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Climate Change and Natural Resources: Is It Too Soon to Start Adapting?

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Because it will probably be decades before impacts of climate (or global) change can be modeled with sufficient geographical and temporal specificity to devise site-specific adaptive resource management practices or strategies, conventional wisdom is that it is premature to implement measures to adapt to the impacts of climate change on natural resources. (In this article, "natural resources" includes land, water and biological resources as well as the human activities and systems dependant on them, e.g., agriculture and forestry). Such reasoning is responsible, in part, for the general lack of attention to adaptation in both the Framework Convention on Climate Change and the Global Environmental Facility. Contributing to this state-of-affairs is that, on one hand, some skeptics of human-induced climate change view any response as premature; while on the other, some believers tend to focus on control of greenhouse gas emissions because they consider the issue as one of climate change per se rather than its potential impacts on natural resources. These impacts, which could be critical to human and natural systems, include those on national and global food security, on our ability to clothe and shelter ourselves, on the abundance, distribution and health of species (i.e., on biodiversity), on land cover (e.g., forests and grasslands), on water supply and demand, and on the productivity and uses of all lands from the coasts to the interior of continents.

This article examines whether the current neglect of adaptation is justified. In doing this, it is useful to review what has been learned over the past few years. First, climate is going to change with or without man's help and such a change could affect natural resources--despite whatever heroic control measures are actually implemented or our inability to pin-point any particular impacts at specific locations. Hence, adaptation is unavoidable.

Second, not all mitigation options are compatible with adaptation (or the goals of adaptation). For example, mono-culture forests may be more efficient carbon sinks than multi-species forests but they also provide less biodiversity, the conservation of which is one of the major reasons for the concern over climate change. Therefore, care should be taken that mitigation and adaptation strategies are mutually compatible.

Third, the impacts of climate change will be on top of the much larger impacts on natural resources

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due to other agents of global change, e.g., population and economic growth. On a global basis, over the next 50-100 years, the impact of these other agents of global change on land, habitat and water could exceed that of climate change by an order of magnitude or more.[2] Measures to adapt to these other changes will make coping with climate change that much easier.

Fourth, these other agents of global change are already affecting natural resources: witness continuing land conversion and land cover change resulting in losses of forests, other habitats and biodiversity. (See the Table, which provides data on global population and land use change from 1700 to 1989, and the Figure, which graphs changes in population and cropland from 1920 to 1989). Hence, coping with and mitigating the impacts of these other agents of global change can not be delayed.

Fifth, the impacts of these other changes would be much worse, but for improved productivity and better utilization of natural resources. Increases in the productivity of agriculture and forestry over the last few decades have done more to slow land conversion, and preserve habitat and carbon sinks than all the other protection measures put together, including establishment of fully or partially protected areas. Analysis of the changes in global land use and land cover from 1950 to 1989 indicates that mainly because of increased productivity, while population doubled (from 2.6 to 5.2 billion), cropland increased only 26 percent (from 1.17 to 1.48 billion hectares). (See the Table and Figure). Cropland per capita declined from about .46 to .28 hectares even though per capita food and protein consumption increased significantly over that period.[3] While an environmental price has been, and continues to be, paid for the increases in agricultural productivity, absent those increases, the demand for cropland would have increased to at least 2.39 billion hectares, i.e., an additional .91 billion hectares would have been converted from forest, wood, pasture and grass lands--an amount equivalent to the net global loss of forest and wood lands between 1850 to 1980. By contrast, globally there are .65 billion hectares set aside as fully or partially protected areas (excluding Antarctica).[4]

U.S. experience from 1910 to the present (1988) is similar. Even though population increased two-and-a-half times and exports in 1988 accounted for about 40% of agricultural production, the amount of land harvested was virtually unchanged (300 million acres) because of technological change. Absent that, at least four times as much land (about 1200 million acres) would need to be harvested. That is more than three times the total amount of reserved area in national parks, refuges and forests.[5] It is also more land than the sum of arable and forested lands, i.e., absent such change virtually all productive land would be in agriculture, with drastic consequences for U.S biodiversity.[5]

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[2] Goklany, I.M., "Adaptation and Climate Change," presented at the 1992 Annual Meeting of the American Association for the Advancement of Science, February 6-11, 1992.

[3] Between 1961 and 1989, daily per capita calorie intake for the world rose from 2259 to 2649, and protein intake rose from 59.5 to 66.3 grams (<u>1991 Country Tables</u>, FAO, Rome, Italy).

[4] <u>World Resources 1992-93</u>, World Resources Institute, Washington, D.C., p.298.

[5] Goklany, I.M., and Sprague, M.W., "A Different Approach Toward Conserving Forests, Habitat and Biodiversity: Increasing the Efficiency and Productivity of Land Utilization", Office of Program Analysis, U.S. Department of the Interior, Washington, D.C., Dec., 1991.

Clearly, technological change while unable to halt land conversion, has so far--arguably--averted catastrophe by substantially holding down losses of forests, habitats and biodiversity.[6] But the worst is yet to come: in the next century, human demands on land and water resources could increase between two to six times if, as is expected, the world's population more than doubles and the average person becomes wealthier.[7] Yet technological change is not pre-ordained. There is no guarantee it will necessarily come to our future rescue as it did in the past. Hence, it is essential to implement measures that would increase the likelihood of maintaining, if not accelerating, into the future the current pace of technological change in the use and management of natural resources.

Such technological change must also be consistent with the principles of sustainable development. It should cover all facets of natural resource production, delivery, utilization and consumption so that human needs are met using as little land and water as is practicable. With respect to land, as noted, this will reduce conversion to human uses, preserve habitat, and conserve biodiversity as well as carbon sinks. Similarly, making water use more efficient will reduce the diversion of water from in-stream uses such as maintaining populations of fish and other species, and recreation.

Sixth, vulnerability of a nation to climate change depends as much, if not more, on its wealth than on merely the degree of climate change it would experience. Thus, the poorer developing nations and the erstwhile centrally planned economies are more at risk from climate change, because lack of financial and technological resources makes adaptation harder.[8] And as the Brundtland Commission noted, poverty is also a major barrier to sustainable development. Moreover, greater wealth generally results in reducing a nation's economic dependency on natural resource sectors which further reduces its vulnerability to climate change. Sustainable economic growth in developing nations could also reduce the rate of population growth faster and, in turn, moderate future greenhouse gas emissions and demands on natural resources. Greater economic growth will also make mitigation measures more affordable. Hence, sustainable economic growth and reducing poverty are musts.

So, are there measures that (a) are not site-specific, (b) reduce vulnerability of human and natural systems to climate and global change, (c) increase our ability to feed, clothe and shelter expanding populations, while reducing losses of forests, habitats and biodiversity, (d) are compatible with strategies to limit climate change, (e) have clear benefits today and in the future, and (f) can be implemented in short order? Indeed, there are. These are the measures necessary to help maintain and, where appropriate, develop and establish the institutional, legal and economic frameworks that would assure:

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[6]This is not to say that all technologies' consequences are beneficial, e.g., overuse of fertilizers and pesticides creates water quality problems which are detrimental to biological resources, without providing commensurate agricultural benefits.

[7]See references cited in footnotes 2 and 5.

[8]See the references provided in footnotes 2 and 5. Also see The IPCC Response Strategies, IPCC Work Group III Report, Island Press, Washington, DC, 1990.

- Technological change to ensure greater productivity and efficiency in the sustainable production, use and development of natural resources, and

- Sustainable economic growth while conserving fragile finite resources.

Fortunately, there is a remarkable congruence between the frameworks needed to stimulate both technological change and economic growth. It is probably no accident that the most economically advanced nations also the major contributors to technological change.

In general these frameworks should be based upon the following general principles:

- The political, economic and legal institutions should foster a free market system which rewards individuals and innovators for their endeavors.

- Everyone involved in each aspect of the management and use of land and water resources (i.e., production, distribution, processing, storage or consumption) should have an economic incentive in developing, adopting or utilizing innovations.

- Local communities and individuals should be provided with economic stakes in the resources they manage and depend upon, including investing them with clear property rights to those resources and/or long term tenure, and allowing voluntary transfers of those rights.

- Decision-making on resource use and management should be decentralized, where practicable. Simultaneously, mechanisms should be established to coordinate between adjacent jurisdictions and ensure that interests of the broader society are considered.

- Research and development of new, more efficient and productive technologies and practices should be increased.

- There should be no unnecessary or unfair barriers to research into, and development, dissemination and adoption of, new technologies. In general, laws and institutions favor the status quo through devices such as "grandfathering" existing practices and requirements for more complicated and comprehensive reviews prior to allowing new practices. These discourage innovation, and increase the life span of old and, sometimes, more polluting technologies. This is neither good economics nor good environmental policy.

- Subsidies for over-production and over-utilization of food, natural resources and other commodities should be eliminated.

- Barriers to trade should be eliminated. Trade globalizes adaptation by spreading the risk of catastrophic and non-catastrophic under-production of food or other commodities in smaller regions, regardless of its cause. It also contributes to general economic growth, particularly in developing and other less wealthy nations.

Specific approaches and greater elaboration on the general principles for such frameworks are described in more detail in the references provided in footnotes 2, 5 and 8.

Work on establishing these frameworks can not start soon enough. Each culture and society needs to develop its own particular framework. That can take decades--and considerable trial-and-error--to evolve and take hold. Moreover, the quicker the framework is fashioned; the less will be the land conversion, and losses of habitat, biodiversity and carbon sinks and reservoirs; the less the future growth of populations and greenhouse gases; the less the vulnerability to climate change; and the greater the future adaptability. In fact, even if the most ambitious greenhouse gas control program were to be immediately effective, one could win the battle but lose the war--if greater efforts are not spent on enhancing adaptability by spurring technological change and sustainable economic growth.

TABLE

GLOBAL POPULATION AND LAND USE, 1700-1989

Year	World[1] pop (millions)	Cropland[2] (10^6 ha.)	Forest & Woodland[2] (10^6 ha.)	Pasture & Grassland[2] (10^6 ha.)
1700	679	265	6,215	6,860
1850	1,286	538	5,919	6,350
1900	1,712	773	5,749	6,286
1920	1,895	913	5,634	6,260
1930	2,109	999	5,553	6,255
1940	2,339	1,085	5,455	6,266
1950	2,565	1,169	5,345	6,293
1960	3,050	1,278	5,219	6,310
1970	3,721	1,409[3]	5,103	6,308
1980	4,479	1,454[3]	5,007	6,299
1989	5,238	1,476[3]	N/A	N/A

[1] 1700 data from Demeny, P., "Populations", in The Earth as Transformed by Human Action, ed., B.L. Turner II et al., Cambridge, UK (1990), p. 42. Remainder from Peggy Seybolt, U.S. Bureau of the Census, Division of International Statistics, personal communication, October 1992.

[2] 1700 data from Richards, J.F., "Transformations of the Global Environment" in The Earth as Transformed by Human Action, ed., B.L. Turner II et al., Cambridge, UK (1990), p. 164. Unless indicated in footnote 3, remainder from World Resources 1987, World Resources Institute, Washington, DC, p. 272.

[3] 1991 Country Tables, Food and Agricultural Organization, Rome, Italy.