also reduced. However, as flow in a dammed river is slower the duration of the ice cover is longer and the problems of ice jams may occur in cold climate areas. The effect of strengthened wind can also be considerable. In comparison to road, rail and plane transport, water transport is the cheapest option, the least polluting and does not require very expensive and ecologically-unfriendly infrastructure (motorways, railways).

Reservoirs change the landscape. They may adversely affect the original natural scenic beauty. This is often a strong argument against large projects nowadays. However, reservoirs may also offer a new, welcome, landscape dimension. Constructing a reservoir may create new wetlands, water habitat for flora and fauna, including pisciculture, facilities for recreation, and a new landscape dimension which is aesthetically pleasing. It can also serve to improve water quality (low flow augmentation, dilution of pollution, assuring biologically inviolable flow, salinity control, flushing accidental contamination, recharge of groundwater). A specific flow regime which can be controlled due to a reservoir may be desirable because of the requirements of biota, scenic and recreational purposes, historical interests or religious activities and cultural events.

3.3 FINAL REMARKS

Sustainability considerations require a comprehensive assessment of costs, benefits and impacts, including side effects, delayed and cumulative impacts for all alternative feasible options (both "reservoir" and "non-reservoir" ones). The internalization of costs of damage to the environment, remediation and safety is necessary.

Reservoirs are built to serve important uses. However, they are not free of adverse effects which sometimes can be very critical. It is essential to foresee and assess the adverse effects in each particular project and to account for them in the decision process. Perhaps the most significant common impacts are the direct effects of an impoundment, such as; following the loss of land due to inundation, the involuntary relocation of people, the loss of cultural property and historical heritage and the disturbance to the ecosystems.

Traditionally, development planning used to follow a "top-down" scheme as objectives and activities were often defined by experts of central authorities. Construction of several large reservoirs has been important for political reasons. They serve as a demonstration of power (the monument-building syndrome) aimed at enhancing safety and robustness, capability of accommodating vagaries in the natural variability of weather and wetness conditions, and liberating humans from such calamities as floods and droughts. They follow the spirit of the philosophy—"Man conquers Nature", "Nature obeys Man". Bandyopadhyay & Gyawali (1994) quoted a prominent

politician from Nepal who had declared publicly at a mass meeting that his country "will be like Singapore if we could implement Pancheswor and Karnali hydroelectric projects".

A statement which has been attributed to great leaders of nations, Napoleon and Churchill, is that every single drop of water flowing in the Nile should be retained and used rather than being wasted in the Mediterranean. This attitude proves that these leaders appreciated the high value of water but their judgements were a one-sided oversimplification of a complex situation.

Recently, the structure of water resources planning has been re-thought to enhance the participatory approach. Action programmes may be initiated at the local level. Local participation in the decision-making process in matters of sustainable development and consensus building are essential. If a need for a water supply extension is envisaged, it is necessary to agree upon the approach to be chosen; whether a reservoir, water transfer, or just increased water saving measures, such as for instance pricing or water re-use enhancement. Those affected by the project need to be involved in the process of planning and decision making for new reservoir construction and operation of both existing and new reservoirs. They should be adequately informed, their opinion canvassed and by taking part in the decision-making process they should accept the solution as their own and feel a kind of responsibility. A broad consultative process and persuading a large part of the society to support the concept may ease its implementation. Subsidiarity principles and a participatory approach help to internalize measures and to promote efficiency and savings thanks to community control. In order for the participatory approach to function properly, more information is needed for the general public about dams and reservoirs, their advantages and disadvantages and also the pros and cons of other, non-reservoir alternatives.

Decentralization and an increase in the participation of stakeholders is very welcome (local authorities, private ownership, cost sharing). However, participatory approach and consensus building are terms easier said than done. Even in negotiation between government agencies the need for a difficult compromise solution, reflecting different priorities, may not come about.

Due to the complexity of impacts, siting reservoir projects is continuing to raise much concern. In fact, two types of sites are relatively easily acceptable. The first type are canyons in which reservoirs do not rise above the top and streams with waterfalls that fish never ascend, i.e. where problems concerning migratory fish do not exist. The second type are in-stream, low head axial turbines projects, where no flooding is involved. Such a site has a relatively low volume of biomass, whose decay neither contributes significantly to greenhouse gases nor impairs fish and water quality.

Large dams are in practice irreversible. There is a need therefore for flexibility (prudent stepwise design policy). Collingridge (1980) distinguished four technical indicators of inflexibility: capital intensity, large scale, long lead time, and major infrastructure needs early on.

In order to enhance flexibility one strives towards consideration of alternative designs of reservoirs. Comparing alternative designs: different locations, different construction options, different sizes, one may arrive at the most acceptable and sustainable solution. Specialists studying the possible climate change impacts recommend that in order to cope with overwhelming uncertainties, flexibility of the project should be enhanced. A dam should not be constructed now in anticipation of being needed in several decades. However, if it is being built now, it may be useful to "design-in" the possibility of further augmentation, should the need arise in the future.

Synghal (1994) compared two alternative plans proposed independently by different agencies for the same region in South Asia. The first plan with one large reservoir was compared to a more decentralized plan with 34 reservoirs. The latter option, while better in terms of higher flood storage, surface water area for recreation, and lower area of inundated bottom, costs only one third of the centralized option. The only advantage of the large reservoir over the set of smaller units was in energy production.

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