PERCENTAGE OF POPULATION LIVING IN HAZARD PRONE AREAS		
Natural hazards	**Vulnerability to natural hazards**	**Core indicator**

1. INDICATOR

(a) Name: Percentage of population living in hazard prone areas.

(b) Brief Definition: The percentage of national population living in areas subject to significant risk of death or damage caused by prominent hazards: cyclones, drought, floods, earthquake, volcanoes and landslides. The indicator maybe calculated separately for each relevant prominent hazard. The risk of death in a disaster caused by natural hazards is a function of physical exposure to a hazardous event and vulnerability to the hazard. The indicator measures the risk at sub-national scale by using historical and other data on hazards and on vulnerability. The sub-national risk levels are then aggregated to arrive at national values.

(c) Unit of Measurement: Percentage.

(d) Placement in the CSD Indicators Set: Natural hazards/ Vulnerability to natural hazards

2. POLICY RELEVANCE

(a) Purpose: To calculate the percentage of population living in disaster prone areas, thus providing a useful estimate of national vulnerability to cyclones, drought, floods, earthquake, volcanoes and landslides, which combines almost the totality of human and economic loss due to disasters caused by vulnerability to natural hazards. This indicator will contribute to a better understanding of the level of vulnerability in a given country, thus encouraging long-term, sustainable risk reduction programs to prevent disasters, which are a major threat to national development.

(b) Relevance to Sustainable/Unsustainable Development (theme/sub-theme): There is a recognized high degree of interdependency between sustainable development and vulnerability to natural hazards. High vulnerability means higher exposure to natural catastrophes in the absence of disaster reduction measures. Disasters caused by vulnerability to natural hazards have a strong negative impact on the development process in both industrialized and developing countries. Therefore, the degree of vulnerability to a given natural hazard provides a key measure of social welfare and development in a given country, as well as an indication of the risk (probability) of natural disasters.

The general increase in vulnerability of societies worldwide has caused the social, economic and environmental impact of to natural disasters to become far greater now than ever before. In fact, the overall number of people affected by disasters has been growing by 6 % each year since 1960. This trend is expected to continue primarily because of increased concentration of people and values in the areas exposed to natural hazards.

(c) International Conventions and Agreements: Under the Hyogo Framework for Actions, countries and other actors work towards a substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries.

(d) International Targets/Recommended Standards: None.

(e) **Linkages to Other Indicators:** This indicator is linked with many demographic indicators, including population growth rate (total, urban and rural) and percentage of population in coastal areas. It is also linked to most poverty indicators, as poverty is a major determinant of vulnerability. It is directly linked to the indicator on human economic losses due to natural disasters.

3. METHODOLOGICAL DESCRIPTION

(a) Underlying Definitions and Concepts:

The individual vulnerability to hazard is the probability being killed in the event of a hazard. Alternatively, the indicator can be calculated on the basis of the expected economic damage in the event of a hazard.

The mortality risk due to hazards in a geographic area is the product of the probability of a hazard taking place in that area and the average vulnerability to hazards.

An area is defined as hazard prone area if the mortality risk is higher than a certain threshold.

A cyclone is defined as a wind storm with maximum speed of more than 64 knots per hour. The definition includes typhoons and hurricanes.

A drought is a period of deficiency of moisture in the soil such that there is inadequate water required for plants, animals and human beings. It can be further defined as weighted anomaly of standardized precipitation over an extended period (e.g., 3 months).

A flood is a significant rise of water level in a stream, lake, reservoir or coastal region. Only extreme floods are typically counted.

Earthquake is sudden break within the upper layers of the earth, sometimes breaking the surface, resulting in the vibration of the ground, which where strong enough will cause the collapse of buildings and destruction of life and property. Typically, earthquakes >4.5 on the Richter Scale are considered.

Volcano, or volcanic eruption, is the discharge (aerially explosive) of fragmentary ejecta, lava and gases from a volcanic vent.

Landslides are, in general, all varieties of slope movement, under the influence of gravity. More strictly refers to down-slope movement of rock and/or earth masses along one or several slide surfaces. Snow avalanches may also be included under landslides.

(b) Measurement Methods:

For earthquakes, the percentage of population living in seismic risk zones will be obtained by combing population density maps with seismic hazard maps. The most suitable way to express the level of seismic risk is through zoning (very high, high, medium, and low). Richter Scale and Modified Mercalli scale (easily compatible) are

recommended as basis for the zoning. Population living in "very high" and "high" zones are considered to be at risk.
The percentage of population living in flood prone areas will be obtained by combining the area affected by the 100 year return period flood with population density data.
For other hazards, the risk at a sub-national scale can be measured by using historical and other data on hazards and on vulnerability.

(c) Limitations of the Indicator: The validity of this indicator is limited by the quality and the format of the data used for its calculation. Comparability over time may represent a particular problem for this indicator.

(d) Status of the Methodology: This methodology is being used by a the Disaster Risk indexing project of the UNDP in partnership with UNEP-GRID; the Hotspots indexing project implemented by Columbia University and the World Bank, under the umbrella of the ProVention Consortium and the Americas programme of IDEA in partnership with the InternAmerica Developing Bank. These projects are based on a conceptual framework that includes particular understanding of the factors contributing to human vulnerability and disaster risk. The methodology for seismic risk assessment is widely used through the scientific community, in particular in RADIUS (Risk Assessment Tools for Diagnosis of Urban Areas Against Seismic Disasters), a tool developed to assess earthquake risk in urban areas worldwide.

(e) Alternative Definitions: Not available

4. ASSESSMENT OF DATA

(a) Data Needed to Compile the Indicator: Cyclone prone areas; drought risk map, floods risk map, earthquake risk maps, volcanoes and landslides risk maps (see above); population distribution maps; flood hazard (floodplain) maps; population distribution maps.

(b) National and International Data Availability and Sources: Data availability at the country varies according to countries. At the international level, data on global hazard frequency and risk and their distribution is available through the Hotspot project implemented by the Center for Hazards & Risk Research at Columbia University. Data on global disasters is available in the EM-DAT database, maintained by the Centre for Research on the Epidemiology of Disasters (CRED) in Brussels.

(c) Data References: For the Hotspot core data set, see
http://www.ldeo.columbia.edu/chrr/research/hotspots/
For the EM-DAT database, see http://www.em-dat.net/

5. AGENCIES INVOLVED IN THE DEVELOPMENT OF THE INDICATOR

(a) Lead Agency: The lead agency is the Secretariat for the International Strategy for Disaster Reduction (ISDR), United Nations, Geneva.

(b) Other Contributing Organizations: UNDP, UNEP-GRIP, World Bank (ProVention Consortium), Inter American Development Bank, **:** ICSU – International Council of Scientific Unions, WMO, Munich Reinsurance.

6. REFERENCES

(a) Readings:

CRED. Statistical Update from CRED Disaster Events Database in: CRED Disasters in the World. November 1991.

UNDP. *Reducing Disaster Risk, A challenge for development*. UNDP, 2004.

ISDR/UNDP, *Vision of Risk, A Review of International Indicators of Disaster Risk and its Management, A report for the ISDR inter-Agency Task force on Disaster Reduction, Working Group 3: Risk, vulnerability and Disaster Impact Assessment,* Geneva, December 2004. (http://www.undp.org/bcpr/disred/documents/publications/visionsofrisk.pdf#search='Hotspots%20indexing%20project');

ISDR, *Living with Risk, a global review of disaster reduction initiatives,* UN Geneva 2004.

International Bank for Reconstruction and Development/The World Bank and Columbia University, *Natural Disaster, Hotspots: A Global Risk Analysis Dilley, M., Chen, R.S., Deichmann, U., Lerner-Lam, A.L. and Arnold, M. with Agwe, J. Buys, P., Kjekstad, O., Lyon, B. and Yetman, G.,* Washington, D.C 2005.

IBD, *Indicators of Disaster Risk and Risk Management, Inter-American Development Bank,* Washington, D.C.

See also the internet sites below for further references

(b) Internet sites:

http://www.unisdr.org
http ://www.munichre.com
http://www.geohaz.org/
http://www.ldeo.columbia.edu/chrr/research/hotspots/
http://www.cred.be
http://www.undp.org/bcpr