An Assessment of Risks and Threats to Human Health

Associated with the Degradation of Ecosystems

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FOREWORD

Ecological systems provide humans with products and services essential for good health and survival. Ecosystem degradation by humans has increased the risks and threats to our human health. In recent years, there has been a growing interest by the scientific, business, industrial and civil society communities with regard to the potential links between the collapse and degradation of an ecological system and its impacts on human health.

On December 8, 1998, in Washington D.C., the Division of Environmental Information, Assessment & Early Warning (DEIA&EW) of the United Nations Environment Programme (UNEP), convened a meeting of experts to discuss issues related to Early Warning of Emerging Environmental Threats.

One of the issues identified was the potential risks and threats to human health due to degradation or a collapse of an ecosystem. In consequence, UNEP conducted this study to assess the status of and identify scientific knowledge about this subject. The report attempts to explain the consequences of environmental change and deterioration of ecosystems on human health and analyzes global, regional, and national trends. The study also seeks to provide a rational basis for decision-making in the formulation and implementation of environmental policy.

The analysis indicates that most of the health impacts linked to degradation of the Ecological System result from a combination of environmental processes that create conditions conducive to diseases. Invariably there are intermediaries connecting the change in the ecosystem and human health.

The report does not make any judgements about, nor does it attempt to provide direction on, how to resolve human health problems. It is however, becoming clear that there is a need and an opportunity to address emerging global and regional health concerns resulting from environmental degradation.

Daniel van Claasen,
Acting Director

Division of Environmental Information,
Assessment and Early Warning, UNEP

"A healthy population and a healthy environment are (a) social and economic good. We cannot think of a healthy population without a healthy environment and ecosystem."

Klaus Toepfer,
Executive Director

United Nations Environment Programme

(Third World Health Organization. The Ministerial Conference on Environment and Health, London 16-18 June, 1999)

1. INTRODUCTION

The health and well being of humans cannot be separated from the natural environment. Many of the threats to human health are an intrinsic part of ecosystems. The challenge lies in maintaining people's health while simultaneously improving the health of ecosystem sas a whole.

The total impact of a transformed environment causes considerable harm to natural life support systems and a threat to the sustainability of human health (Rapport *et al.*, 1998). The environmental threats to human health can be divided into two main categories: (1) lack of development — inability to cope with natural hazards and/or lack of access to essential environmental resources, and (2) unsustainable development — ecosystem degradation (WRI, 1998). Major causes of environmental changes, as well as characterization of environmental hazards, i.e. biological, physical, and chemical, are critical items to be analyzed.

The goal of this study is to establish whether there are strong and direct links between ecosystem degradation and human health. The main objectives of this report are: (1) to review key emerging and re-emerging threats to human health at global, regional, and local levels due to ecosystem degradation; and (2) to establish causal linkages between ecosystem degradation and human health. Environmental conditions that foster the transmission or spread of disease, exposure to harmful chemicals, or hazardous physical conditions have been reviewed. This study also intends to raise public awareness about the critical need for a more holistic understanding of the links between ecosystem well-being and human health.

By synthesizing the information from different sources, this report provides an overview of the recent findings surrounding the linkages between environmental change and population health. This review intends to establish a basis for a global data collection system, as well as promote the idea of the inter-relationships between human health and the state of the ecosystems, by compiling examples and grouping them in accordance to specific regional natural conditions and ecological characteristics.

2. ENVIRONMENTAL DEGRADATION

An ecosystem is a functioning unit of nature that combines biotic communities and the abiotic environments with which they interact (LaRoe *et al.*, 1995). There are three main features characterizing a healthy ecosystem: vigor, resilience and organization. A healthy ecosystem is a sustainable component of the biosphere that has the ability to maintain its structure (organization), and function (vigor) through time and in the face of external stresses (resilience) (Mageau *et al.*, 1995). Healthy ecosystems provide support to the human community, such as food, shelter, the capacity to assimilate and recycle wastes, clean air and water. Still, there is a certain difficulty in defining ecosystem health given the qualitative and quantitative differences among ecosystems. For instance, there are ecosystems in which rich biodiversity is a sure sign of health and in others it is

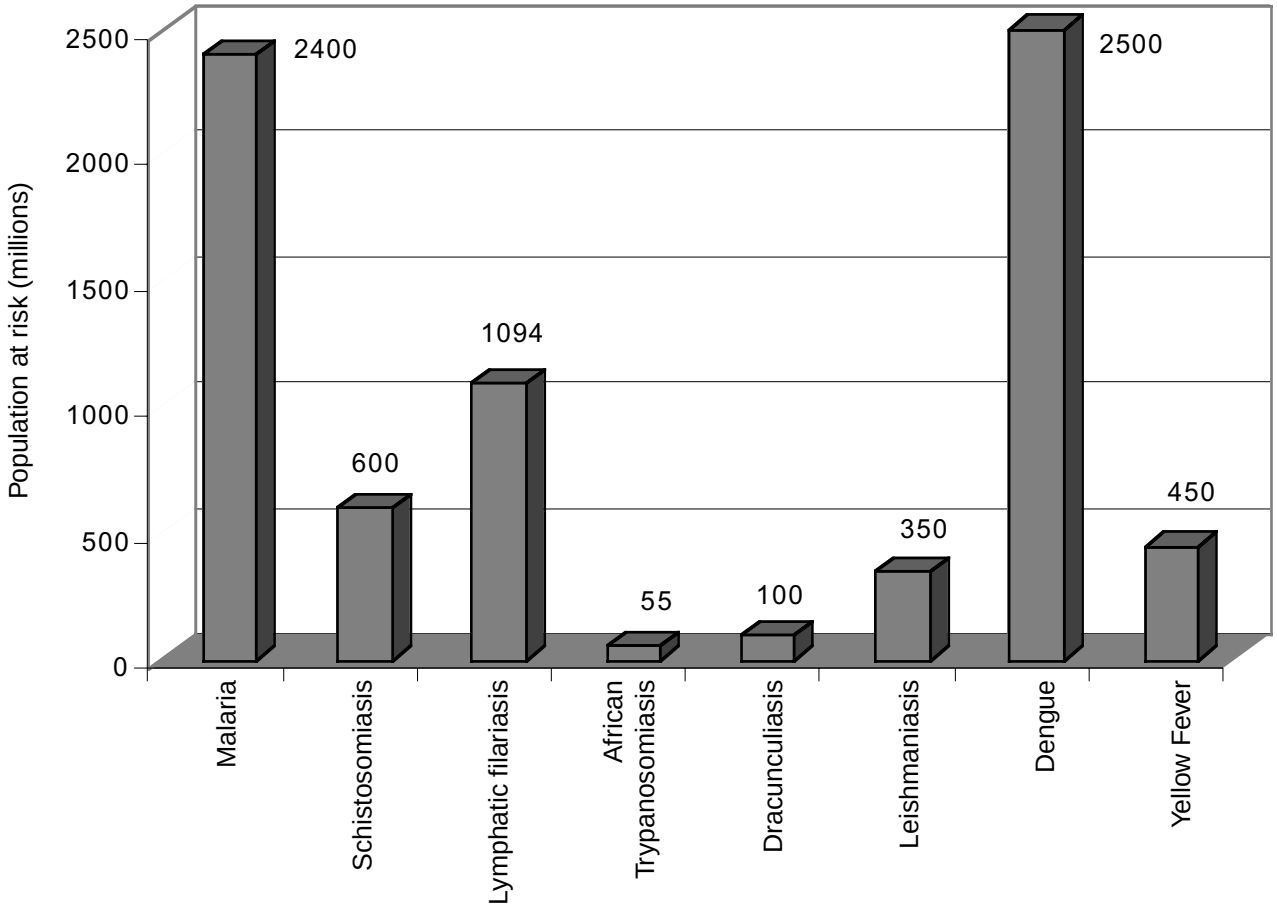

Figure 1. Major tropical vector-borne diseases as a result of climate change.

(Source WHO, 1996)

a sign of disturbance (Enhrenfeld, 1995). From a global perspective the environment has continued to degrade during the past decade. According to the Global Environment Outlook Report 2000, different regions in the world experience various environmental concerns (UNEP, 1999).

Humans have modified approximately 50 percent of the land surface, account for more than 20 percent of the atmospheric carbon dioxide concentration, utilize over 50 percent of the accessible surface fresh water, and are responsible for about 60 percent of all nitrogen fixation (Rapport, 1998). The total impact of these modifications are a significant danger to the favorable functioning of the natural life support systems, which are the major part of the ecological systems, and to the sustainability of the population health. The combination of environmental changes that creates the conditions leading to disease occurrence is also of a significant concern here.

Human activities are directly responsible for creating agroecosystems and cultural landscapes at the expense of many natural communities and the reduction in ecosystem services. With current rates averaging about 0.7 percent per year, serious loss of forest quality and old-growth habitat in many temperate and boreal forests due to pollution and tropical deforestation are problems of a significant concern.

Desertification and drought are problems of a global dimension that affect more than 900 million people in 100 countries. Twenty five per cent of the Earth's land area is being affected by land

degradation. Desertification is occurring in 30 percent of irrigated areas, 47 percent of rainfed agricultural lands and 73 percent of rangelands. Hydrological and ecological functions of over one-half of all wetlands have been altered due to encroachment. Global freshwater biodiversity is declining significantly. Today about one-third of the world's population is living under moderate to severe water stress, most notably in Middle Asia and North Africa. Coastal water is being contaminated by land-based sources, particularly by municipal wastes that cause eutrophication. Many fishery resources are classified as overexploited. Red tides have increased in distribution and frequency. Stratospheric ozone has decreased since 1979 by about 5.4 percent at northern mid-latitudes in winter and spring, and about 2.8 percent in summer and fall. The amount of spatial and temporal patterns of precipitation are changing (Watson *et al.*, 1998). These changes are responsible for bringing adverse consequences to human populations.

Environmental change and ecosystem degradation in particular are the result of many different occurrences in natural and/or man-made systems. Major parameters responsible for changes in ecosystems that affect human populations can be a result of direct manipulation or an environmental consequence of human activity.

Some direct cultural changes include:

- **Development and intensification of agriculture**

  The direct result of agricultural practices is the conversion of forest, grassland, and wetland ecosystems into agroecosystems, which are poorer in biodiversity and consequently less stable and resistant to other interventions. Other effects include soil and water contamination with chemicals and pesticides, land degradation, and salinization. (WRI, 1998).

- **Industrialization, increasing energy use, and urbanization**

  Industrial development and excessive energy use lead to direct changes and very often destroy ecosystems by simply occupying the space and converting natural environments into industrial sites and urban areas. Habitat fragmentation and loss in biodiversity, alteration and destruction of vegetation cover, removal and disproportional distribution of species, water (fish kills and eutrophication), soil degradation, and pollution contribute to changes in the global ecosystem. Stratospheric ozone depletion is also considered to be the result of industrial development (WRI, 1998).

Some environmental consequences of human activity include:

- **Changes in climate**

  According to the Intergovernmental Panel on Climate Change (IPCC) the mean surface temperature of the Earth may increase by approximately 1-3.5˚ C. Sea level rise due to climate change may lead to an increase in coastal zone erosion and loss of natural protective features such as dunes and mangroves. Potential health impacts are considered to be cumulative and interact synergistically (WHO, 1996).

  Changes in climatic conditions are enabling mosquitoes and other disease carrying insects to survive and breed more at northern latitudes and higher altitudes. The distribution of species in an ecosystem may vary due to such changes (Fig. 1).

- **Natural Disasters**

  Natural disasters may lead to devastating consequences to both natural and man-managed ecosystems. High amounts of rain may cause inundation of a river flood plain and

lowlands as well as degrade top soil layers and wash out nutrients and microelements. Volcanic eruptions can lead to ecosystems collapsing by polluting the atmoshpere and covering the land surface with lava and ash. Earthquakes may lead to land degradation and landslides that affect day to day life and loss of property, and droughts may lead to the loss of biodiversity and species migration.

Other activities, such as construction, forestry, hunting, fishing, and recreation, may lead to the loss of biodiversity, habitat fragmentation, river or stream regime alteration, resource extraction, vegetation cover destruction, disproportional distribution of species, and pollution of the environments.

The loss of species and habitat degradation erode genetic diversity. In addition, many of the 20,000 plant species used as traditional medicines around the world are under threat due to over-exploitation (UNEP, 1993). The genetic diversity of species is not only one of the keys to successful agriculture, which prevents malnutrition-related health problems, but also a source of pharmaceuticals and a field for medical research and findings.

The consequences of ecosystem collapse are often a breakdown in terms of biological, physical, social, and economic dimensions (Rapport *et al.*, 1998). Discovering original and improved ways to assess ill-health and problems in ecosystems, which represent the basic functional unit of the natural desertification as a result of overgrazing, and invasions of exotic species are examples of ecosystem distress syndrome. These can influence human population health and may be readily detected, even by the general public, in all countries (Rapport *et al*. 1998).

3. HUMAN HEALTH

The World Health Organization (WHO) characterizes health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (Purdom, 1980). The major current trends of human health globally include the following features (WHO, 1996):

- increases in life expectancy,
- a decline in infant and child mortality in developing countries,
- reduction of certain vaccine-preventable diseases, and
- increased incidences of chronic non-infectious diseases and HIV/AIDS.

Still, avoidable illnesses and premature deaths are occurring in large numbers in many regions of the world, where environmental factors are responsible (NEHA, 1998). The sustainability of human health is a highly important criterion of successful social