SUMMARY

This is a discussion of human experience in major ecosystem modification using man-made lakes as an example. Such modification inundates land and not only suddenly changes a riverine environment into a lake, but has far-reaching effects upstream, downstream, and on the surroundings. Accompanying transformations affect the earth's crust, the regime of water quantity and quality, biological production on land and in the water, and social and economic welfare of people — most importantly the relocatees. These transformations are considered for their bearing on feasibility studies, on the planning and construction of the dam, on the short-term period of first filling and instability of the lake, and on the relatively stabilized long-term condition that follows. Deficiencies in past practices and needs in research and policy are identified, and recommendations are made that involve public policy, intergovernmental support, and scientific cooperation.

The ecosystem of a man-made lake is the product of its interacting component systems, principally atmospheric, hydrological, biological, and socio-cultural. The creation of such lakes has accelerated in the past score of years as a part of man's effort to manage water resources. Many benefits have accrued in water storage, hydroelectric power, flood control, navigation, irrigation, fisheries, and various forms of recreation. There have been significant ecological and social costs as well.

Identifiable stages in the life history of a man-made lake are:

(I) feasibility study and consideration of alternatives;

(II) planning and construction;

(III) initial filling with water and stabilizing; and

(IV) stabilized.

Decisions to build dams are based on feasibility studies of varying degrees of depth and precisions. They may be taken without due consideration of alternative means of attaining social goals, and often the socio-economic impacts of dams and their reservoirs are not integrated into the fabric of national or regional life. The most direct social costs and gains are experienced by relocated people and the host populations among whom they are resettled. Because of deficiencies in social investigation or its application, the full impacts of relocation on both the socio-cultural system and the habitat are not anticipated. The attraction of the lake shore for residents and for voluntary settlement by fishermen is often underestimated.

Many dam-related problems of the hydrologic system have proven to be manageable through use of increasingly effective models. The physical dimensions of the new water body and its discharge are predictable in most instances.

However, the mechanics of biological production in reservoirs, especially in the tropics, are poorly understood. Management of the fishery potential, for example, is still largely empirical. This has resulted in difficulty in assessment of fishery values during feasibility studies, and has stimulated efforts to develop practical indices of fishery potential and to attempt predictive modelling.

Conflicting with contact uses of water in reservoirs, particularly in the tropics,

have been water-borne or water-organism-vectored diseases and invasion by aquatic nuisance plants.

The effects of man-made lakes on the immediate shore, from the point of view of biological production on the land, including agriculture, are even less well understood. Here, developmental procedures have been largely fortuitous.

The problems encountered in the modification of river systems by dams lead to the following recommendations for public action.

RECOMMENDATIONS

PUBLIC POLICY

1. **Assessment of Alternatives** - Any decision to build a man-made lake should be based upon a comparison of its likely effects with those which would result from other technical or social actions to reach the same public goals.

2. **Canvass of Impacts** - Any decision to build a man-made lake should include an attempt, however rudimentary, to canvass the full consequences of the dam and the new lake — consequences in the socio-cultural system and in those of the earth's crust, hydrology, and biological production in the water of the reservoir, upstream, downstream, and in the surrounding land.

3. **Consultation with the People Affected** - Such assessment should treat the people directly affected by the reservoir as a dominant part of the ecosystem to be transformed, and should involve them appropriately in the decision-making process.

INTERGOVERNMENTAL SUPPORT

4. **Criteria and Impact Statements** - Criteria for appraising proposals for feasibility study and financing of new dams and lakes, should be developed on a cooperative basis by the governments and intergovernmental agencies concerned. in order to assure that broad impact considerations, including social impacts, are a part of any new financing proposal.

5. **Early Warning System** - The present informal « early warning system » of the United Nations Development Programme should be extended to include all intergovernmental agencies, not only to improve awareness of opportunities to offer assistance in feasibility studies but also to create a new service of teams of advisory specialists and to assist in building suitable competence in the planning and financing agencies.

6. **World Register, Classification, and Global Evaluation** - An international register of all man-made lakes authorized for construction or completed, with an area of more than 100 km^2, should be established and maintained by an agency having ready access to national planning activities, with the ICSU Committee on Water Research to be requested to advise on the register and on a problem-oriented classification based on major factors affecting the quality and quantity processes that are known, and with SCOPE to use the register as a basis for assessing trends and magnitude of the effects of the earth's man-made lakes on the global environment.

7. **Clearing House Service** - An international clearing house service on current scientific investigations on man-made lakes should be developed for the exchange of information in order to expedite interdisciplinary collaboration.

8. **Training** - Intensive training courses should be provided for national and international administrators, scientists, and technicians who are seeking to further interdisciplinary work on man-made lakes, to be organized in cooperation with the responsible agencies.

SCIENTIFIC COOPERATION

9. **Scientific Cooperation** - In order to strengthen scientific competence in dealing with the problems of man-made lakes, it is recommended that SCOPE take steps to encourage action along the following lines:

a) A compehensive, sustained effort to construct models involved in the evolution and the management of man-made lake ecosystems, as a means of improving predictive capability.

b) Thorough application of benefit-cost analyses to impacts and planning of sample man-made lake projects as a means of refining the present crude methodology.

c) Pilot demonstrations of instrumentation, data processing, analysis, and automated monitoring of a major man-made lake to test the practicability and value of such efforts in other areas.

d) Preparation by a study group of exemplary social impact statements for a man-made lake proposal, including assessment of the role and cost of baseline studies and of the problems of making judgments with inadequate data.

e) Design and supervision of a pilot community to demonstrate new production systems for relocatees and other lake basin inhabitants, including training, extension, and continuing evaluation.

f) Special international reviews of ways of improving research on interdisciplinary problems of high importance in predicting transformation in man-made lakes with particular reference to:

1) the effects of water balance and watershed management on flow conditions and biological production;

2) the effect of aquatic vegetation on physical, chemical, biological, and human-use aspects of man-made lakes; and

3) the manner in which new technology, social organization, and livelihood are diffused among lake basin populations.