Course "The Environmental Web" U316

ECA Part C

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The continued emphasis on climate change in international, national and local policy and politics is leaving other urgent environmental concerns including biodiversity loss and water issues neglected. This is slowing progress towards a more integrated vision of sustainability.

1. Introduction

Climate change has become one of the most salient issue within international environmental politics and is today one of the greatest environmental challenge facing the world. In contrast, biodiversity has not risen to the same level of importance, although the Convention on Biological Diversity and the Framework Convention on Climate Change were linked to a similar negotiation process. Climate warming has a great influence on changes in biodiversity and impact on Earth's water cycle and water resources. A holistic systems approach looks at the planet as a complex network of physical, chemical and biological interactions among several subsystems (Simon 2003, pp. 24-26). Atmosphere, biosphere and hydrosphere, for example, are part of one great system.

2. The complexity of the Earth's climate system

The Earth's climate system is very complex. It includes five main components: the atmosphere, the hydrosphere (oceans, seas, rivers, surface and subsurface water), the cryosphere (snow, sea-ice, ice-sheets, glaciers), the land surface and the biosphere (all ecosystems and living organisms). (Karl and Trenberth 2005, p. 15)
The system is influenced by the interaction of many positive and negative feedbacks between the components. One example of a negative feedback is carbon dioxide fertilization. It occurs when elevated carbon dioxid levels enhance the plant growth. The plants store the carbon as biomass leading to a partial reduction on CO_2 concentration. (Peake and Smith 2003, p. 53) Water vapour is the largest positive feedback in the climate system. As temperature rises, evaporation increases and more water vapour accumulates in the atmosphere. As a greenhouse gas, the water absorbs more heat, further warming the air causes more evaporation and water vapour concentration.

3. Climate change and hydrological cycle

Changes in the heat balance of the Earth are likely to have effects on the hydrological cycle. Global warming through an increase in downwelling infrared radiation not only raises the temperature, but also enhances the water cycle. The heating at the Earth's surface goes into evaporating surface moisture. (Karl and Trenberth 2005, p. 25) The increased water vapour in the atmosphere is fuel for storms, enhances rainfall and snowfall intensity and might mean increasing risk of flooding. Changes in atmospheric circulation could lead to a new distribution of precipitation. (Hulme 2005, p. 35) Some regions become drier, some wetter. Annual precipitation has increased in most of the mid to high-latitude regions in the Northern Hemisphere over the last 100 years. In subtropical regions such as the African Sahel, parts of southeast India and southeast Africa there were decreases of precipitation in the last decades. Semi-arid and arid areas (e.g. Mediterranean basin, western USA, southern Africa, and north-eastern Brazil) are particularly exposed to the impacts of climate change on freshwater, many of them will suffer a decrease in water resources.
Water supplies stored in glaciers and snow cover will decline in the future. Experts of the IPCC emphasize that the water availability will be reduced by a seasonal shift in streamflow, an increase in the ratio of winter to annual flows and reductions in low flows in regions supplied by melt water from major mountain ranges. (IPCC 2007) Higher water temperatures and weather

extremes like floods and droughts are considered to affect water quality and exacerbate many forms of water pollution. In many regions climate change will increase the demand for irrigation water. (Simon 2003, p. 16)

4. Impacts of climate change on biodiversity

Habitat destruction of tropical forests, for example, introduction of invasive species, overexploitation of biological resources such as overfishing in the seas, pollution and global climate change are major threats to biodiversity. Worldwide biodiversity loss is accelerating. Nearly one-quarter of mammals, 32 per cent of amphibians and 12 per cent of all bird species are threatened with extinction. Climate change alone is expected to force a further 15 to 37 per cent of species to the verge of distinction within the next 50 years. (Loreau and Oteng-Yeboah 2006, p. 245). Destruction of natural habitats and the effects of climate change are causing species to die out at 100 to 1,000 times faster than the natural rate.
Some species are particularly vulnerable to the impacts of climate warming. In the Arctic, shorter periods of sea ice coverage endanger the polar bear's habitat and existence; the animals have less time to hunt. (Convention on Biological Diversity 2007) Australia's Great Barrier Reef could lose up to 95 per cent of its living coral by 2050 due to changes in ocean temperature.
Coral reefs are very sensitive ecosystems that can only tolerate a narrow temperature range of 25 to 29° Celsius. Rising temperature disturbs the relationship between the coral and the algae (zooanthellae) that live within them and provide them with nutrients through photosynthesis. The corals expel their zooanthellae, resulting in the bleaching and often in the death of the coral. (Brandon and Clark 2003, p. 60)

Seasonal biological phenomena such as plant growth, flowering, animal reproduction or migration depend on temperature and respond sensitively to climate warming. (Root and Hughes 2005, p. 61) Climatic changes may effect the phenology, the timing of life cycle events of animals and plants. New patterns of temperature and rainfall will apply major selection pressures on terrestrial species. With warming trends, species shift their distributions polewards or towards higher altitudes. (Walther et al. 2002) The expansion continues until populations reach the limits of the geographic range and are then threatened by extinction (Thomas 2005, p. 83).

5. Making biodiversity more visible and understandable

By its nature, biodiversity is diverse and complex: It encompasses several levels of biological organization, it is the sum of genes, species and ecosystems on Earth. (Hannah et al. 2005, p. 3) Biodiversity cannot be measured by simple universal indicators such as temperature and atmospheric CO_2 concentration. Its distribution and management are more local than global. The definition of biodiversity also includes biological processes. From this viewpoint, a single objective measure of biodiversity is not possible. This may be one of the reasons why it is difficult to make issues of biodiversity understandable to the public.

Two important multilateral agreements resulted from the United Nations Earth Summit 1992 in Rio de Janeiro: the Convention on Biological Diversity (CBD) and the Framework Convention on Climate Change (FCCC). The FCCC has built on a strongly organized scientific community and the existing Intergovernmental Panel on Climate Change (IPCC) to inform subsequent political negotiations over climate change. In contrast, the CBD and the other international agreements concerned with biodiversity do not have the structural means to mobilize the expertise of a large scientific community to inform governments. In July 2006, nineteen leading specialists in the field of biodiversity called for a new global coordinating mechanism to provide a united, authoritative scientific voice to inform government decision-making internationally: "We are on

the verge of a major biodiversity crisis. Virtually all aspects of biodiversity are in steep decline and a large number of populations and species are likely to become extinct this century. Despite this evidence, biodiversity is still consistently undervalued and given inadequate weight in both private and public decisions. There is an urgent need to bridge the gap between science and policy by creating an international body of biodiversity experts." (Loreau and Oteng-Yeboah 2006, p. 245) The scientists from 13 nations want an inter-governmental mechanism similar to the IPCC "that is able to bring together the expertise of the scientific community to provide, on a regular basis, validated and independent scientific information relating to biodiversity and ecosystem services, to governments, policymakers, international conventions, non-governmental organizations and the wider public.

6. Conclusion

Issues of biodiversity and hydrology have not risen to the same level of salience as climate change although global warming have effects on the hydrological cycle and influence on biodiversity. Biological diversity as well as the availability and quality of water are most urgent environmental concerns: Habitat destruction, introduction of invasive species, overexploitation of biological resources, pollution and global climate change are major threats to biodiversity. Global warming through an increase in downwelling infrared radiation enhances the water cycle, unequal distribution of precipitation causes floods and droughts. Water scarcity will be one of the great problems in the future.
Biodiversity is still given an inadequate weight in political decisions. Therefore is necessary to establish an intergovernmental mechanism similar to the IPCC. This organization should provide information relating biodiversity to politicians and common people.

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