

## **Balancing the costs and benefits of dams: an environmental perspective**

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**SYNOPSIS** While dams have brought many benefits, they have also caused major environmental impacts, especially on freshwater ecosystems which are suffering a serious decline. This paper explores how the benefits promised by dam schemes can be gained without excessive, unacceptable environmental costs, with a particular focus on Europe. The Spanish National Hydrological Plan is used as an example of an ill-conceived, unbalanced scheme. The paper then looks at examples from Zambia and Switzerland to show how mitigation measures can reduce the impacts of some dams, while still maintaining economic benefits. The paper promotes the decision-making framework of the World Commission on Dams as the way forward.

### **INTRODUCTION**

Dams have played an important role in development for centuries, if not millennia, and have created a range of socio-economic benefits (WWF, 2003a). However, the World Commission on Dams (WCD) found that these benefits often come at an unacceptable and unnecessary environmental and social cost (WCD, 2000). Perceptions as to what is acceptable or not vary between different sides of the dams debate. While economic cost and benefits are relatively easy to calculate in financial terms, environmental costs are often less quantifiable, thus making it more difficult to arrive at a balanced assessment of all costs and benefits. To some extent, the same applies to social costs, although when it comes to the displacement of people or loss of agricultural lands, such costs are easier to calculate.

The environmental impacts of dam projects can be wide-ranging and diverse. Some impacts are directly related to the construction phase and flooding through the reservoir. Downstream impacts from the operation of dams can be significant. Major impacts can also be caused by civil works such as access roads and power lines. In many cases, some of the worst effects can be avoided through mitigation measures, yet sadly such measures are not applied universally. Unnecessary costs can also be caused by

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the failure to carry out a comprehensive options assessment (as proposed by the WCD), resulting in the construction of dams where there may have been suitable alternatives, such as demand side management.

Not all impacts can be mitigated and in the worst case, they can result in the destruction of unique habitats or even species extinction. Such cases are likely to be considered 'unacceptable costs' - not only by environmental organisations but also by key decision-makers. For example, the World Bank uses the loss of endangered species as a key criterion for evaluating dam projects.

### VALUING ENDANGERED SPECIES

According to WWF's Living Planet Report, the world is currently undergoing a very rapid loss of biodiversity comparable with the great mass extinction events that have previously occurred only five or six times in the Earth's history (WWF, 2002). In the last 30 years, freshwater species have seen a particular serious decline, with 54% of 195 indicator species showing a population decline. Dams are one of the factors in this decline, in particular through their effects on fish migration and impacts on downstream wetlands.

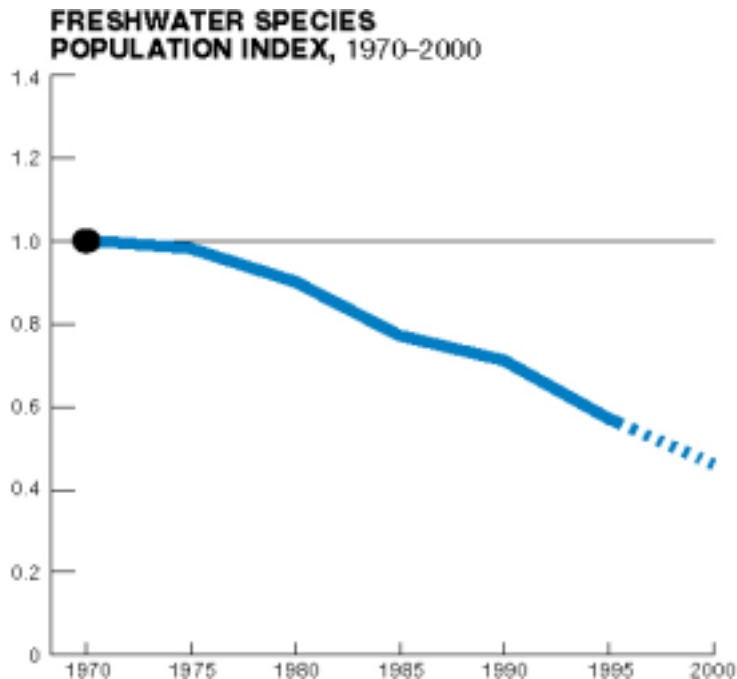


Figure 1: Freshwater species decline (from WWF, 2002)

Some dam sites are particularly threatening as far as endangered species are concerned. One extreme case is that of the Kihansi spray toad (*Asperginus*

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*nectophrynoides*) which lives only in the fine mist created by the cascading waters of the Kihansi Falls in the Southern Udzungwa Mountains of Tanzania. Diversion of the Kihansi River for power production resulted in the threat of global extinction for the spray toad and possibly other species in the Gorge. The original EIA failed to look at the downstream impacts of the dam, which was obviously a major omission. Mitigation measures (i.e. spraying the toads' habitat artificially) have resulted in a loss of 15 MW of capacity at the 180 MW plant. Saving the toad has thus come at a considerable economic cost.

But how do you value the survival of a unique species of toad? Clearly, one cannot put a monetary value on such a species. The Convention on Biological Diversity, ratified by 188 countries, recognises the intrinsic value of biodiversity and requires the promotion of viable species populations. In Europe, habitats and species are also protected by a various national and European Union (EU) legislative measures, as discussed below.

### EU ENVIRONMENTAL PROTECTION

In Europe, there are currently around 5500 large dams in operation. Few European rivers (or stretches of them) are unregulated and there has already been a major freshwater habitat loss. At the same time, environmental protection is high on the agenda in many European countries, hence new dam proposals are often met with considerable opposition.

With the expansion of the EU in 2004, the majority of European countries (including those who aspire to future membership, such as Turkey) will have to conform to EU environmental legislation. In principle, this legislation will provide clear guidance as to where dam projects might be acceptable. Key legislative measures in this context are the Birds (79/409/EEC) and Habitats Directives (92/43/EEC), as well as the Water Framework Directive and the Environmental Impact Assessment Directive. In the future, the Strategic Environmental Impact Assessment Directive (2001/42/EC) will also play a role for programmes and plans.

Under the Water Framework Directive (2000/60/EC) member states are expected to prevent the deterioration of surface waters. This should in principle protect sites that achieve good or very good ecological status. The Habitats Directive requires member states to prevent the deterioration of natural habitats and the disturbance of species in designated areas (so-called Natura 2000 sites), which should mean protection from developments such as dams. However, 'overriding public interest' can be used by member states as a way out. Despite these ambiguities in European legislation, habitats and species protection are a fundamental requirement that needs to

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be taken into account in siting decisions for dams in the region. Yet, as the following example shows, not all member states take this seriously.

### SNHP – UNACCEPTABLE AND UNNECESSARY

One project that stands out both in terms of its sheer scale and its infringement of European legislation is the Spanish National Hydrological Plan (SNHP). The SNHP, approved in Spanish law in 2001, consists of two parts:

- A water transfer from the Ebro River, impacting the Pyrenees, Lower Ebro basin and Ebro Delta;
- An investment programme to build more than 100 dams and associated reservoirs and canal networks throughout the rest of the country, re-routing another 35 rivers and tributaries.



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Figure 2: Spanish National Hydrological Plan (SNHP). Map of the planned use of Ebro waters in the SNHP. Spain

The SNHP is likely to have major negative environmental impacts. Following an initial assessment, WWF found that 47 of the planned dams are likely to have a significant impact on at least 46 of the official Sites of Community Importance (SCI) proposed by the Spanish Environment Ministry for the Natura 2000 network. There are 35 dams that are situated completely or partly in Natura 2000 sites. At least 126 Important Birds Areas and 86 Special Protected Areas (designated under the Birds Directive) will be affected, including at least 14 habitat types and 18 species. While the exact impact is not known in the absence, at this stage, of individual EIAs, the plan undoubtedly puts huge development pressures onto sites that should be protected under European law.

Furthermore, the Ebro Delta is currently undergoing serious erosion due to lack of sediments (held back by existing dams in the Ebro river basin). This condition will deteriorate with the SNHP because the Plan does not acknowledge the need for a minimum flow of solids.

The Plan fails to give proper recognition to alternatives such as water demand management and makes assumptions about future demand (especially from agriculture) that are unlikely to materialize. According to an independent assessment by the Third World Centre for Water Management, the SNHP in its present form cannot be justified for economic and environmental reasons and it would be a very expensive 'white elephant' (Biswas and Tortajada, 2002).

#### THE WAY FORWARD – TOWARDS GREENER DAMS?

##### Implementing the WCD in Europe

With 5500 large dams in operation, Europe has already heavily dammed most of its major rivers. However, there are still numerous new dam projects, especially in Spain and Turkey. Obviously, the development pressures (as well as water stress) in these countries are greater than elsewhere in Europe, while their storage and hydropower potential is much less developed. At the same time, those countries also have some of Europe's most valuable ecosystems.

So how can some of this potential be developed, without causing large scale destruction? Obviously, there are various requirements under European legislation, as mentioned above. However, the WCD provides additional guidance which needs to be implemented in Europe to avoid further large-scale damage.

Out of the strategic priorities of the WCD, 'comprehensive options assessment' and 'sustaining rivers and livelihoods' are particularly critical for protecting vulnerable environments.

Firstly, options assessment will ensure that alternatives to dams are given due consideration. As the example of the SNHP shows, demand-side management (energy or water conservation) can in many cases reduce the need for new supply through dams. Not every proposed dam can be replaced by a demand-side programme but there can be little doubt that the current supply-side mentality in water and energy supply needs to be redressed. This makes both economic and environmental sense.

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Secondly, 'sustaining rivers and livelihoods' recognised the importance of rivers, watersheds and aquatic ecosystems as the basis for life and livelihoods of local communities. A basin-wide understanding of the impacts of development options such as dams is crucial. WWF promotes Integrated River Basin Management (IRBM) which aims to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems (WWF, 2003b). The WFD also requires river basin management, although its implementation schedule is slow.

Under this strategic priority, the WCD also suggested the development of national policies for maintaining selected rivers with high ecosystem functions and values in their natural state. WWF has long been campaigning for the designation of free flowing rivers. For example, in Iceland, where the Kárahnjúkar hydropower plant will cause considerable damage to two glacial rivers, WWF is urging the Icelandic government to afford protection to a third glacial river, Jökulsá á Fjöllum, including its designation as a Ramsar site.

### Addressing existing dams

The WCD also stressed the need to address the environmental and social problems caused by existing dams. Considering Europe has already 5500 dams in operation, a key challenge is to ensure that they operate in an environmentally acceptable way. In the past, many dams were built without EIAs and without mitigation measures. Some mitigation measures can be introduced at a later stage, as the following two examples show.

### *Environmental flows in Zambia*

The reduction of the downstream flow of a river is one of the key ecosystem impacts of dams. Maximising the output of a dam can have serious consequences both for ecosystems and other users downstream. However, in many cases it is possible to adjust the operational regime of a dam to better meet a variety of needs. So-called 'environmental flows' provide critical contributions to river health, economic development and poverty alleviation (IUCN, 2003).

To demonstrate that environmental flows are not just the 'luxury' for rich developed nations, WWF is working with the Zambian Ministry of Water and Energy Development and the Zambian Electricity Supply Company to introduce environmental flows at the Itezhi Tezhi dam, upstream of the Kafue flats wetland. The restored flow regime will have benefits not just for wildlife but also for fisheries and cattle grazing downstream of the dam.

*Naturemade hydropower in Switzerland*

The naturemade green electricity label in Switzerland supported by WWF ([www.naturemade.ch](http://www.naturemade.ch)), accredits new and existing hydropower plants under certain conditions. To achieve the highest standard, the 'naturemade star' label, hydro plants have to meet strict environmental conditions. These include environmental flows, sediment flushing, fish ladders and protection of wetland habitats. Additionally, operators have to pay a percentage of their income into a fund for environmental improvement measures, including habitat recreation. 14 Swiss electricity suppliers have gained certification under this label.

**EUROPE'S POOR RECORD**

Despite some good examples, a recent WWF report on water management in Europe has shown key gaps in national water policies as far as dams and environmental protection are concerned (WWF, 2003c). In particular, the report identified the lack of strategies to maintain free-flowing rivers and too few regulations to monitor and reduce the impact of existing dams. For example less than 40% of the surveyed countries have obligations to maintain ecologically acceptable flow regimes downstream of dams and fewer than 30% require fish ladders or passes specifically tailored to the site and species where the dam is located. Even where these requirements exist (e.g. Switzerland, Poland, Hungary, Slovakia and Turkey), their practical implementation and effectiveness is poor and there little or no monitoring to check that measures have been put into place. So far, there is little evidence of the implementation of the WCD's recommendations.

**CONCLUSIONS**

Freshwater ecosystems are of crucial importance to human survival – they serve as spawning grounds for fisheries, as cleansing systems for pollution, and as sources for our fresh water. Nevertheless, the loss of freshwater biodiversity continues at a rapid pace. Dams are a major culprit in this process – yet the destruction caused is quite often unnecessary. While dams bring benefits in terms of water supply, electricity generation or flood control, often alternatives are available to provide the same services, sometimes even at lower cost. Where they are not available, careful siting and balanced operation can significantly reduce the impacts of dams. There can be little doubt that we need to find a better balance between costs and benefits. WWF believes that the decision-making framework proposed by the WCD points the way forward. Even in Europe, where the planning of dam projects is subject to various environmental directives, the WCD framework provides additional guidance that if adhered to, should enhance decision-making and help protect precious ecosystems.

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