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In-depth review of measuring extreme events and disasters

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Summary

The present note is the in-depth review paper on measuring extreme events and disasters. The Bureau of the Conference of European Statisticians conducted the in-depth review at its meeting in October 2014. The purpose of the reviews is to improve coordination of statistical activities in the region of the United Nations Economic Commission for Europe, identify gaps or duplication of work, and address emerging issues.

The note summarises international statistical activities related to measuring extreme events and disasters, identifies issues and challenges, and makes recommendations how the international statistical community could tackle the issues.

The outcome of the review is provided in document ECE/CES/2015/9/Add.1.

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I. Executive summary

1. Disasters are caused by natural phenomena or human action triggering processes that cause physical and environmental damage, loss of human lives and capital. These disasters may be natural or man-made, ranging from earthquakes, floods and tsunamis to extreme temperatures, forest fires and other natural phenomena. Disasters impact communities and individuals, as well as the economic activity of the affected territories. Recovery from such events requires government action. In many countries this would be impossible without external resources.

2. Whenever a disaster strikes, statistical offices are one of the sources asked to quickly provide data on the population, areas and businesses affected. This in-depth review presents a summary of the activities of several national and international statistical organizations for measuring extreme events and disasters.

3. The paper outlines the main actions and challenges entailed in this area. Over the past three decades, the frequency of natural disasters has increased worldwide, especially in certain regions such as Asia and the Pacific. Additionally, risk exposure has increased with the growth of unplanned urbanization and concentration of people and economic activities in disaster-prone areas.

4. Different statistical offices and international organizations are addressing these issues. Therefore, it would be useful to address this problem in a collaborative way with a common conceptual basis, instead of each organization searching and offering its own solution.

II. Introduction

5. The Bureau of the Conference of European Statisticians (CES) regularly reviews selected statistical areas in depth. The aim of the reviews is to improve coordination of statistical activities in the UNECE region, identify gaps or duplication of work, and address emerging issues. The review focuses on strategic issues and highlights concerns of statistical offices of both a conceptual and a coordinating nature. The current paper provides the basis for the review by summarising the international statistical activities in the selected area, identifying issues and problems, and making recommendations on possible follow-up actions.

6. The CES Bureau selected the topic of measuring extreme events and disasters for an in-depth review at its meeting in January 2014. The National Institute of Statistics and Geography (INEGI) of Mexico volunteered to prepare the paper providing the main basis for the review.

7. Climate change and disaster risk reduction and their effects are one of the areas of focus of the UN Open Working Group discussing the post-2015 development agenda. A world conference on extreme events and disasters was held in March 2015.

III. Scope/definition of the statistical area covered

8. A disaster can be defined as “a situation or event which overwhelms local capacity, necessitating a request for external assistance at national or international level; an unforeseen and often sudden event that causes great damage, destruction and human suffering”. This definition is used by the World Health Organization collaborating Centre for Research on the Epidemiology of Disasters (CRED) that provides a worldwide database on disasters with a number of statistics.

9. Measuring the environmental, social and economic impact of disasters is important for decision-making related to prevention and preparation to deal with these events. The coordinated delivery of good quality data helps to define the type of actions to be taken for an effective recovery of the affected areas. The key data needs relate to statistics on the environment, climate change and sustainable development. Access to geographic information is a necessity. To date, it has not yet been exactly defined which statistics would be needed most for the measurement of extreme events and disasters, their causes, impacts and for preparedness and recovery efforts.

10. All nations are exposed, to a greater or lesser extent, to extreme natural events. However, these natural events do not always cause a disaster. To improve preparedness to facing a natural event the conditions of vulnerability need to be considered. The potentially destructive natural phenomena over a territory are identified as threats.

A. Types of disasters

11. Disasters arise from a complex relationship of effects generated by natural phenomena with preconditions of social, economic and environmental vulnerability. They are usually classified according to the characteristics of the natural threat that originated them, the type of phenomenon, the way it appears (sudden, such as earthquakes, or mediate, such as hurricanes), and its duration (short, medium or long-term). One of the most commonly used classifications is contained in the United Nations International Strategy for Disaster Reduction (UNISDR), which classifies disasters in four categories according to their origin:

(a) Earth's internal dynamics, geophysical phenomena;

(b) Earth's external dynamics;

(c) Meteorological and hydrological;

(d) Biological.

Table 1
Disaster classification, according to the type of phenomenon that it is caused by

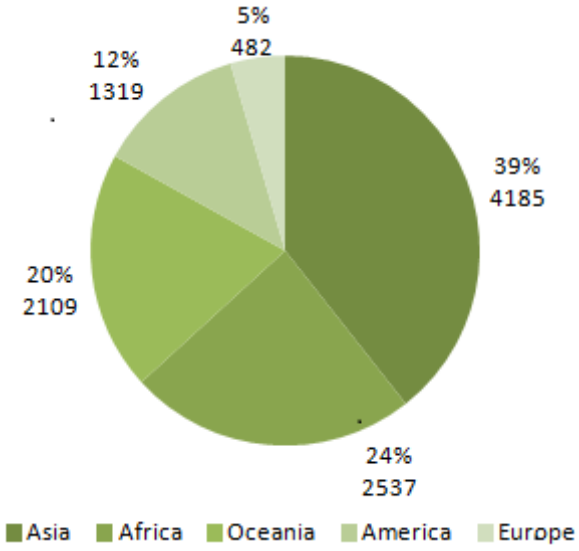
1.- Disaster generated by dynamic processes inside the earth: a) Earthquakes - Crustal movements that generate intense deformation in rocks inside the earth, the accumulated energy is suddenly released in waves that shake the earth's surface. b) Tsunamis - Crustal movements that originate in the ocean, forming and propagating high waves. c) Volcanic Eruptions - Pass of material (magma), ash and gases from within the earth to the surface. **2.- Disasters caused by dynamic processes in the surface of the earth:** a) Landslides - Occur as a result of sudden or gradual changes in the composition, structure, hydrology or vegetation of a slope or sloping ground b) Collapse - Drop of a strip of land that loses stability or destruction of a man-built	**3.- Disasters caused by meteorological and hydrological phenomena:** a) Flooding - Slow or violent flooding of water from rivers, ponds or lakes, due to heavy rainfall or dam breaks, causing considerable damage. They can occur slowly or gradually over plains and violently or suddenly in mountainous regions. b) Droughts - Deficiency of moisture in the atmosphere due to irregular or insufficient rainfall, or inappropriate use of groundwater, reservoirs and irrigation systems. c) Frost - Atmospheric phenomena produced by low temperatures that cause damage to plants and animals. d) Thunderstorms - Atmospheric phenomena produced by electrical discharges in the atmosphere. e) Hailstorm – A form of solid precipitation (rainwater forming into ice).

structure. c) Snowslides – Movement of mass of snow downhill. d) Floods - Flow of large volumes of mud, water, ice or rocks caused by the rupture of a water body or sliding snowy mass. e) Huaicos - Detachment of mud and rocks due to rainfall (presented as a stroke of muddy water sliding at high speed and low dry ravines flow, dragging rocks and logs).	f) Tornadoes - Hurricane winds rotating at high speed. g) Hurricanes - Winds in excess of 24 km / h as a result of the interaction of warm, moist air from the Pacific Ocean with the cold air. **4.- Disaster of biological origin:** a) Pest - Calamities to crops caused by certain types of insects. b) Epidemic - a widespread occurrence of an infectious disease to a large number of people in a particular place.
Source: Economic Commission for Latin America and the Caribbean (ECLAC), based on: United Nations Terminology on Disaster Risk Reduction, Geneva, International Strategy for Disaster Reduction, 2009 (online) http://www.unisdr.org/files/7817_UNISDRTerminologyEnglish.pdf	

12. Most of the disasters studied by the Economic Commission for Latin America and the Caribbean (ECLAC) are of climate - meteorological and hydrological - or geophysical origin. Between 1972 and 2011 these disasters were responsible for 309,742 deaths, affecting about 30 million people. They caused a total economic impact of approximately 213,000 million dollars, of which 150,000 million are damages and 63,000 million are losses. The following chart summarizes the disasters in the world.

Figure 1

Distribution of disasters in the world, according to the affected region, 1970-2011



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Center for Research on the Epidemiology of Disasters (CRED) / Attendance Office for Foreign Disaster Assistance (OFDA), International Database on disasters (EM-DAT)

13. The Latin American and Caribbean region is highly exposed to meteorological and hydrological phenomena. All areas of the continent are exposed to geophysical phenomena - earthquakes and volcanic eruptions. The following table shows the disasters, by region of the Americas and the type of event that caused them.

Table 2
America: disasters, by region and type of originating event. 1970-2011 (percentages)

Threat		North America	Central America	Mexico	Caribbean	South America
Geophysical	Earthquakes	3,4	11,5	12,2	2,4	9,8
	Mass movements	0,5	4,4	5,1	1,2	13,4
	Volcanic eruptions	0,3	5,2	4,1	2,0	3,7
	Total	4,3	21,0	21,3	5,6	26,9
Meteorological and hydrological	Hurricanes and storms	64,6	23,0	38,1	57,9	8,1
	Floods	24,5	38,3	27,9	27,6	45,9
	Droughts	1,6	7,1	3,6	4,9	5,7
	Extreme temperatures	3,7	1,4	7,6	0,0	5,0
	Total	94,4	69,7	77,2	90,5	64,8
Biological	Epidemics and plagues	1,4	9,3	1,5	3,9	8,4
	Total	100,0	100,0	100,0	100,0	100,0

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Center for Research on the Epidemiology of Disasters (CRED) / Attendance Office for Foreign Disaster Assistance (OFDA), International Data Base Disaster (EM-DAT)

14. These events need to be addressed with a systematic approach to develop capacities for prevention, adaptation and recovery.

15. In Mexico, the prevention strategy establishes three basic steps. *First*, know the dangers and threats that the territory is exposed to. *Second*, identify and establish characteristics and current risk levels at national, state, municipal and community levels. *Finally*, design actions and programs to mitigate and reduce the risks before the occurrence of phenomena, by strengthening and upgrading the infrastructure on the one hand and the training of population to know what to do before, during and after an emergency on the other hand.

IV. Overview of international statistical activities in the area

A. United Nations organisations

1. Economic and Social Commission for Asia and the Pacific (ESCAP)

16. The Economic and Social Commission for Asia and the Pacific (ESCAP) at its 70th session in 2014 adopted a resolution to establish an expert group comprising statisticians and disaster management experts to work towards developing a basic range of disaster-related statistics.[1]

17. The first meeting of the expert group took place from 27-29 October 2014 in Sendai, Japan, where the group discussed development of a proposed framework for collection and dissemination of the basic range of disaster-related statistics,

[1] http://www.unescap.org/sites/default/files/E70_RES2E.pdf

including definitions, standards, and classifications. The framework will help member States in Asia and the Pacific to produce quality statistics on disasters that adhere to agreed standards to support policy decisions for disaster risk reduction and climate change adaptation.

18. The ESCAP data center[2] compiles statistics pertaining to development issues in the region from data series published by international organizations. It contains statistics on disasters from the Emergency Events Database (EM-DAT) including

- Number of natural disaster events;
- Mortalities from natural disasters;
- People affected by natural disasters; and
- Economic damages from natural disasters.

19. The definitions and methodological criteria used in various international disaster databases are not consistent with those currently used for official statistics by countries in the region, which leads to inconsistencies between statistics reported by different databases and measurements produced by official agencies within the member States. These inconsistencies and the general lack of agreed standards for disaster-related statistics in the region are a major hindrance for effective monitoring of the risks and resilience to disasters for ESCAP member States.

20. As an initial step to investigate these issues further, ESCAP, in collaboration with the UNDP Asia-Pacific Regional Centre, has conducted studies in five countries (Indonesia, Kiribati, Mongolia, Republic of Korea, and Sri Lanka) to understand current practices and coordination between National Statistical Offices (NSOs) and National Disaster Management Agencies (NDMAs) for the production of statistics on disasters. One of the key findings suggests that strong coordination between NSOs and NDMAs helps to improve the quality of statistics on disasters and associated analysis. A full summary of the findings will be presented in the first meeting of the expert group.

2. Economic Commission for Latin America and the Caribbean (ECLAC)

21. ECLAC has developed information systems related to economic, social and environmental development of Latin America and the Caribbean. These include the CEPALSTAT database that provides also information on natural disasters.[3]

22. In February 2014, ECLAC published the third edition of the *Handbook for Disaster Assessment*. The Handbook establishes procedures for the estimation of the effects and impacts of disasters within a consistent accounting logic. This allows separating the loss and additional costs, and systematizing the linkages between different sectors of the economy.[4]

3. Intergovernmental Panel on Climate Change (IPCC)

23. The World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) jointly created the Intergovernmental Panel on Climate Change (IPCC) in 1988 to provide a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-

[2] http://www.unescap.org/stat/data/

[3] CEPALSTAT database: http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp?idioma=

[4] http://www.cepal.org/publicaciones/xml/9/52219/ManualparalaEvaluaciondeDesastres.pdf

economic impacts. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters. Since 1990, the IPCC has produced several assessment reports, special reports, white papers, methodologies and other key documents as official reference for policy makers and scientists.

24. A special report on managing the risks of extreme events and disasters was published in 2012[5] to advance climate change adaptation. It contains a Summary for Policymakers and nine chapters focusing on the relationship between climate change and extreme weather events, impacts of such phenomena and strategies to manage related risks and facilitate decision making. Chapter 1 describes the question of weather and climate extremes to understand and manage the risks; Chapter 2 discusses the determinants of exposure and vulnerability and concludes that each disaster has social and physical dimensions; Chapter 4 evaluates the observed and projected impacts, taking into account the characteristics by sector and by region; and Chapter 8 evaluates the interactions between sustainable development, reducing vulnerability and disaster risk.

4. Office for the Coordination of Humanitarian Affairs (OCHA)

25. OCHA is the part of the United Nations Secretariat responsible for bringing together humanitarian actors to ensure coherent response to emergencies. Its mission is to mobilize and coordinate effective humanitarian action in partnership with national and international actors in order to alleviate human suffering in disasters and emergencies.[6]

26. When an emergency occurs, OCHA's information management officers immediately start working with key partners to produce standard information products to support coordination of all the humanitarian organizations and the response operation. These include the Who What Where (3W) database, contact lists and meeting schedules. Tools such as the information need assessment and maps are made available to support better relief planning and action.

27. A clear information management structure ensures that all the organizations involved work with the same or complementary information, and that this information is as relevant, accurate and timely as possible. The data collected and analyzed is used as a foundation for situation reporting and for crafting public information messages. Properly collected and managed information during the emergency phase can benefit early recovery and disaster preparedness activities later.[7]

28. OCHA publishes annually "The World Humanitarian Data and Trends" that presents global and country-level data and trends analysis on humanitarian crises and assistance, including on natural disasters.[8] OCHA also produces an array of reports and publications from in-depth analytical papers to daily situation reports on major new crises and annual appeals for humanitarian funding.[9]

[5] https://www.ipcc.ch/pdf/special-reports/srex/IPCC_SREX_ES_web.pdf
[6] http://www.unocha.org/about-us/who-we-are
[7] http://www.unocha.org/what-we-do/information-management/overview
[8] http://www.unocha.org/what-we-do/policy/resources/world-humanitarian-data-and-trends-2013
[9] http://www.unocha.org/about-us/publications

5. United Nations Fund for Population Activities (UNFPA)

29. The report entitled "UNFPA State of World Population 2007" in chapter 5, Urbanization and Sustainability in the 21st Century[10], provides an analysis of some extreme events and disasters such as:

- Land cover changes;
- Cities and climate change;
- Poverty and vulnerability to natural disasters;
- Sea level rise: not if but when and how much?
- Adapting to climate change;
- Local actions, global consequences: global change, local impact.

30. UNFPA has developed the Demographic Explorer for Climate Adaptation (DECA) for Indonesia and Malawi, which can incorporate various data, particularly census data and other social survey data, into planning for climate change adaptation though spatial analytics.[11] It is an innovative free online tool for automated integration and analysis of multiple kinds of spatial data for knowledge in social, environmental and science policy by involving stakeholders in the spatial analysis and decision-making process.

6. United Nations Institute for Training and Research (UNITAR)

31. The UNITAR work related to extreme events and disasters aims to make satellite solutions and geographic information easily accessible to the UN family and to experts worldwide who work at reducing the impact of crises and disasters and help nations plan for sustainable development.[12]

32. Since early 2013, the Operational Satellite Applications Programme (UNOSAT) of UNITAR focuses on the use of Geographic Information Systems (GIS) and Remote Sensing (RS) to improve planning, emergency preparedness and risk prevention in vulnerable communities, mainly in Africa. This initiative is called GEODRR (Geographic Information Systems and Earth Observation for Disaster Risk Reduction[13].· The project‘s main objectives are to:

- Strengthen technical knowledge and skills in the use of GIS and RS technologies to enhance planning.
- Improve emergency preparedness and prevention across the region.
- Raise awareness on geospatial technologies for Disaster Risk Reduction and how to use this information for coordination, dissemination and decision making in the region.
- Improve service delivery and data delivery by developing an accessible, open source geo-portal.

[10] http://www.unfpa.org/swp/2007/spanish/chapter_5/poverty.html

[11] http://nijel.org/un_popclimate/blog/item/30-demographic-explorer-for-climate-adaptation-deca%E2%80%93an-automated-spatial-analysis-tool

[12] UNITAR. (s.f.). UNOSAT. http://www.unitar.org/unosat/who-we-are

[13] GEODRR. (s.f.). Building Capacities for Disaster Risk Reduction Using Geospatial Technologies in the Horn of Africa. http://www.geodrr.org/project.php?pId=7

7. United Nations International Strategy for Disaster Reduction (UNISDR)

33. UNISDR's mandate is to serve as the focal point in the United Nations system for the coordination of disaster reduction and to ensure synergies among disaster reduction activities. It reflects a major shift from the traditional emphasis on disaster response to disaster reduction, and seeks to promote a "culture of prevention".[14]

34. UNISDR coordinates international efforts in Disaster Risk Reduction and guides, monitors and reports regularly on the progress of the implementation of the Hyogo Framework for Action. UNISDR organizes a biennial Global Platform on disaster risk reduction with leaders and decision makers to advance risk reduction policies and support the establishment of regional, national and thematic platforms.[15]

35. The Hyogo Framework for Action is the guiding document in strengthening and building international cooperation to ensure that the principle of disaster risk reduction be used as a foundation for sound national and international development agendas. Moreover, the regional platforms are multi-stakeholder forums that reflect the commitment of governments to improve coordination and implementation of disaster risk reduction activities while linking to international and national efforts.

36. UNISDR informs and connects people by providing practical services and tools such as the risk reduction website PreventionWeb, publications on good practices, country profiles and the Global Assessment Report which is a biennial global assessment of disaster risk reduction and comprehensive review and analysis of the natural hazards that affect humanity.[16]

8. United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER)

37. The UN-SPIDER was established in 2006 to "Ensure that all countries and international and regional organizations have the ability to develop and access all types of information obtained from space, in order to support the full disaster management cycle".[17]

38. The UN-SPIDER program serves as a gateway to the information obtained from space to support the activities carried out in the context of risk management and response to emergencies and disasters; acts as a bridge between communities involved in risk management and response and the space community in case of emergencies or disasters; and facilitates capacity building and institutional strengthening, in particular in developing countries.

9. United Nations Statistics Division (UNSD)

39. UNSD disseminates global environment statistics[18] on ten indicator themes compiled from a wide range of data sources. One of these themes is natural disasters, further classified into climatological, geophysical, hydrological and meteorological disasters. UNSD notes that these environment statistics are still in early stages of development in many countries, and data are often sparse.

[14] http://www.unisdr.org/who-we-are
[15] http://www.unisdr.org/we/coordinate
[16] http://www.unisdr.org/we/inform
[17] http://www.un-spider.org/es
[18] UNSD Environmental Indicators: http://unstats.un.org/unsd/environment/qindicators.htm

40. Furthermore, the Framework for the Development of Environment Statistics (FDES) provides a conceptual and statistical framework and an organizational structure to guide the collection of environment statistics.

41. One of the six components of FDES, Component 4, focuses on extreme events and disasters, promoting the generation of information on the occurrence of the different types of extreme events, and statistics on the impact of the disasters, including people affected and the assessment of economic loss.[19]

B. Other organizations

1. Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC)

42. CATHALAC is an autonomous international organization dedicated to promoting sustainable development through applied research and development, education, and technology transfer in the areas of integrated watershed management, climate change, environmental modeling and analysis, and risk management in Latin America and the Caribbean.[20]

43. CATHALAC contributes to the SERVIR project, a regional visualization and monitoring system maintained in collaboration with the National Aeronautics and Space Administration (NASA), the United States Agency for International Development (USAID), the Central American Commission on Environment and Development, World Bank and Nature Conservancy. SERVIR integrates satellite and other geospatial data for research and decision-making by managers, researchers, students and the general public. It is available for Mesoamerica, East Africa and Himalaya, and covers nine areas under the Global Earth Observation System of Systems: disasters, ecosystems, biodiversity, weather, climate, water, health, agriculture and energy. SERVIR can be used to monitor and forecast ecological changes and significant events for forest fires, red tides, and tropical storms.[21]

44. The SERVIR team at CATHALAC has developed a geo-spatial portal which provides access to data and metadata from Mexico, Central America and the Caribbean. It maintains training programs and infrastructure to strengthen the use of earth observation and models for decision-making among government officials, scientists and researchers, NGOs, and academic institutions.

2. World Bank

45. During the past 10 years, the World Bank has emerged as a world leader in disaster risk management thanks to its support to client countries in the assessment of hazards and ways to address them. It provides technical and financial assistance in the assessment and risk reduction, preparedness, financial protection and recovery, and reconstruction resilient to these phenomena. The portfolio of disaster risk management maintained by the World Bank has grown about 20% annually in

[19] http://unstats.un.org/unsd/environment/FDES/FDES%20Flyer%20Spanish_7August2013_WEB.pdf

[20] http://cathalac.org/

[21] http://www.servir.net/sobre-servir.html

the past four years; reaching nearly $ 4,000 million in fiscal year 2013. The World Bank promotes a comprehensive and multisectoral approach in this area.[22]

46. The Global Facility for Disaster Reduction and Recovery (GFDRR) is the World Bank's institutional mechanism for disaster risk management. It is an alliance of 41 countries and eight international organizations with a growing number of participants. In February 2014 a World-Bank GFDRR Center in Tokyo was created with the support of Japan with a new program of $ 100 million. This will help to associate relevant expertise with customers and World Bank operations related to this field. The Earthquakes and Megacities Initiative is a related international scientific initiative and a member of the UN Global Platform for Disaster Risk Reduction and partner of the GFDRR. Its mission is to advance urban risk reduction policy, knowledge, and practice in megacities and fast-growing metropolises.[23]

47. Through the World Bank, the Code for Resilience initiative is promoted, which brings together technologists with mentors and experts to create technology-based tools that help communities to reduce disaster risk. The emerging applications range from support to rescuers in an emergency to the tool for digitizing data on maternal health.[24] The World Bank provides a Climate Change Knowledge Portal which provides possibilities to query, map, compare, chart and summarize key information on climate-related vulnerabilities and impacts. The Portal contains spatially referenced environmental, disaster risk, and socio-economic datasets, and country-level disaster statistics and maps displaying sub-national risk data for natural hazards, such as cyclones, droughts, earthquakes, volcanoes, floods, and landslides. In the coming months, the Climate Change Knowledge Portal will include access to Open Data for Resilience Initiative, which aims to reduce the impacts of disasters by empowering decisions-makers with better information and tools.[25]

3. World Health Organisation collaborating Centre for Research on the Epidemiology of Disasters (CRED)

48. CRED has been active for more than 35 years in the field of international disaster and conflict health studies, with research and training activities linking relief, rehabilitation and development. The Centre promotes research and provides a database on the burden of disease and related health issues due to disasters and conflicts.

49. CRED has a long history of standarized data compilation, validation and analysis. It provides free and open access to its data through its website. One of CRED's core data products is the International Emergency Disasters Database (EM-DAT)[26] that contains worldwide data on the occurrence and impacts of more than 19500 disasters in the world dating from 1900 to the present. EM-DAT is compiled from various sources, including UN agencies, non-governmental agencies, insurance companies, research institutes and news agencies. This database is free and fully searchable through the website, also allowing users to download available data.[27]

[22] http://www.bancomundial.org/es/topic/disasterriskmanagement/overview#2
[23] http://www.emi-megacities.org/home/
[24] http://www.bancomundial.org/es/news/feature/2014/06/30/innovative-apps-for-disaster-risk-reduction-win-global-attention
[25] http://sdwebx.worldbank.org/climateportal/index.cfm
[26] EM-DAT database: http://datahub.io/fi/dataset/emdat
[27] http://www.cred.be/projects

50. For a disaster event to be registered in the EM-DAT database, at least one of the following criteria must be met:[28]

- Ten (10) or more people reported dead.
- One hundred (100) or more people reported affected.
- Declaration of state of emergency.
- Call for national or international assistance.

Note: These criteria are not consistent with the definitions used in official statistics of countries, causing inconsistencies between sources.

51. CRED notes in their Annual Disaster Statistical Review 2012 that development of guidelines and tools for creating national and sub-national disaster databases and compiling reliable, standardized, interoperable disaster occurrence and impact data should be prioritised for more effective disaster risk reduction.[29]

V. Country practices

A. Involvement of statistical offices

52. There are a number of national disaster databases, although national statistical systems rarely collect data on disasters. In some cases national statistical offices are involved in such databases, usually as provides of economic, social and environmental statistics that will be linked with information on extreme events and disasters in the database.

53. National disaster databases include for instance the Emergency Management Australia Disasters Database, the Canadian Disaster Database, the Indian disaster statistics database, the Spatial Hazard Event and Losses Database for the United States, the United States Storm and Hazard Database, the United States National Hazard Statistics, the Philippines Disaster Response Operations Monitoring and Information Center, and the Philippines National Disaster Coordinating Council database.

54. Often the primary sources for disaster databases appear to be research institutions and the media but also government agencies, local emergency management organizations, municipal governments, insurance companies and non-governmental organizations. According to available information at least in Australia, the statistical authorities provide statistical data to the national disaster database. This includes data on the number of people killed, injured and otherwise affected. In India and Philippines the statistical authorities have an active role also in developing the national disaster databases.

55. For instance, the Indian statistical office, in collaboration with the National Disaster Management Institute, has developed a disaster statistics database. Due to the geography and topography, India has faced serious large scale natural disasters like droughts, cyclones and earthquakes, and the number of disasters and people affected has been rising.

[28] Session 4: Extreme Events and Disasters. http://www.unescap.org/resources/session-4-extreme-events-and-disasters FDES-Component 4 (Core set) Extreme Events and Disasters_ESCAP_SD

[29] http://reliefweb.int/sites/reliefweb.int/files/resources/ADSR_2012.pdf

56. These two organizations in India are developing a framework for compilation of hazards and disaster statistics to be released on regular basis in the form of an annual publication. The database includes information on the impacts of climate change and other disasters such as droughts, floods, landslides, extreme variations of temperatures etc. The disaster statistics contain three parts: damage, relief and reconstruction.

57. This project has shown that there is a need for coordination among agencies and institutionalization of the process for learning from experiences obtained from disasters. Data has an important role in promoting a culture of prevention, mitigation, preparedness and response.

B. Measurement of extreme events and disasters in Mexico

58. Mexico is exposed to a great variety of phenomena that may cause disasters, in part because of its geographic position. It is located in the Ring of Fire or Circum-Pacific belt, and is subject to earthquakes and eruptions of volcanoes. Two thirds of the country have an important seismic risk because of the Pacific Ocean coast where the tectonic Cocos and the North American plates meet. There are also many volcanoes of which fourteen are considered as active.

59. The country is located in the intertropical region and is regularly in the path of hurricanes from the Pacific Ocean, the Gulf of Mexico and the Caribbean Sea. The effects from hurricanes are felt mainly in the coastal zones. Four or five hurricanes out of the average 23 which approach the country each year cause landfalls and severe damage.

60. Rain scarcity is common in several regions in the country. When maintained during long periods, the drought affects agriculture, livestock and the economy in general. Forest fires are also frequent during the dry season and scarce rainfall. In some years there are particularly numerous forest fires causing severe forest losses and other damages.

61. Other types of disasters are caused directly by human activities, mainly from industrial accidents involving hazardous materials.

1. Hydrometeorological phenomena

62. From 2000 to 2011, about 90% of the disasters in Mexico were hydrometeorological. Between May and November there is an average of 23 hurricanes; 14 in the Pacific Ocean and 9 in the Gulf of Mexico and the Caribbean Sea. Four of these cause landfall.

63. Based in the regions where the hurricanes enter the country, the states of Baja California Sur, Michoacan, Sinaloa, Sonora and Tamaulipas have the largest hurricane frequency affecting 40% of the total population in those states. In the states of Campeche, Colima, Quintana Roo and Jalisco, the hurricanes occur about every five and seven years. About 26.3 per cent of the population is located in the coastal zones in these states. Finally, in the states of Nayarit, Guerrero, Tabasco Tamaulipas, Oaxaca, Veracruz, Chiapas and Yucatan, the recurrence time is between eight and 26 years, with 23.9 per cent of the population exposed.

64. Droughts are an incidental or sporadic phenomena that cause a disaster. They occur in areas with moderate rainfall when there is no rain for long periods. In the case of Mexico, in 2011 the National Peasant Confederation estimated that 450,000 cattle were lost during the drought in the northern states of the country. Other effects of this phenomenon include: lack of potable water, exodus of people from rural areas; weight loss of cattle as there are no pastures, and vulnerability to epidemics.

2. Geologic phenomena

65. Among geologic disasters, landslides have the biggest impact. Among the main causes of landslides are instability because of morphological factors, geologic materials, high slopes and high rainfall, as well as deforestation. A partial list of landslides in the past years is presented in the following table.

Table 3
List of some landslides registered between 1999 and 2013

Date	Type of landslide	State	Municipality	Town/City	Deaths
16 Sep 2013	Detritus flow	Guerrero	Atoyac de Alvarez	La Pintada	71
06 Feb 2010	Detritus flow	Mexico	Temascaltepec	Temascaltepec	10
03 Feb 2010	Detritus flow	Michoacan	Mineral de Angangueo	Mineral de Angangueo	35
28 Sep 2010	Detritus flow	Oaxaca	Santa Maria Tlahuitoltepec	Santa Maria Tlahuitoltepec	11
05 Nov 2007	Combined landslide	Chiapas	Ostuacan	Juan de Grijalva	30
03 Jul 2007	Translational landslide	Puebla	San Miguel Eloxochitlan	San Miguel Eloxochitlan	60
04 Oct 2005	Mudflow	Chiapas	Mapastepec	Valdivia	15
04 Oct 2004	Detritus flow	Chiapas	Motozintla	Motozintla	11
05 Oct 1999	Landslide	Puebla	Teziutlan	Col. La Aurora, Teziutlan	70

Source: CENAPRED-2001- Diagnosis of hazards and disaster risk identification in Mexico

3. Chemical phenomena

66. Chemically related accidents may be caused by natural phenomena, flaws in industrial processes, mechanical failures and unintentional or intentional human errors. Some of the substances with pose the greatest risk in Mexico according to the hazard level of chemical substances, their geographic distribution and stored amounts, are: liquefied petroleum gas (LPG), ammonia, sulfuric acid, chloride, gasoline, nitrogen, propyl and isopropyl alcohol.

67. In 2011, chemical disasters caused 60 deaths and economic losses of $1.376 billion Mexican pesos. That is about 3% of all the economic losses caused by disasters that year. However, damages have increased in the last years, mainly because of forest fires, as shown in the following table.

Table 4
Summary of damages by chemical disasters in 2011

Type	*Temporal shelters*	*Deaths*	*Population affected **	*Population with damages*	*Households*	*Schools*	*Hospitals and other health facilities*	*Cropland or pasture (hectares)*	*Businesses*	*Total damage (million pesos)*
Forest fires	0	0	944	0	0	0	0	956,404.8	0	1,366.1
Fires in urban zones	1	4	8,440	142	30	4	0	0.0	280	5.5
Explosions	1	52	1,541	268	115	1	1	0.0	25	2.9
Spills	0	0	651	50	10	0	0	0.0	1	1.6
Leakages	1	4	10,481	0	0	0	0	0.0	2	0.0
Total	**3**	**60**	**22,057**	**460**	**155**	**5**	**1**	**956,404.81**	**308**	**1,376.1**

***** It includes injured, evacuated and/or missing persons. Source: CENAPRED, with data from CENACOM and CONAFOR.

4. Other types of disasters

68. Other disasters are caused by human error or intentional actions involving a high number of people.

Table 5
List of disasters caused by human error or intentional actions

Date	*Disaster*	*State*	*Municipality*	*Deaths*
17 Apr 2006	Transport accident	Veracruz	Maltrata	57
05 Jun 2009	Urban fire	Sonora	Hermosillo	49
06 Aug 2002	Transport accident	Michoacán	Zinapécuaro	32
09 Sep 2007	Transport accident	Coahulia	Sacramento	29
19 Mar 2002	Transport accident	Jalisco	Mascota	27
06 May 2006	Transport accident	San Luis Potosí	Cerritos	26
24 Jan 2007	Transport accident	Oaxaca	Huautla	26
15 Feb 2006	Transport accident	Guanajuato	Sta. Catarina	25
28 Dec 2006	Transport accident	México	Cuautitlán	22
05 Nov 2010	Transport accident	Sinaloa	Escuinapa	21
05 Apr 2005	Transport accident	Baja California Sur	Comondú	21
19 May 2008	Transport accident	Hidalgo	Metzquititlán	21

Source: Economic and Social Studies Office, with data from the National Communication Center.

Table 6
Summary of impacts from accidents and disasters in 2011

Disaster/ accident type	Deaths	Population affected (persons) [1/]	Damaged households	Damaged schools	Health care units	Cropland /pasture (hectares.)	Damaged roads (km)	Total economic losses (in million Mexican pesos)
Geological	16	35.874	1,217	11	9	0.0	1.0	416.6
Hydro-meteorological	164	1,717,533	49,410	3,882	90	1,540,861.6	19,359.5	39,543.8
Chemical [2/]	60	22,057	155	5	1	956,404.8	0.0	1,376.1
Health	1	62	0	0	0	0.0	0.0	0.0
Social	186	3,267	2	1	0	0.0	0.0	74.5
Total	427	1,778,793	50,784	3,899	100	19,390.5	19,360.5	41,411.0

[1/] Includes persons injured, evacuated or with some other kind of damage.
[2/] Chemical disasters: leakages, spills forest and urban fires, explosions.
Source: CENAPRED.

5. Work on data related to disasters in Mexico

69. Statistics on the occurrence and effects of disasters in Mexico are generated primarily from the records of the Coordination of Civil Protection under the Ministry of Interior. These data are supplemented with information from INEGI, the National Weather Service, the National Seismological Service and various civil society organizations.

70. The gaps in data for Mexico can be estimated based on the Framework for the Development of Environment Statistics (FDES). The component 4 "Extreme Events and Disasters" describes 33 statistics that can be generated on this topic. The main information gaps are in the estimation of economic losses, in the occurrence of technological disasters and the effects of disasters on the ecosystem integrity.

71. INEGI coordinates the project "Development and Strengthening of Official Environmental Statistics through the Creation of a Regional Framework in Latin America and the Caribbean" with support from the Inter–American Development Bank. The main objective of the project is to promote a collective effort to strengthen the official environmental statistical system in the countries involved. The project has the following goals:

(a) Analyze the present state of environmental statistics and develop and improve the quality of these statistics;

(b) Promote coordination among the institutions related to environmental statistics, indicators and accounting at the national level;

(c) Strengthen cooperation among countries in the region to promote standardization and compatibility of environmental statistics.

72. As part of the actions related to disasters, the INEGI Governing Board will designate a Specialized Technical Committee of Information on the National Civil Protection Subsystem and Environment. The Committee will promote the coordination between the three levels of government to strengthen the preventive actions, reduce risks and mitigate the consequences of extreme events and disasters. The Committee will be chaired by the Government Secretary of the National

Coordination of Civil Protection. It will be responsible for ensuring that statistical and geographical information on environment will be generated to:

(a) Identify natural phenomena and effects that are of interest for early warning systems;

(b) Organize data and information on hazards, risks and vulnerabilities, relating to economic, social, and environmental aspects;

(c) Characterize the major risk factors and threat levels of each phenomenon, their probability of occurrence, and the vulnerability and exposure to the phenomena.

73. The federal government established the General Law on Climate Change, making provisions to address the adverse effects of climate change. The law also stipulates the development of Mexican official standards and creation of the National Climate Change System for effective coordination of the various levels of government and cooperation between the public, private and social sectors.[30]

74. Additionally, the sectoral fund CONACYT-SECTUR prepared a "Study of vulnerability and adaptation program to climate variability and climate change in ten strategic tourist destinations and the proposal of a early warning system for extreme weather events". The study analyses, among other things, the physical and social vulnerability to climate change.[31]

(a) The following indicators were calculated for physical vulnerability:

- Coastal vulnerability index
- Storm surge flooding indicator
- River flooding indicator

(b) The following indicators were calculated for social vulnerability:

- Governance
- Citizen perception
- Exposure
- Social cohesion
- Responsiveness of the health sector
- Social vulnerability

75. This study represented an interdepartmental effort to generate knowledge on the impacts of climate change on the tourism sector and in designing adaptation programs for the analyzed destinations, with implications at national, regional, state and municipal level. The impacts of climate change are most evident at the municipal level and actions should be implemented at this level.[32]

76. It is proposed to establish an official standard in Mexico for specifications for environmental protection and mitigation of climate change effects in the planning, design and construction of coastal resorts and housing developments. These requirements will concern the site selection, design, planning, construction,

[30] CENAPRED Diagnosis of Hazard and Disaster Risk Identification in Mexico.
[31] Characteristics and socioeconomic impacts of major disasters occurred in Mexico in 2011. 1st Edition October 2013. Mexican Secretariat of the Interior (SEGOB)
[32] http://www.atlasnacionalderiesgos.gob.mx/index.php/riesgos-socio-organizativo

operation and decommissioning, rehabilitation, remodeling and expansion of tourism infrastructure, as well as the recovery of beaches.[33]

77. One of the main challenges is to have high quality, relevant, accurate and timely information to contribute to national development, as established in Article 3 of the Law of the National System of Statistical and Geographical Information.

VI. Impact of crises on the statistical area

78. In the event of disasters, it is common that economic losses are devastating for developing countries. The report "Natural hazards, natural disasters", prepared with support from the World Bank/GFDRR, shows that the impact of disasters to Gross Domestic Product (GDP), is 20 times bigger in developing countries than in developed countries.[34]

79. The effects of disasters will keep growing and climate change will aggravate that trend. The World Bank report "Building resilience", referred to in the Warsaw Climate Change Conference 2013, concludes that economic losses caused by natural disasters have grown from US$50 billion dollars per year during the 1980-ies to almost US$200 billion dollars a year in the last ten years.

80. Because of its geographic location and climate characteristics, the Caribbean area is a clear example of the vulnerability to natural disasters. The impacts involve several areas including the economy. However, the high human, environmental and economic costs associated to these natural events are mainly the result of a high vulnerability aggravated by inadequate or insufficient economic development policies, including those related to infrastructure, services, risk management and environment. The following table shows the main types of natural disasters and their impact in Latin America and the Caribbean (2010).

Table 7
Main types of natural disasters and their impact in Latin America and the Caribbean (2010)

Disaster type	Total occurrences	Deaths	Affected population	Cost (Million USD)
TOTAL	**98**	**225,684**	**13,868,359**	**49,188**
Climate related	79	1,380	9,318,685	9,840
Epidemiological	13	1,211	334,740	565
Geophysical	6	223,093	4,214,934	38,783

Source: Economic and Social Disaster Assessment Unit, UNO - ECLAC (1972-2009).

81. When natural disasters occur, attention to the direct human cost is the primary focus. However, negative economic effects are also significant. In the short term, these cause temporary interruption of economic activities and the loss of

[33] http://www.colpos.mx/web11/pdf/Proteccion_Civil/Riesgos_químicos_s.pdf
[34] http://www.bancomundial.org/es/topic/disasterriskmanagement/overview

capital goods and human resources. Disasters also have long term economic effects such as decrease of GDP and increased foreign debt and social inequality.

Table 8

Natural disasters by continent (1999-2014)

Continent	Number of disasters	Deaths	Persons affected	Persons injured	Homeless	Total affected	Economic losses (x 1000 USD)
Africa	1473	80346	254790097	35571	3378427	258204095	13437735
America	1443	294473	104589792	2464130	3681767	110735689	691456061
Asia	2450	776083	2819962968	1837204	32936154	2854736326	817127834
Europe	897	142206	17096442	37475	215095	17349012	211600581
Oceania	238	2095	1993765	5263	92542	2091570	55298408
Total	**6501**	**1295203**	**3198433064**	**4379643**	**40303985**	**3243116692**	**1788920619**

Source: Compilation of data by continent. The International Disaster Database (CRED / EM-DAT), Université Catholique de Louvain, Belgium http://www.emdat.be/

82. Based on the above, we can say that disaster risk management requires both knowledge of threats and vulnerabilities, and the systematic collection of data on damages and losses. The increasing number of disasters creates a growing need for statistical data. It is increasingly necessary to link the data from statistical offices and other agencies that provide various administrative records to determine the impact of disasters on people and businesses.

VII. Issues and challenges

83. The following issues and challenges can be identified in connection with the efforts to increase awareness about disasters and associated risks:

A. Issue 1 - Information to measure the impact of disasters

84. To formulate and estimate the financial requirements for the recovery and reconstruction it is essential to have quantitative information about the effects and impacts of the disasters and estimates of their economic cost. Monetary estimates of the damage and sectoral losses and the potential macroeconomic effects are needed. In addition, the diversity of scenarios of being affected by a disaster must be accounted for: the economic, spatial and demographic impact, the value of capital exposed to damage, the institutional development of countries and the size and resilience of the affected economies.

B. Issue 2- Lack of common classifications and definitions

85. There are no common classifications and agreed definitions of disasters and extreme events. Countries identify different types of disasters, some covering only natural disasters, others only man-made disasters and in some cases both. Measurements are often designed to serve specific policies. Therefore, it is necessary to have more comprehensive classifications to characterize different types of events and capture appropriately the differences between natural and socio-natural disasters. It should allow to reflect the cumulative effects that usually occur in bigger disasters or by the accumulation of consequences of past disasters.

C. Issue 3 - Measuring vulnerability

86. The vulnerability factors that recurrently contribute to the occurrence of disasters should be clearly identified: poverty, closely related to the level of economic development of countries; urban expansion to areas at high risk of floods and landslides; absence of building codes and lack of financial prevention measures; strong economic dependence on agricultural activities with high exposure to climatic variations and hurricanes; increasing degradation of the environment, both locally and globally, and the presence of large-scale processes, ranging from deforestation in certain areas to the climate change, causing the increase in sea level and major changes in regimes of rainfall worldwide.

D. Issue 4 – Vulnerability of cities to disasters

87. Cities are highly dependent on external inputs (energy, raw materials, food, etc.) and therefore highly vulnerable. Cities are not self-sufficient to ensure their reproductive cycles, and are therefore hard to sustain. In Risk Management analysis, the cities could be considered as a Socio-Artificial Ecosystem with functions that exceed its spatial limits. Thus, the study of urban vulnerability to disasters should be a guiding principle of a Risk Atlas and a normative benchmark for Plans and Programs for Urban Development.

E. Issue 5- Duplication and heterogeneity of information

88. The data on disasters and extreme events are compiled from various sources, including UN agencies, NGOs, insurance companies, research institutes and press agencies. Sometimes new data sets duplicate the available data in existing statistical systems. In addition there may be lack of adequate data, insufficient frequency of updates, inconsistency of information between different institutions, difficulty to access the information, differences in data quality depending on the variable in question and the geographical unit, and unclear and imprecise identification of government actions in different areas.

F. Issue 6 - Importance of national coordination

89. Coordination at national level is very important. In Mexico, the National System of Civil Protection (NSCP) is a set of structures, functional relationships, methods and procedures that include the departments and agencies of the public sector together with various social and private voluntary groups, and the state authorities at different levels. The system must operate in a coordinated way in the event of a disaster and in recovery efforts.

90. A forum is needed to provide socio-economic, geographical and environmental information allowing to monitor the change of the risk conditions for civil protection purposes (e.g. in Mexico a National Center for Disaster Prevention). Its task is to coordinate the updating of this information and conducting field operations to collect information, and allow to use public resources, such as remote sensing images, for the development of a risk atlas.

VIII. Conclusions and recommendations

91. A flexible and adaptable international classification of disasters is required to systematize information and statistics on disasters. One of the more often used classifications is the one by the United Nations International Strategy for Disaster Reduction (UNISDR).

92. The data from the population and housing census and sectorial censuses (agricultural and livestock, manufacturing and mines, inter alia) are of particular utility to acquire reliable and accurate information about the affected territory and its population. Statistical yearbooks and publications of statistical offices and census departments can be also used, as well as those prepared by national research centers, universities and recognized institutes. Information from national government, including on civil protection related issues, organizational capacity, regulatory provisions and equipment and infrastructure available for disaster relief are important to support the design, implementation, monitoring and evaluation of policies on public safety.

93. The availability of a whole range of base data are important for an extensive and well documented analysis of the impact of disasters: information on population, economy and geography, as well as on government programs. Good coordination among institutions is needed to collect and share data and build an efficient Geographic and Statistical Information System. In this context, the NSOs should work together with other agencies in charge of prevention and response to natural disasters in several ways:

(a) Making available relevant geographic and statistical data, such as detailed data on population, roads, hydrography, terrain, natural resources, land cover and soil;

(b) Mapping areas and/or places affected by disasters using aerial photographs or satellite images acquired after the occurrence of a disaster;

(c) Sharing and making data available through a Web data exchange site;

(d) Contributing to the discussion to define strategies and information infrastructure to support government actions for the prevention and response to natural disasters.

94. The use of geographical and georeferenced statistical data is needed to develop services, such as the Risk and Vulnerability Atlas. It allows determining the areas or regions affected and their topographic characteristics. In addition to delimiting the affected territory, information on the organization and general functioning of different sectors is needed. Having a national framework for geo-referenced statistical information is imperative for these purposes. This must be recognized by all levels of government.

95. An important supporting element is the National Geospatial Data Infrastructure (NGSDI) allowing collection, maintenance, analysis, presentation and dissemination of spatial data. These are vital in the complex processes of decision making, particularly in sustainable development. This is of particular interest in the regions that are exposed to natural hazards. Efforts must be undertaken to promote this kind of initiatives. A good example is the Proyecto Caribe initiative to promote the development of a NGSDI in member countries of Association of Caribbean States to strengthen production, integration, analysis and dissemination of geospatial information. The aim is to create a knowledge database to face the climate change in these countries and strengthen their resilience capacity.

96. The number of natural disasters and the severity of their impacts have increased in recent decades. This has significantly hampered the economic development and allocation of resources for relief and recovery.

97. The scenarios analysed on the possible consequences of climate change indicate that droughts will become more intense and hurricanes more frequent; agricultural areas will be displaced or modified, and the sea level will rise. This highlights the need to incorporate in spending and investment decisions issues related to risk management of natural hazards and the implementation of appropriate policies and actions for forecasting and environmental mitigation.

98. According to the report "Impact of Disasters in Latin America and the Caribbean, 1990-2011 - Trends and statistics for 16 countries" published by the UNISDR and OSSO Corporation in September 2013, the national systems for collecting data on disaster damages and losses should meet the following minimum requirements:

(a) Include extensive risk analysis: national data collection systems should strengthen the observation and collection skills at local levels of such risk analysis to be included in national inventories;

(b) Be systematic: data should be collected systematically throughout the year to allow temporal analysis and provide a complete picture of the manifestations of risk;

(c) Be comprehensive: in addition to collecting data on basic effects on people and housing, an inventory of the damage and losses in all sectors should be done: health, infrastructure, education, agriculture, etc.;

(d) Provide an economic estimation of damages and losses, including the impact on various sectors;

(e) Ensure regional breakdown of the damages and losses by major disasters and their aggregation at local level. This information is often scattered in different sources without standard formats to facilitate accessibility and systematization. When making the inventory of affected people during major disasters, it is recommended to design the data collection so that a reference to local administrative levels can be included.

99. It is necessary to cooperate with other government agencies to get up-to-date and timely information. A national statistical and geographical information system that includes economic, demographic and social, environmental and geographic information but also information on government, public security and administration of justice, will allow addressing civil protection holistically and generating useful information for disaster prevention and management.

100. Incorporating disaster risk management to development planning may help to revert the tendency of increasing losses and damages from disasters driven by economic development, population growth and rapid urbanization. Decisive action can save lives and properties. However, many developing countries do not have the tools, experience and resources needed to anticipate the potential impact of extreme natural events when making their investment decisions.

101. There is a need for better involvement of national statistical offices. This would be useful to:

(a) Agree on common classifications and definitions on extreme events and disasters;

(b) Agree on terminology and typology of disasters for statistical purposes;

(c) Exchange good practices and innovative approaches in supporting disaster preparedness with official statistics;

(d) Define which statistics are the key to disaster analysis and preparedness;

(e) Define how to improve national statistical offices' involvement in this area and the availability of official statistics;

(f) Develop international recommendations on measuring extreme events and disasters and using official statistics for this purpose.

102. There are innovative approaches and best practices in the use of official statistics to increase disaster resilience such as Demographic Explorer for Climate Adaptation (DECA) in Indonesia. This tool allows incorporating various official statistics and other data including census and social statistics in spatial analysis of climate change. The tool could be developed further for adoption in other regions.

103. Further work to improve the statistical description of the occurrence and impact of disasters should include the following:

(a) Defining processes for responding to disasters;

(b) Setting up and maintaining a collaborative website for information exchange;

(c) Regulating and promoting the use of mobile devices to implement early warning systems to the population;

(d) Regular publication of statistics and indicators related to disasters.

104. The information management during an emergency is a crucial part of any effective and timely humanitarian assistance operation. A strong information management network is needed to support emergency coordination. It requires processes to collect, analyze, and share information on economic situation and the environment among various organizations. The network should include representatives of people affected by the emergency, aid agencies, government and media. Information should be presented in easy to use formats such as maps or tables to support rapid decision-making at all levels.

105. As a conclusion, regional meetings would be very useful to exchange experience, join the efforts of various organizations and contribute to the global initiatives in this area.