protecting, restoring and managing the environment towards more sustainable use. Monitoring and tracking the level of environmental protection and resource management expenditure is important for policymakers, analysts and civil society in order to determine the current and desired levels of engagement and commitment from both government and the private sector.

3.262. Environmental protection activities are those activities whose primary purpose is the prevention, reduction and elimination of pollution and other forms of degradation of the environment. These activities include the protection of ambient air and climate, wastewater management, waste management, protection and remediation of soil, groundwater and surface water, noise and vibration abatement, protection of biodiversity and landscapes, protection against radiation, research and development for environmental protection and other environmental protection activities.

3.263. Resource management activities are those activities whose primary purpose is preserving and maintaining the stock of natural resources and hence safeguarding against depletion. These activities include, but are not limited to, reducing the withdrawals of natural resources (including through the recovery, reuse, recycling and substitution of natural resources); restoring natural resource stocks (increases or recharges of natural resource stocks); the general management of natural resources (including monitoring, control, surveillance and data collection); and the production of goods and services used to manage or conserve natural resources. They cover the management of mineral and energy resources; timber resources; aquatic resources; other biological resources; water resources; research and development activities for resource management; and other resource management activities.

[82] United Nations, European Union, Food and Agriculture Organization of the United Nations, International Monetary Fund, Organisation for Economic Co-operation and Development, and the World Bank (2014). *Classification of Environmental Activities, contained in the SEEA Central Framework*. Available from http://unstats.un.org/unsd/envaccounting/seeaRev/SEEA_CF_Final_en.pdf (accessed 4 August 2017).

3.264. The Classification of Environmental Protection Activities (CEPA) has been in place since 2000, covering the classes of activities pertaining to environmental protection. Subsequent work to develop an overarching CEA that incorporates the CEPA and an interim listing of resource management activities has been undertaken. The CEA classification has been developed as part of the SEEA-CF (for further information see Annex D: Classifications and environment statistics).

3.265. In addition to classifying environmental protection and resource management expenditures according to their purpose, an important distinction should be made between those who bear the expenditures. They may be the general government, corporations, non-profit institutions and households.

3.266. The economic statistics of the Environmental Goods and Services Sector (EGSS)[83] are closely linked to the CEA. EGSS consists of a heterogeneous set of producers of technologies, goods and services that (i) measure, control, restore, prevent, treat, minimize, research and sensitize environmental damages to air, water and soil as well as problems related to waste, noise, biodiversity and landscapes. This includes "cleaner" technologies, goods and services that prevent or minimize pollution; and (ii) measure, control, restore, prevent, minimize, research and sensitize resource depletion. This results mainly in resource-efficient technologies, goods and services that minimize the use of natural resources.[84]

[83] Eurostat (2009). "The environmental goods and services sector." Eurostat Methodologies and Working Papers. Available from http://ec.europa.eu/eurostat/documents/3859598/5910217/KS-RA-09-012-EN.PDF/01d1733e-46b6-4da8-92e6-766a65d7fd60?version=1.0 (accessed 4 August 2017).

[84] Ibid.

Topic 6.1.1: Government environmental protection and resource management expenditure

3.267. This topic includes government expenditure whose primary aim is to protect the environment and manage its resources. Government (local, regional and central) expenditures to protect the environment are usually calculated by identifying and aggregating the expenditures considered to be primarily for environmental protection and resource management purposes. These expenditures may be found by examining official government finance statistics in government budgets and/or administrative reports on actual government expenditure.

3.268. The main institutional partners are the official institutions in charge of reporting government expenditure (e.g., internal revenue services) and the national and subnational level institutions (e.g., municipalities). The resulting statistics will usually be at the national level and can sometimes be disaggregated by functional governmental entities or level of government. Within the NSO, national accounts and government finance statistics also contribute to the development of government expenditure statistics. The statistics are expressed in monetary units, typically with annual periodicity, depending on the availability of resources.

Table 3.6.1.1
Statistics and related information for Topic 6.1.1

Component 6: Environmental Protection, Management and Engagement			
Subcomponent 6.1: Environmental Protection and Resource Management Expenditure			
Topic 6.1.1: Government environmental protection and resource management expenditure			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Government environmental protection and resource management expenditure		• By environmental activity • By type of expenditure: current, investment	• Eurostat-SERIEE Environmental Protection Expenditure Accounts Compilation Guide (2002) • Eurostat-Environmental Expenditure Statistics. General Government and Specialised Producers Data Collection Handbook (2007) • Classification of Environmental Activities (CEA) SEEA Central Framework (2012) Annex 1
1. **Annual government environmental protection expenditure**	Currency	• By ministry • National • Subnational • By funding	
2. Annual government resource management expenditure	Currency		

Topic 6.1.2: Corporate, non-profit institution and household environmental protection and resource management expenditure

3.269. Supplementary to the previous topic, this one includes corporate, non-profit institution and household environmental expenditure whose primary aim is to protect the environment and manage its resources. Statistics on environmental protection and resource management expenditure for corporations, non-profit institutions and households usually require the use of specific surveys of establishments in different sectors and industries. Therefore, key factors that affect the quality of statistics produced through this type of source include the existence of updated and precise establishment registers, sampling procedures and the quality of questionnaires. The technical capacity of individual establishments to respond adequately to environmental protection and resource management questions is also an important factor.

Table 3.6.1.2
Statistics and related information for Topic 6.1.2

Component 6: Environmental Protection, Management and Engagement			
Subcomponent 6.1: Environmental Protection and Resource Management Expenditure			
Topic 6.1.2: Corporate, non-profit institution and household expenditures on environmental protection and resource management expenditure			
Statistics and related information			
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	Category of measurement	Potential aggregations and scales	Methodological guidance
a. Private sector environmental protection and resource management expenditure		• By environmental activity • By type of expenditure: current, investment • By ISIC economic activity • National • Subnational	• Eurostat-Environmental expenditure statistics. Industry data collection handbook (2005) • Eurostat-Environmental expenditure Statistics. General Government and Specialised Producers Data Collection Handbook (2007)
1. Annual corporate environmental protection expenditure	Currency		
2. *Annual corporate resource management expenditure*	Currency		
3. *Annual non-profit institution environmental protection expenditure*	Currency		
4. *Annual non-profit institution resource management expenditure*	Currency		
5. *Annual household environmental protection expenditure*	Currency		
6. *Annual household resource management expenditure*	Currency		

Subcomponent 6.2: Environmental Governance and Regulation

3.270. To provide a holistic view of a country's efforts towards sustaining and protecting the environment, policymakers, analysts and civil society require statistics on environmental governance and regulation at the national level. The magnitude of these activities can inform about the extent of institutional development, availability of resources, and the existence and enforcement of regulatory and market instruments whose primary purpose is to protect, regulate and manage the changing environment.

3.271. Successful national environmental governance requires institutional strength, as well as regulatory capabilities. Therefore, this subcomponent includes setting standards and norms, providing adequate resources and ensuring the ability to enforce those standards and norms. Additionally, a nation's participation in MEAs and global environmental conventions are also included in this subcomponent to describe national participation in the global commitment to protect the environment.

3.272. Stakeholders need to be made aware of, and must sometimes also be given incentives to comply with, norms and standards. However, it is also critical that they be encouraged to accept changes in production and consumption behaviour voluntarily to protect the environment and use it sustainably. In this respect, information, education and perception elements are also included in this subcomponent. Sector or industry-based voluntary agreements are also included.

Topic 6.2.1: Institutional strength

3.273. Government and citizen engagement in environmental and sustainable development public policy is reflected in the extent to which institutions that manage and regulate the environment exist and function properly at the national and subnational levels. This topic includes statistics on environmental institutions and their resources, organized according to the main government environmental authority (name, budget and staff), and other relevant environmental institutions (names, budget and staff).

3.274. The main institutional partners here include the environmental authority (e.g., Ministry of Environment or equivalent institution) and other relevant environmental institutions. The information to be produced for this topic should be mainly descriptive, but may also include monetary statistics on budgets. It is usually compiled at the national level but should also cover subnational levels and natural resources (e.g., rivers, forests).

Table 3.6.2.1
Statistics and related information for Topic 6.2.1

Component 6: Environmental Protection, Management and Engagement				
Subcomponent 6.2: Environmental Governance and Regulation				
Topic 6.2.1: Institutional strength				
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)		**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
a.	Government environmental institutions and their resources		• National • Subnational	
	1. Name of main environmental authority and year of establishment	Description		
	2. Annual budget of the main environmental authority	Currency		
	3. Number of staff in the main environmental authority	Number		
	4. List of environmental departments in other authorities and year of establishment	Description		
	5. Annual budget of environmental departments in other authorities	Currency		
	6. Number of staff of environmental departments in other authorities	Number		
b.	Other environmental institutions and their resources			
	1. Name of institution and year of establishment	Description		
	2. Annual budget of the institution	Currency		
	3. Number of staff in the institution	Number		

Topic 6.2.2: Environmental regulation and instruments

3.275. This topic refers to policy responses to regulate and establish acceptable limits for protecting the environment and human health. It entails both direct regulatory and economic instruments. Direct regulatory instruments include environmental and related laws, standards, limits and their enforcement capacities. These can be described using statistics on regulated pollutants, licensing systems, applications for licences, quotas for biological resource extraction, and budget and number of staff dedicated to enforcement of environmental regulations. Economic instruments may comprise the existence and number of green/environmental taxes, environmental subsidies, eco-labelling and certification and emission permits.

3.276. Depending on the national institutional arrangement, the main partners in this context include the environmental authority, internal revenue services and other environmentally relevant authorities, along with other institutions that may enforce environmental regulations (e.g., local governments or sectoral authorities). Information to be produced for this topic will be mainly descriptive, for example, a list of regulated pollutants and their descriptions, but may also include quantitative data on budgets or emission permits traded.

Table 3.6.2.2
Statistics and related information for Topic 6.2.2

Component 6: Environmental Protection, Management and Engagement			
Subcomponent 6.2: Environmental Governance and Regulation			
Topic 6.2.2: Environmental regulation and instruments			
Statistics and related information	**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
(Bold text—Core Set/Tier 1; regular text—Tier 2; *italicized text—Tier 3*)			
a. Direct regulation		• By media (e.g., water, air, land, soil, oceans) • By ISIC economic activity • National • Subnational	
1. **List of regulated pollutants and description** (e.g., by year of adoption and maximum allowable levels)	Description, number		
2. Description (e.g., name, year established) of licensing system to ensure compliance with environmental standards for businesses or other new facilities	Description		
3. Number of applications for licences received and approved per year	Number		
4. List of quotas for biological resource extraction	Number		
5. Budget and number of staff dedicated to enforcement of environmental regulations	Currency, number		
b. Economic instruments			
1. *List and description* (e.g., year of establishment) *of green/environmental taxes*	Description, currency		
2. *List and description* (e.g., year of establishment) *of environmentally relevant subsidies*	Description, currency		
3. *List of eco-labelling and environmental certification programmes*	Description		
4. Emission permits traded	Number, currency		

Topic 6.2.3: Participation in MEAs and environmental conventions

3.277. This topic includes information on a country's participation[85] in MEAs and other global environmental conventions, including, for example, the Montreal and Kyoto protocols. The main institutional partners include the environmental authority, along with other institutions that may be responsible for MEAs or environmental conventions. The information to be produced on this topic is mainly descriptive, although comparable time series can also be derived from these statistics.

[85] Participation means that the country or area has become party to the agreements under the treaty or convention, which is achieved through various means, depending on the country's circumstances, namely, accession, acceptance, approval, formal confirmation, ratification and succession. Countries or areas that have signed but not become party to the agreements under a given convention or treaty are not considered to be participating.

Table 3.6.2.3
Statistics and related information for Topic 6.2.3

Component 6: Environmental Protection, Management and Engagement			
Subcomponent 6.2: Environmental Governance and Regulation			
Topic 6.2.3: Participation in MEAs and environmental conventions			
Statistics and related information	**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
(**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)			
a. **Participation in MEAs and other global environmental conventions**			MEA Secretariats
1. **List and description** (e.g., country's year of participation[d]) **of MEAs and other global environmental conventions**	Description, number		

[d] Participation means that the country or area has become party to the agreements under the treaty or convention, which is achieved through various means, depending on the country's circumstances, namely, accession, acceptance, approval, formal confirmation, ratification and succession. Countries or areas that have signed but not become party to the agreements under a given convention or treaty are not considered to be participating.

Subcomponent 6.3: Extreme Event Preparedness and Disaster Management

3.278. Statistics describing extreme event preparedness and disaster management will differ by country, based on the type of extreme event and disaster that usually occurs or may occur. In general, these statistics include the existence and strength of the disaster management agency's facilities and infrastructure.

3.279. Extreme event preparedness and disaster management expenditure should also be captured under this subcomponent. It refers to any public or private expenditure whose primary purpose is to help inform, educate and protect the population from extreme events and disasters, including but not limited to, establishing and maintaining warning systems, monitoring stations and systems, signals, communication systems, emergency centres and shelters.

Topic 6.3.1: Preparedness for natural extreme events and disasters

3.280. Measures of disaster preparedness vary according to the community and location's characteristics and historical profile for natural extreme events and disasters. Relevant information may include the existence and description of national disaster plans; the type and number of shelters in place; the type and number of internationally certified emergency and recovery management specialists; the number of volunteers; and the quantity of first aid, emergency supplies and equipment stockpiles. The existence of early warning systems for all major hazards, and expenditure on disaster prevention, preparedness, clean-up and rehabilitation, are also important data requirements.

3.281. Lead responsibility for disaster preparedness plans is often delegated to infrastructure authorities or ministries of public works, construction and housing. Common data providers are national and subnational authorities responsible for disaster management and assistance as well as emergency management agencies and municipalities. Global and regional meteorological forecasting agencies can also provide useful data on the spatial scale and likelihood of a crisis. NSOs may provide relevant population data, while authorities responsible for flood and drainage control may provide pertinent flood and drainage control information. Close agro-meteorological collaboration can also provide effective and actionable joint forecast information from agriculture ministries and counterparts in meteorological agencies, complementing data from each of their domains.

Table 3.6.3.1
Statistics and related information for Topic 6.3.1

Component 6: Environmental Protection, Management and Engagement			
Subcomponent 6.3: Extreme Event Preparedness and Disaster Management			
Topic 6.3.1: Preparedness for natural extreme events and disasters			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
a. National natural extreme event and disaster preparedness and management systems		• National • Subnational	• International Emergency Management Organization (IEMO) • UNISDR • Hyogo Framework for Action
1. Existence of national disaster plans/programmes	Description		
2. Description (e.g., number of staff) of national disaster plans/programmes	Description		
3. Number and type of shelters in place or able to be deployed	Description, number		
4. *Number and type of internationally certified emergency and recovery management specialists*	Description, number		
5. *Number of volunteers*	Number		
6. *Quantity of first aid, emergency supplies and equipment stockpiles*	Number		
7. *Existence of early warning systems for all major hazards*	Description		
8. *Expenditure on disaster prevention, preparedness, clean-up and rehabilitation*	Currency		

Topic 6.3.2: Preparedness for technological disasters

3.282. Preparedness for technological disasters can be quite different from natural extreme event and disaster preparedness. This is because technological disasters usually arise at an industrial location or on a mode of transportation where it is often the corporate sector that has a vested interest or legal obligation in contributing to preparedness and clean-up. Natural

extreme events and disasters usually occur on a larger scale and, typically, the government is primarily involved in preparedness and clean-up.

3.283. Measures of corporate disaster preparedness will vary according to the enterprise's size, location and historical profile for technological disasters. The impact of the disaster may vary by the size of the enterprise relative to the local area. The same disaster may not have a substantial effect on a large industrial complex in a major city, but may reach tragic proportions in a one-factory town, where that enterprise is the main employer. Relevant information may include the existence of an emergency management plan and expenditure on disaster prevention, preparedness, clean-up and rehabilitation.

Table 3.6.3.2
Statistics and related information for Topic 6.3.2

Component 6: Environmental Protection, Management and Engagement			
Subcomponent 6.3: Extreme Event Preparedness and Disaster Management			
Topic 6.3.2: Preparedness for technological disasters			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
a. National technological disaster preparedness and management systems		• National • Subnational	• IEMO • UNISDR • Hyogo Framework for Action
1. *Existence and description* (e.g., number of staff) *of public disaster management plans/programmes (and private when available)*	Description		
2. *Expenditure on disaster prevention, preparedness, clean-up and rehabilitation*	Currency		

Subcomponent 6.4: Environmental Information and Awareness

3.284. This subcomponent covers statistics about environmental information and diverse processes that contribute to increasing social awareness of environmental issues, thus promoting pro-environmental engagement and actions by the public and decision-makers at both local and national levels.

3.285. The statistics in this subcomponent are relevant for policymakers, analysts and civil society. With these statistics, they are able to learn which information and education programmes are in place in their countries; whether these activities are increasing or decreasing over time; and the potential impact of information and education on public perception, awareness of environmental issues and social engagement in pro-environmental actions. An understanding of environmental perceptions among the general public and key local constituencies can also help policymakers to shape local and national environmental policies and programmes.

3.286. Information dissemination, outreach and education, and public perceptions of environmental issues and policies are all necessary but not sufficient to forge environmentally sustainable options. In general, as information and awareness increases in a society, individuals and groups expect more pro-environmental actions and choices. Informed consumers and organized citizens have been able to change environmental and social practices in some industries, providing that there are reasonable alternatives and that public policies have directed the incentives properly.

3.287. The statistical topics included here are in an early stage of development in general, although countries have developed important good practices and expertise. Because methods of production differ, so do the sources and institutional partners in each of the following sets of environment statistics.

Topic 6.4.1: Environmental information

3.288. Environmental information includes quantitative and qualitative facts describing the state of the environment and its changes as described in the components of the FDES.

Quantitative environmental information is generally produced in the form of data, statistics and indicators, and is generally disseminated through databases, spreadsheets, compendiums and yearbooks. Qualitative environmental information consists of descriptions (e.g., textual or pictorial) of the environment or its constituent parts that cannot be adequately represented by accurate quantitative 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.

3.289. This topic may include information on the characterization of (i) national environmental information systems (e.g., existence of publicly accessible systems and number of users) and (ii) environment statistics programmes within national statistical systems (e.g., description of programme, number and type of environment statistics products, inter-agency platforms or committees).

3.290. The production and dissemination of environment statistics within national statistical systems makes it possible to produce robust environmental and sustainable development indicators to substantiate reports on the changing environment and guide policymaking. Measuring and constructing statistics on information production and dissemination is not very difficult once a methodology is established and the information is updated on a comparable basis. Determining which institution is responsible for producing which types of information can be helpful in identifying information gaps, areas of overlapping responsibility or efforts, and areas where efficiency gains can be achieved. Information on the structure and details of environment statistics programmes within NSOs (including their mandates, resources and dedicated staff), the existence of other relevant production in other ministries (e.g., environment), and the existence of inter-agency platforms of environmental statistics and indicators at the national level, have been subject to greater examination and reporting. These efforts have formed part of global and regional efforts to strengthen this emerging field within NSOs and have been applicable at both the national and subnational levels. The role of NSOs should also be placed in the broader context of institutions that produce environmental information.

3.291. The main institutional partners here include the environmental authority and the NSO, along with other institutions that may produce databases containing environmental information and reports containing environmental statistics and indicators. Information to be produced on this topic is primarily descriptive but may also include quantitative data on budgets. It is usually compiled at the national level.

Table 3.6.4.1
Statistics and related information for Topic 6.4.1

Component 6: Environmental Protection, Management and Engagement			
Subcomponent 6.4: Environmental Information and Awareness			
Topic 6.4.1: Environmental information			
Statistics and related information (**Bold text—Core Set/Tier 1**; regular text—Tier 2; *italicized text—Tier 3*)	**Category of measurement**	**Potential aggregations and scales**	**Methodological guidance**
a. Environmental information systems		• National • Subnational	
1. Existence of publicly accessible environmental information system	Description		
2. Annual number of visits/users of specific environmental information programmes or environmental information systems	Number		
b. Environment statistics			
1. Description of national environment statistics programmes (e.g., existence, year of establishment, lead agency, human and financial resources)	Description		
2. *Number and type of environment statistics products and periodicity of updates*	Description, number		
3. Existence and number of participant institutions in inter-agency environment statistics platforms or committees	Number		