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IPCC WORKING GROUP III
RESOURCE USE AND MANAGEMENT SUBGROUP

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LAND USE MANAGEMENT: ADAPTIVE RESPONSES TO CLIMATE CHANGE

(Submitted by the co-chairmen of the Resource Use and Management Subgroup of IPCC Working Group III)

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

SEP 13 1989

ear Colleague:

ttached is a working paper produced for the Resource Use and anagement Subgroup of the Intergovernmental Panel on Climate hange's Response Strategy Work Group identifying various easures for adapting to the effects of climate change on land se management.

Similar to other papers, this does not address each measure's cost and effectiveness; its social, environmental and economic consequences; the legal and institutional hurdles to its adoption or methods to reduce these hurdles. Nevertheless, the measures identified in this draft paper seem reasonable options for further evaluation in the context of the U.S. Your comments -- especially on whether these options are suitable for evaluation in the context of other nations -- would be invaluable. I expect you would bring your comments to the scheduled October 30 - November 1 workshop in Geneva.

I may be contacted at the Department of the Interior, Mail Stop 4412, 18th and C Streets, NW, Washington, DC 20240 (telephone (202) 343-4951; fax (202) 343-4867). 20240 (telephone (202) 343-4951; fax (202) 343-4867).

Sincerely,

Indur M. Goklany
Executive Director,
Departmental Working Group
on Climate Change

Attachment

Celebrating the United States Constitution

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Working Paper
prepared for the
Resource Use and Management Subgroup of
Working Group 3 of the
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Contents:

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1. **Introduction**

Climate change could alter the physical suitability and economic viability of land for different uses in many areas. Adjustments, including changes in land use and management practices, will be made in response to changing climatic conditions and population growth rates. In open market economies, many of these adjustments will made by private resource managers who are guided by market incentives (changes in prices and cost). Yet, many land use decisions have environmental and social consequences that are not considered in private benefit-cost calculations.

One of the government's goals in the management and planning Of private lands in a market economy is to induce private resource managers to consider the external environmental and social consequences of their land use decisions. In the management and planning of public lands, the government must consider the environmental, social and economic consequences of its own management decisions.

This paper outlines the increased pressures on land use that could result from global climate change and suggests planning and management options for minimizing conflict. It also makes suggestions for helping rapidly growing populations meet the demand for land for various human activities, while assuring conservation of the environment and maintenance of biological diversity.

2. **Current Pressures on Land**

The effects of increasing greenhouse gas concentrations and associated climate change on land use must be considered against a backdrop of rapidly increasing population growth. Such growth alone will result in increasing demand for food, fiber and forest products, and living and recreational space. These demands increase pressures to (a) remove more land from its natural state, in turn, increasing pressures on less

intensively managed habitats, biodiversity and ecosystems and increasing atmospheric concentrations of carbon dioxide as forests are converted to other land uses, (b) adopt more intensive land uses that could increase soil erosion and farther degrade water quality, and (c) convert agricultural and other lands to urban and suburban uses.

3. **Additional Pressures Resulting from Climate Change**

Increasing greenhouse gas concentrations and associated global climate change could affect patterns and intensity of land use in significant ways. Ranges for most managed and unman aged ecological systems could shift poleward, tracking the poleward movement of suitable climatic regimes. At this time, however, the precise direction or distance of migration of species cannot be predicted. While such changes in ranges provide us information on possible shifts in ecological systems, they cannot easily be translated into specific changes in uses of land for agriculture, forestry, or other purposes. Unman aged ecosystems could be at the greatest risk if climate zones shift poleward faster than many species can migrate, resulting in reductions of ranges and populations. Current land use patterns could change: some areas which today are used for agriculture may become unsuitable for that purpose or change in the intensity of use because of changes in climate or availability of water; for the same reasons, other areas which are not today used for intensive agriculture may be able to support it in the future. Where agriculture remains viable, crops or cultivars may change to optimize expected farm income. The demand for lands for human settlement may be affected: some coastal areas may become uninhabitable in the event of sea level rise; areas in the higher latitudes may become more hospitable for human habitation. In some areas current land uses may be continued only if relatively expensive measures are taken to mitigate the effects of climate change; in other areas, adapting the land to new uses may result in a net social benefit.

4. **Adaptation Measures**

To meet the various demands on land and to preserve lands for conservation of natural resources under future climatic regimes, governments may need to consider more intensive efforts to achieve economically efficient and sustainable land use. Adaptive responses to climate change should optimize socioeconomic welfare and growth subject to environmental constraints and operate in concert with any strategies that may be employed to limit the growth of greenhouse gases. Emphasis should be given to responses that remove barriers to rapid and

efficient adaptation, identify decisions with long-term consequences, maintain flexibility in resource use and management where possible, limit costs and administrative burden, and promote public input and acceptance. Adaptive measures that meet the above objectives are described below under three general strategies for adapting land use to climate change.

a. Consideration of Climate Change in Land Use Planning. Effective adaptation to climate change is largely dependent on the integration of information on the impacts of climate change with long-term land use planning activities. Specific adaptive measures could include:

i. Inventory. Resource managers could use information on the current state of resources to analyze what is vulnerable to climate change and what might be done about it. Inventories, which describe the current uses of land, such as now exist in the U.S., would be of value. Developing such inventories, where they do not exist, would be a useful step regardless of climate change.

ii. Assessment. Based on the above inventories of natural resources, land use, and current stresses, resource managers could examine vulnerabilities of natural resources to climate change, assess how various resources and land use patterns could be affected by increased greenhouse' gas concentrations, and identify potential land use conflicts resulting from climate change.

iii. Maintaining flexibility in land use. The uncertain, but potentially significant, shifts in land use suitability associated with climate change argue for building flexibility into land use decisions. Nations could explore methods of making future land use more flexible and adaptable to climate change. Such flexibility might allow for switches in land use practices to activities that are expected to provide the highest social values under future climatic regimes. For instance, programs designed to acquire and manage recreation or conservation areas should have the capability to adjust to shifts in the needs for –- and suitable locations of -- these areas. Greater use of property easements is one way for maintaining flexibility in land use. More flexible methods of acquiring, developing and managing areas to be set aside for fuel wood, forage production, and expanding human domicile needs (including recreation and other amenities) within or in close proximity to existing human settlements should be explored.

However, any methods of increasing the flexibility of land use must be consistent with the principle of fair and equitable compensation to land owners.

b. Enhanced Conservation Efforts for Vulnerable Resources.

Some marginal ecological or agricultural systems and over-drawn water basins could be further stressed by climate change, while others may become more viable. Various initiatives should be explored for conserving the most sensitive and valuable resources, including:

i. Strengthening, enlarging, and establishing conservation corridors between protected natural areas. Protected area enlargements could be beneficial for the maintenance of biodiversity and recreation opportunities; poleward or up-slope additions in ecotone regions could be particularly beneficial under a warmer climate. Conservation corridors, such as greenways, river corridors, trails, hedgerows along the edges of fields, and transportation and transmission corridors could serve to facilitate migration of species as well as increase the degree of protection to the species involved. This too would be more beneficial to ecotone areas. In addition, corridors could enhance the capacity for species to shift distributions in response to climatic change. One potential problem is that, given the uncertainties about regional climate change, the eventual direction and magnitude of dispersal cannot be predicted with certainty. An approach to be explored is to set aside protected areas with concentric buffer zones of protection (e.g., as in biosphere reserves). The innermost zone could be the most protected, with successive outer ring allowing more human use and occupancy. Such a design would also consider the possibility that species in the highly protected zones could migrate out of the area in response to climate change. In many cases strengthening of existing protected areas through the provision of greater financial or managerial support or increasing the economic and emotional stake of local communities in protected areas (see below) may be the best management approach. In any case, the social and economic consequences of designating lands as protected areas should be considered.

ii. **Managing Development of Highly Vulnerable Areas.** Certain areas that are already under stress, such as erodible farmland, heavily used water basins, and unprotected natural areas, may be particularly sensitive to climatic disturbances. In some currently stressed areas,

climate change could relieve existing pressures. Assessments of the potential impacts of climate change, as discussed in section 4.a.ii, would help identify which areas could be subject to increased stress. Future development in areas that may come under increasing stress should be carefully managed using such means as: regulation of development, purchase from the owner or payments to the owner, tax incentives, and impact charges. The Conservation Reserve Program in the U.S., where farmers are paid to take marginal and highly erodible lands out of production, is an example of a means of protecting vulnerable resources. As for all responses, social, economic, and environmental consequences must be considered.

iii. Increasing the economic and emotional stake of surrounding populations in conservation, preservation and recreation areas. Without strong ties to the protected area, populations may have a strong incentive to respond negatively to altered land use demands caused by climate change, resulting, in some cases, in destruction of protected areas.

c. Adoption of Sustainable and Efficient Land Use Management. Improving conservation and efficiency in land use management may increase the resiliency of agricultural, forest, grasslands, and water basins to climate change by easing the total amount of stress on land and reducing demands for development of new lands.

i. Promoting resource conservation and sustainability in agriculture, forestry, and water use. Conservation practices could increase the resiliency of resources to climatic stresses by moderating local climates, promoting water retention, decreasing soil erosion, increasing genetic variability, and reducing other stresses from environmental degradation, assuming static populations. This may allow for the maintenance of long term productivity. Particular attention might be given to reducing deforestation, improving water use efficiency, and increasing the use of sustainable agricultural practices. The cost of alternative land uses should reflect the true social costs to ensure that land use decisions reflect such externalities as ecological damages and infrastructure improvement. Also, analysis of land use options should consider factors such as simultaneously accomplishing floodplain hazard reduction, wetland and fisheries protection and a migration corridor.

ii. Encouraging efficient use of land for agriculture, forestry, and human settlements. (See Biodiversity and Agriculture/Forestry papers). This could be done by (a) encouraging technologies and practices which increase efficiency while assuring adequate environmental quality; and (b) by reducing direct and indirect subsidies to agriculture, forestry, and development of human settlements, such subsidies can cause overproduction and conversion of marginal lands to agriculture and development).

iii. Improve long-term storage, food distribution and storability of agricultural products. Improved methods of storing and distributing food and agricultural products, supplemented by methods of minimizing storage losses would lessen the severity of future food-deficits, whether or not caused by climate change, and would reduce pressures for additional land for food production, thus enabling the world to cope with rapidly growing human populations.

iv. Encourage efficient and environmentally safe levels of agricultural and forest practices, and location and densities for human settlements. Government review of practices, products and technologies that enhance agricultural and forest productivity and efficiency of land use for human settlements should proceed expeditiously while balancing the potential benefits of such reviews against the costs of delays. Such reviews must carefully evaluate environmental and health impacts, yet still meet the needs of rapidly growing human populations. In some areas, changing zoning to allow higher population densities would slow the amount of land devoted to human settlements and result in less agricultural land taken out of production. Reduction of zoning barriers to increased density would also make more efficient energy use possible by, for example, increasing the economic feasibility of mass transit and district heating and cooling. Enhanced research and field trials are necessary to improve identification and dissemination of new production technologies which take into account all externalities of production usually left out of the resource management calculus (e.q. soil erosion rates, net emissions of greenhouse gases, deleterious side effects of pesticide use on wildlife). In addition to local environmental effects, environmental reviews should take into consideration broader effects such as net efficiency of land use.

v. Research and development of technologies for improving the efficiency of agricultural animal husbandry *I* and forestry and incentives to enable their rapid adoption.

a. R&D efforts that result in more efficient land use could help in coping with new stresses from climate change by reducing land use demands. Both public and private enterprises should engage in research and development directed to more efficient forestry and agricultural practices and biotechnological innovation. Governments should take measures encouraging such R&D while ensuring that such work is conducted in a manner consistent with public health and safety. Nations may consider developing innovative institutional, legal and financial measures which would take advantage of innovation, including measures that would allow innovators to profit from their R&D, e.g., patent protection. Nations might also consider institutional, legal and financial measures which would encourage individuals and communities to develop an economic stake in efficient and environmentally sound land use and development.

b. Increasing the rate of dissemination of research results and technologies to users (e.g., farmers and foresters) to enable them to quickly adopt new crops, practices, and technologies. The United Nations, the World Bank, and other institutional and bilateral agencies provide a framework through which technical and other assistance could be provided to developing countries and regions. An information dissemination service that gets information to farmers, foresters, and other land users would also be beneficial. One model for this is the Extension Service developed and operated by the U.S. Department of Agriculture.

5. **Jurisdictional Issues**

a. Decentralization.

In some cases it may be useful to invest local organizations with clear responsibility and authority for coordinating land use planning that reflects the likely impacts of climate change and rapidly growing human populations. Land use planning efforts should incorporate climate change concerns and operate with full participation of concerned organizations and interests. Nations should consider methods such as "impact" payments and other

schemes to satisfy the concerns of local communities with respect to uses which, while beneficial to the larger society, may not be desirable from the local perspectives.

b. Enhanced Coordination.

Ideally, land use planning should be conducted at the local level. Nevertheless, since climate change could exacerbate conflicts between competing resource uses, increased coordination between managers of different programs (e.g. biodiversity, agriculture, forests, water supply), between public and private resource managers and between all levels of government could become more beneficial. In a changing climate, it may become more important for government bodies with jurisdiction over different geographic areas and uses to coordinate land use policies. For example, agriculture and parks managers should confer where their interests overlap. Coordination might usefully be extended to large areas to incorporate potentially major shifts in land use. Opportunities to strengthen the institutional mechanisms for such coordination could be explored.

6. Research on Socioeconomic Consequences of Responses to Climate Change.

Research should be directed towards better understanding (a) the social, environmental and economic consequences of action or inaction regarding greenhouse gas concentrations, and (b) the issue of the types and timing of responses by nations at different stages of development.