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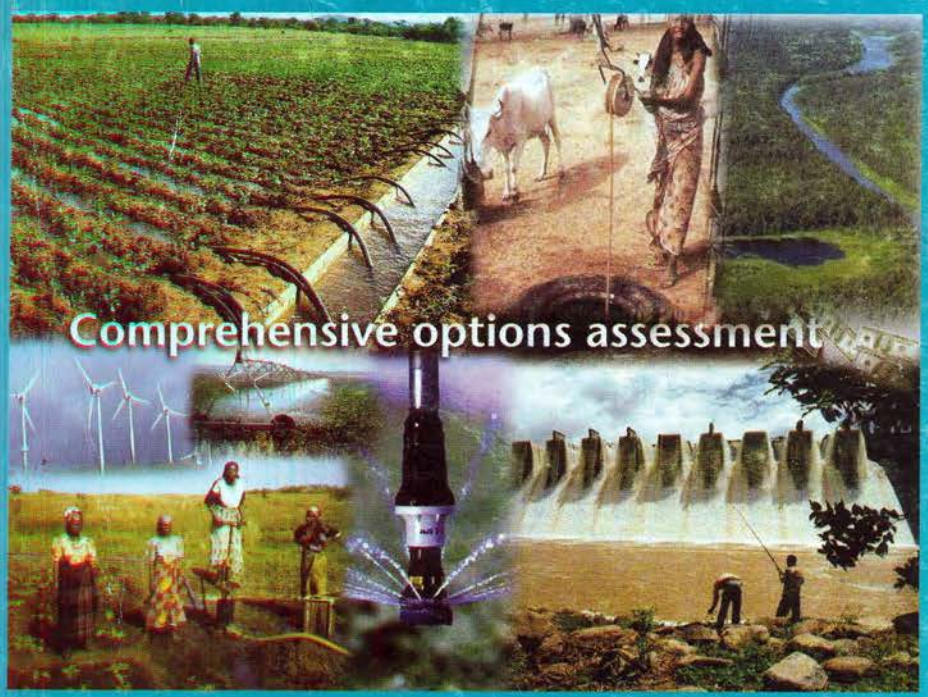
## Dams and Development Project (DDP)

# Comprehensive Options Assessment
## of Dams and their Alternatives

# CASE STUDIES

September 22-24, 2003, Geneva, Switzerland

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UNITED NATIONS ENVIRONMENT PROGRAMME

# DAMS AND DEVELOPMENT PROJECT

ISSUE BASED WORKSHOP # 1

# COMPREHENSIVE OPTIONS ASSESSMENT
## OF DAMS AND THEIR ALTERNATIVES

SEPTEMBER 22 – 24, 2003
International Conference Centre Geneva
GENEVA, SWITZERLAND

## CASE STUDIES



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**February 2004**

Layout and Printing: UNON Printshop
January 2003

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# Introduction to the Case Studies Prepared for the Dams and Development Project's Issue-based Workshop on Comprehensive Options Assessment

The United Nations Environment Programme (UNEP) Dams and Development Project (DDP) convened an issue-based workshop on comprehensive options assessment, which was the second Strategic Priority identified by the World Commission on Dams, on September 22-24 2003 in Geneva, Switzerland. One of the recommendations that came out of the workshop was that the DDP should publish and make available the case studies that were assembled for inclusion in the background document for the workshop, several of which were also presented for discussion at the workshop. The full workshop proceedings are available for downloading from the DDP's web site (http://www.unep-dams.org) or on request from the DDP secretariat in Nairobi, Kenya.

It was the sense of the workshop participants that, while these case studies represent the state-of-the- art in terms of comprehensive options assessments of dams and their alternatives, there remains a gap between aspiration and reality when it comes to implementing options assessment processes. Some of the areas where there was an identified need for improvement as expressed by workshop participants include the following. One was the need to move the process of options assessment further upstream in the decision-making process. To this extent, it was felt that cross-sectoral needs assessments at the national policy level of various countries are a necessary prerequisite to comprehensive options assessment, and that the options assessment process should begin with the consideration of national policies and programs to meet identified needs. At present, many options assessments begin only at the project level and, at this level, the technology to be used has, in many cases, already been determined. A further area for improvement was identified concerning the need for all options for meeting water- and energy-related needs to be put on the table at the outset of the decision-making process. In addition, the need was expressed for more inclusive decision-making processes that bring all relevant stakeholders to the table. Other issues, concerns and opportunities that arose during the workshop are described in the following proceedings.

The case studies presented therefore reflect more the state-of-the art than the ideal, best practices for options assessment. They are offered in the spirit of sharing lessons learned, both successes and failures, and of helping to identify challenges and opportunities to improve decision-making regarding dams and sustainable development.

It is expected that these case studies, in tandem with the proceedings of the workshop on comprehensive options assessments, will contribute to more transparent and participatory decision-making processes and, therefore, to improved development outcomes.

# A Study of A Comprehensive Solution to the Problems of the Wloclawek Dam and Reservoir: Anticipated Social, Economic and Environmental Effects

(full study in Polish, only an overview available in English: www.wwf.pl)

WWF Poland Programme, 2001
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**Key words:** multi-criteria options assessment, alternatives to the Nieszawa Dam, assessment of economic, social and environmental impacts, Vistula River

## Geographical and socio-economic background of the region

More than half of Poland's land area is situated within the basin of the Vistula which, at 1047 km, is the longest river in Poland. For several hundred kilometres of its course, the Vistula has retained a semi-natural character and the dynamics of a free flowing river. Its valley is characterised by very high biodiversity and is an ecological corridor of international importance.

The river is a source of water for millions of people, and provides water to Poland's largest cities: Krakow, Warsaw, Bydgoszcz and Gdansk, as well as for industrial uses such as metallurgy, refineries and thermal plants. These needs are being satisfied without technical measures or negative impacts on the ecosystem of the river.

Water quality, being still very poor, is improving due to measures undertaken throughout the whole basin. Wastewater treatment plants have been built, are under construction or are planned in all of the larger urban and industrial agglomerations. The high landscape value, diversity of habitats, fish and bird species, as well as cultural value of sites along the Vistula, make its valley one of the most attractive areas for tourism and recreation in central Europe.

Economic changes in the beginning of 1990s, resulting from the demise of the communist system in Poland, brought an increase in unemployment, especially in the countryside. The local unemployment rate, already exceeding 20 percent in some areas along the Vistula, could soon increase further due to a reform of the agricultural support system. Tourism, with all its connected services, could be an important alternative for economic development and for reducing unemployment in the Vistula area. However, this tourism potential might be affected by further dam and other river regulation projects.

## Institutional framework and setting: Factors triggering the options assessment

The lower and middle reaches of the Vistula are only obstructed by one dam in Wloclawek. This dam, operating since 1970, has caused a number of problems, in particular an increase in the threat of upstream flooding caused by ice jams at the Wloclawek dam reservoir. Additionally, the stability of the dam is under threat from downstream fluvial erosion due to a lack of sediment transport since the dam was built.

A second dam near Nieszawa was proposed by water management authorities and local governments in the 1990s to secure the stability of the Wloclawek dam. The dam was also to include a hydropower plant. The dam was approved by the Polish government and parliament. This resulted in protests by the Ramsar and Bern Convention secretariats, as well as from numerous Polish and international NGOs who considered the dam at odds with the sustainable development principle included in the Polish constitution and the European Union's Bird, Habitat and Water Framework and Directives. As an EU accession country, Poland is expected to comply with these directives.

WWF believed that no proper needs and options assessment had been carried out by the proponents of the Nieszawa dam and a number of options, including the decommissioning of the Wloclawek dam, had been rejected prematurely. Additionally, an assumption was made that private investors would favour the new dam option. After the government refused to carry out a more comprehensive options assessment, WWF decided to commission its own options assessment, following the WCD methodology.

## Planning level and scope involved by the options assessment

The assessment looked at national, regional and local factors. Options were assessed against the most probable scenarios of economic development for the whole Vistula basin. National documents like the Sustainable Development Strategy for Poland, 2nd

Ecological Policy of the State and Policy Concept for Spatial Management of the State were considered. Plans for the spatial development of municipalities neighbouring the existing Wloclawek and planned Nieszawa reservoirs were analysed.

### Assessment of development goals, sectoral demands, regional and local needs

A key part of the study was the assessment of the performance of the 1970 Wloclawek dam against its projected targets and against national development scenarios. This found that the dam never met its primary and secondary objectives and failed to promote development in the region.

Analysis of strategic documents indicated that flood control should be treated as one of the management priorities of the Vistula. In this context, the existing and planned dams became evident losers. Local needs would not be met as the benefits of the new dam, as those of the existing dam, would accrue elsewhere. A particular focus was on protecting local populations from winter flooding for which building a new dam would not be solution at all.

Furthermore, the study looked at energy demand in Poland and found that the vast potential for energy efficiency, existing surplus capacity and the rapid development of other renewables make both the existing dam and the proposed new dam unnecessary.

A main focus of the study was on the economic costs of four key options (current state, Nieszawa dam, decommissioning of Wloclawek dam, modernisation of Wloclawek) and the potential benefits they might bring.

### Identification and characterisation of the options: methodology; process; approach; indicators; data; barriers, constraints and biases

WWF contracted a multi-disciplinary team of experts to:

- identify all problems and threats caused by the existence of the Wloclawek Dam;
- identify all technically feasible options;
- carry out a comprehensive options assessment;
- assess the relative social and environmental impacts, as well as carry out the relevant economic analyses.

It was accepted that none of the options should be excluded before being analysed. It was agreed that the option of building a dam in Nieszawa, as approved by the Government and Parliament, needed detailed assessment. During the preparation of the study all available data and reports were considered, as well as the conclusions drawn from community meetings within the region. A list of options was identified by studying all available documents, supplemented by the conceptual work of WWF's experts. Seven options (+ option 0) were studied.

The economic evaluation of the environmental costs and benefits of the four options studied in depth was difficult, as generally ecological impacts are difficult to quantify in monetary terms. Additionally, tests of economic efficiency were impeded, as experts had no free access to all the necessary data.

### Assessment of alternative options scenarios: tools used to assess and select the best response, including how environmental and social issues had been taking in account

The options assessment was done in two stages. In the first stage, four technically and economically feasible options were rejected for not meeting the criterion of ensuring the safety of the Wloclawek dam. In the second stage, a multi-criteria options assessment led to identify the preferred options. A set of simplified criteria was chosen to represent the diverse needs and interests of as large and influential social or interest groups as possible. A total of 19 criteria, gathered in 9 subgroups and falling into two main groups – economic and social, and environmental – were accepted by all experts, representing different disciplines and different sectors.

Two assessments were carried out. In the first one, all subgroups were weighted equally, giving over one-third of the total score to environmental criteria, and less than two-thirds to socio-economic ones. In the second assessment, the subgroup 'maximising economic effects' was favoured among socio-economic criteria with 60 percent of weight within this group. The options were ranked by a multi-disciplinary expert group during several workshops.

### Stakeholder participation: how stakeholders had been identified and involved in the process

There was no full stakeholder involvement in the options assessment process. The main reason was the refusal of co-operation from the government and the proponents of the new dam, as well as a lack of funds and shortage of time. However, many meetings were carried out with representatives of different sectors, including energy, hydro-engineering, and local

authorities. Five meetings/debates addressed to local societies were organised in the region, and various opinions were collected there.

## Implementation of the whole process: stages; decision-making points, including aspects concerning data, time frame and funding

The Polish government took the decision to build the Nieszawa dam in August 2000. A few months earlier, WWF had presented a preliminary assessment of the new dam proposal, indicating its weaknesses. In September 2000, WWF published an analysis of the proposal focusing on its compatibility with the framework of the general and environmental requirements that Poland must fulfil for EU membership. This options assessment was commissioned by WWF in November 2000. However, the Polish parliament approved the government's decision to build a new dam in December 2000.

Nevertheless, WWF proceeded with the study, which was completed in December 2001. All the results and recommendations were presented to the Ministry of the Environment, as well as widely disseminated – 2000 copies of the Polish overview were distributed to key stakeholders. The most recent discussion on the national level concerning the options assessment and alternatives to the Nieszawa dam was held during a seminar organised by the Ministry of the Environment in July 2002.

The options assessment was funded by WWF. WWF also covered the costs of five regional meetings and one national meeting, as well as the costs of publication and dissemination of the study. The WCD and its report were promoted to support the process. Two seminars on the WCD report and recommendations were organised in February and July 2001, respectively. The overview of the WCD report was translated and printed in Polish. The promotion of the WCD report was done jointly by 3 partners: WWF, GWP Poland and the WCD Secretariat (followed by DDP).

## Options assessment results

3 options were considered in depth:

1. Construction of new dam at Nieszawa (cost 346 million Euros)
2. Safety and mitigation works at Wloclawek dam (cost 83 million Euros)
3. Decommissioning of Wloclawek dam (cost 48 million Euros)

This led to the following conclusions and results:

- Construction of a new dam at Nieszawa can only exacerbate the adverse environmental and socio-economic problems caused by the existing dam and storage reservoir at Wloclawek.
- Modernisation of the Wloclawek dam would only partly resolve the problems caused by impeded sediment transport and associated downstream erosion.
- The gradual decommissioning of the Wloclawek dam and reduction in the level of the storage reservoir is the most sustainable option for solving these problems.

The multi-criteria options assessment clearly indicated that options II and III are better than option I. Option II (Wloclawek modernisation) can only be justified for hydropower generating reasons. The costs should thus be borne by the operator rather than the taxpayer.

Overall, the study identified the need for a long-term management strategy for the Vistula River and its catchment. Future decisions on projects such as new dams should be made in accordance with its strategy.

## Follow-up

The study was used by WWF in its continued advocacy work with the Polish Parliament, which voted in December 2002 that no state funding should be given to the Nieszawa dam in the financial year 2003. However, this decision is not final. While there is currently no government money available for the new dam, the government has so far failed to seriously consider any alternative options.

# An Assessment of Using Water Recycling to Release Water for New Domestic Consumers

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## Abstract

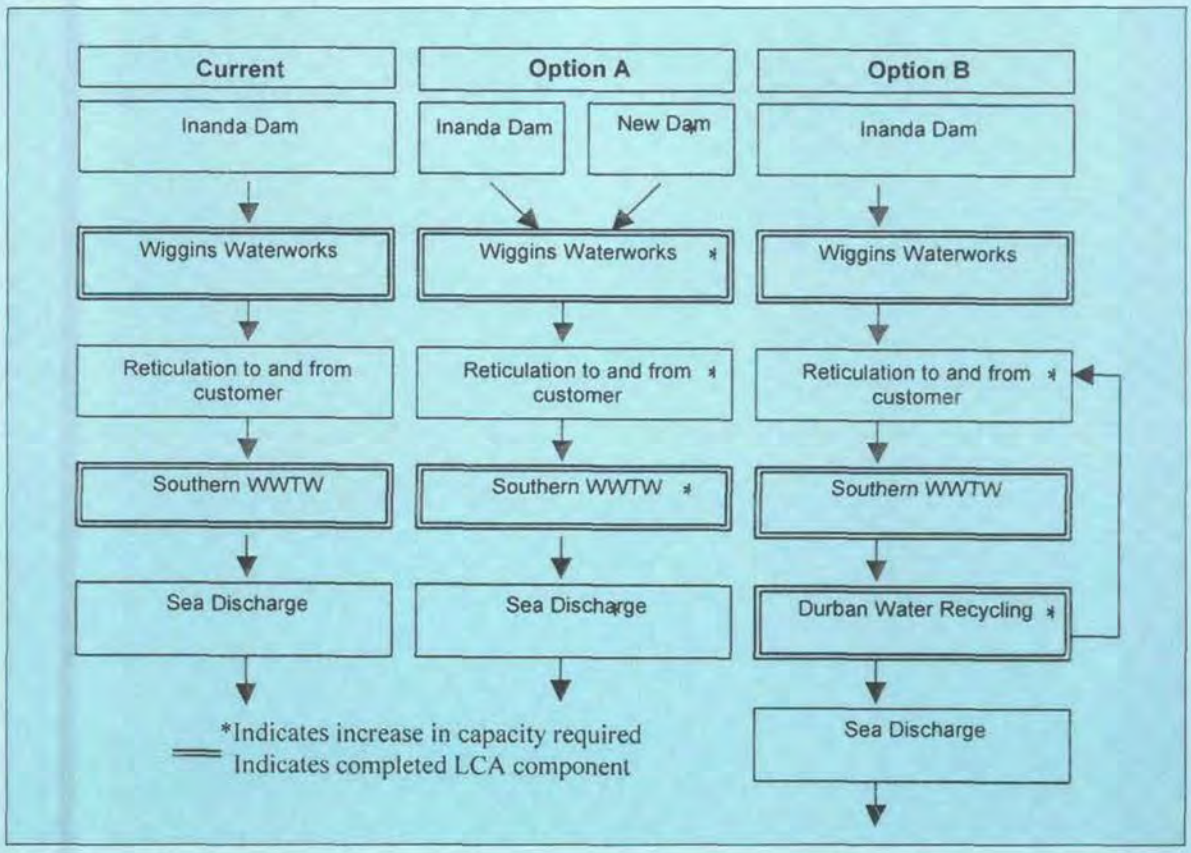
Recently the government of South Africa instituted a free basic water policy. This policy states that every household is entitled to a free water supply of 6000 litres per month. In order to increase the available potable water supply, the eThekwini Municipality were faced with two choices. Option A required a new dam and Option B entailed construction of a water recycling plant. This ongoing study considers the environmental, social and economic costs and benefits of each option. In order to quantify the environmental impacts the life cycle assessment tool was used.

**Key words:** Life cycle assessment, free basic water, recycling

## Introduction

As part of the Government's strategy to alleviate poverty and enhance the quality of life in South Africa, as per the basic rights in the constitution, a policy for the provision of a free basic level of services has been established. The Minister of Water Affairs and Forestry announced in February 2001 that the government had decided to ensure that poor households are given a basic supply of water free of charge. He said that Cabinet had approved a policy to provide 6 000 litres of safe water per household per month (Kasrils, 2001). The primary intention of the policy is to ensure that no one is denied access to water supply simply because they are unable to pay for the service. Underlying this is the recognition that supply of water at a 'basic' level assists in alleviating poverty, improves community health and frees women from drudgery.

Figure 1: The existing supply network and available options



The new free basic water policy means that the eThekwini Municipality will have to increase their delivery capacity in order to cater for new consumers. There are currently 600,000 people in the eThekwini Municipality without access to free basic water.

There are currently two options available to the eThekwini Municipality to increase their water supply capacity. The conventional option is to build a new dam to increase capacity. Another option is to recycle water to industry. This is the route that Durban has chosen. Figure 1 shows the existing water supply network and options A and B were the options available to the Metro. Option A involves building a new dam and expanding capacity at the present waterworks, sewage works and outfall. Option B involves the construction of a recycling plant to treat sewage from the Southern Wastewater Treatment Works.

In order to free up potable water supplies, for distribution to households, Option B was chosen and a recycling plant was commissioned in May 2001 in Merebank, Durban. The plant receives effluent from the Durban Southern Wastewater Treatment Works (WWTW) and treats it to an acceptable standard for industrial use. Industry benefits due to the lower cost of recycled water and the Metro benefits as 40 ML/ day is freed up for use by new customers. This translates to water being made available to about 200 000 consumers of free basic water. However, as with any industrial activity there is a cost associated.

This case study describes a partially completed project, funded by the Water Research Commission of South Africa, investigating the environmental, social and economic costs and benefits associated with recycling water. This is an academic, research study and hence has no accountability. This is a novel approach that considers the 'triple bottom line' associated with water recycling and providing free basic water thus providing a holistic picture of the provision of free basic water in Durban.

In order to calculate the environmental impacts the life cycle assessment (LCA) was used. LCA is a systematic way to evaluate the environmental impacts of products or processes by following a scientific methodology in which the impacts are quantified. The system boundaries were defined as from the point water upstream from the Inanda dam to the final discharge into the sea from the Southern Wastewater Treatment Works.

The system was broken up into seven units and each was modeled separately. These were Inanda dam, a proposed new dam, Wiggins Waterworks, reticulation to and from the customer, Southern Wastewater Treatment works and the Durban Water Recycling plant (the last two include the discharge to sea of sludges via the deep sea outfall). The results direct attention to the processes having the greatest environmental impact.

The social and economic impacts associated with providing and not providing this free basic water, using this system, are being assessed. The social issues considered were; health and health risks, equity, food security, collection effort and alternate use of time, ability to do work, longevity and gender issues.

The study considers the options available for increasing the potable water supply in a region. Although the addition of a recycling plant to an existing water supply network adds immediate environmental burdens, savings come from the environmental impacts associated with the dams, waterworks and infrastructure that do not have to be built. Therefore, the construction and operation of these facilities has to be quantified and then subtracted from the burdens added by the recycling plant. This will then provide a complete picture of the burdens associated with increasing the potable water supply of a region. The benefits associated with providing limited safe water to households accrue to both Option A and Option B.

As stated the study was divided into three parts: environmental, social and economic. Each stage will now be considered in greater detail.

## Environmental

The environmental LCA is a systematic way to evaluate the environmental impact of products or processes by following a cradle-to-grave approach. LCA is the process of evaluating the effects that a product has on the environment over the entire period of its life cycle. It can be used through product design and process selection, to purchasing decisions and final disposal routes. LCA provides objective answers to environmental questions while suggesting more sustainable forms of production and consumption. It uses a scientific approach in which the environmental impacts due to a product or activity are quantified. It is the only tool that has a cradle-to-grave approach and by this it avoids positive ratings for measurements, which only consist in the shifting of burdens (Kloepffer, 1997).

There are numerous purposes of LCA. The ISO 14040 standard (International Organisation for Standardisation, 1997) lists the applications as including: identification of improvement possibilities, decision making, choice of environmental performance indicators and market claims.

## Methodology

The study was carried out using the standard ISO 14040 methodology. This comprises four stages:

1. Goal definition and scoping - This includes definition of system boundaries, details, accuracy and data quality, functional units and impact models to be used for the analysis. For this study, the system boundary was chosen as being from the point where water enters a possible new dam to the point where the sludges and effluent exit the deep sea outfall at the sewage works. The functional unit was chosen to be 1 kL of water as delivered to the customer.

2. Life cycle inventory - The life cycle inventory (LCI) involves data collection and calculation procedures to quantify relevant inputs and outputs of a process. The data are then classified according to the type of environmental impact (e.g. distinguishing between air, water and soil emissions, solid wastes, energy and materials consumption). Information for this study was based on using an average of three months of data from the plant. The plant was assumed to have a life of 30 years.

3. Impact assessment - The aim of the impact assessment is to evaluate the magnitude of the potential impacts resulting from the inputs and outputs summarised in the inventory list. The Gabi 3 software package, which uses the CML (Centre for Environmental Science, University of Leiden, The Netherlands) LCA methodology, was used to compile impact scores for each impact category. Local data were used where available.

4. Interpretation and improvement analysis - In order to propose improvements in the environmental performance, the most significant impact sources must be determined and possible changes or modifications considered for the process. This paper will concentrate mainly on the results associated with this stage.

A modular approach was taken when carrying out the study. Thus, seven unit operations were identified and each was studied separately. These were; Inanda dam, a proposed new dam, Wiggins waterworks, reticulation to and from the consumer, the sewage and recycling works and the deep sea outfall. To date the LCA work on Wiggins waterworks, the sewage and recycling plants and the deep sea outfall have been completed. These results will be presented.

The life cycle of each section was divided into 3 phases: construction, operation and decommissioning. It was found that almost 95% of the environmental burdens associated with the three sections could be traced to the operations stage. This is in line with many other studies on water and wastewater treatment processes (Emmerson et al., 1995, Meijers et al., 1998, Grabski et al., 1996) where it has been concluded that the use stage tends to be dominant due to the continuous use of energy and materials.

The impact categories and the characterisation factors in the CML guide were used in this study. These are: global warming, ozone depletion, acidification, eutrophication, photochemical oxidation, aquatic ecotoxicity, terrestrial ecotoxicity and human ecotoxicity. By using the data gathered and the LCA methodology an environmental profile was created.

Compared with the production of potable water, the environmental impacts associated with the production of recycled water are almost ten times greater. This is due the lower quality of the influent to the recycling plant and the large amount of energy expended in the primary and secondary sections of the sewage works. The impacts from just the tertiary section (i.e. the recycling plant alone) are comparable to those of a conventional potable water treatment plant since they use similar unit operations.

## Future Work

The LCA study of the remaining units (Inanda Dam, new dam, reticulation and sea discharge) has yet to be completed. Work on the social and economic study has not commenced. The social study will consider the impacts associated with and without a potable water supply. No attempt will be made to quantify the financial impacts. The expected completion date for the study is December 2004.

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# Canada BC Hydro Stave River Water Use Plan (WUP)

## A World Bank Case Study

This case study illustrates the implementation of a well-structured, collaborative process to develop a water use plan (WUP) for a new 90 MW Stave Falls hydropower facility on the Stave River in British Columbia, Canada. The process explicitly involved all water use interests in the river basin in recommending a new operating strategy for the facility, and proposing mechanisms for ongoing stakeholder involvement in performance and impact monitoring and informing decisions for the ongoing management of the facility.

### What was the context?

British Columbia, a province on the Pacific west coast of Canada, currently derives 90% of its electrical supply from 30 hydroelectric facilities on 27 watersheds. In the mid-1990s, the provincial-owned power utility, BC Hydro, initiated a new planning process that called for development of a formal Water Use Plan (WUP) for each licensed facility operated by BC Hydro. A WUP is a technical document that specifies the boundaries of operations, and is used by the operating engineers in managing water at dams and power facilities on a day-to-day and month-to-month basis.

The program was designed collaboratively among BC Hydro, the federal fisheries agency and various provincial agencies, with input from First Nations, the public and environmental groups. A period of three years was agreed to develop WUPs for the priority facilities of BC Hydro, and five years for the remaining facilities. The model of cooperation and partnership established in developing the program was also seen an important element in the program's implementation.

The provincial government subsequently extended the WUP planning system to its licensing of all new water control and regulation facilities in the Province (including review of existing licenses), though as yet, the application is mainly in regard to BC Hydro facilities. Reflecting public values, the overall goal was to ensure there was a proper balance between the relevant competing uses of water, including water supply, fish and wildlife, recreation, flood management, logging, electrical generation, and First Nations heritage interests - in a socially, environmentally and economically acceptable manner.

The 13-steps of the WUP planning process are noted in Box 1. A degree of flexibility and choice was provided to enable the process to be adapted to each facility and situation. The steps recognize that trade-offs among multiple objectives are required, that the program must reflect existing provincial and federal regulations, and that a collaborative process of ongoing review and revision involving affected interests is an important component.

**Box 1: 13 Steps in the WUP Process**

Initiating, developing, approving, monitoring and reviewing.

1. Initiate a WUP process for a facility and notify the public
2. Scope the water use issues and interests
3. Determine the consultative process to be followed and initiate it
4. Confirm issues and interests in terms of specific WUP objectives
5. Gather additional information on impacts of water flows on each objective
6. Create operating alternatives for regulating water use to meet different interests.
7. Address tradeoffs
8. Determine and document areas of consensus and disagreement
9. Prepare a draft WUP and submit to the
10. Provincial Comptroller for regulatory review Provincial Review and decision to authorize WUP
11. Federal Review of the authorized WUP and decision
12. Monitor compliance with authorize WUP
13. Review the plan on a periodic and ongoing basis

Steps 10 to 13 are a legal prerequisite for the planning process that are based in legislation, while the first nine steps represent the consensus reached with BC Hydro, other government agencies and stakeholders on the process to inform the legal requirements. In that sense the first nine steps in the process were "voluntary". The provincial government who controlled tariff levels also set a financial limit to the costs of the program.

The primary mechanism for involving stakeholders in evaluating operating alternatives (steps 1 to 9) is a Consultative Committee (CC), with participants drawn from all water use and local community interests, including all levels of government and BC Hydro. The activities of the CC are then linked to a wider consultation processes with the affected constituencies and general public. Apart from providing logistical

support for the CC to function, the process sponsor and manager (BC Hydro) is responsible to provide the CC with access to the best available technical resources, information systems and modeling tools and, where needed, an independent facilitator and independent expertise.

The CC's mandate is to represent the diverse interest of the community and broader society to recommend an appropriate allocation of water to balance various needs. The CC is also responsible for preparing a Consultative Committee Report, signed off by all members, which documents the analysis, discussions, areas of agreement and disagreement within the Committee, and its recommendations. Based on the report, BC Hydro is required to prepare and submit a draft Water Use Plan to the Comptroller of Water Rights for the Province, accompanied by the CC Report. Through an inter-departmental review process, the draft WUP is evaluated under federal and provincial legislated mandates and laws, such as the federal Fisheries and the provincial Water Act. The plan becomes effective after operating boundaries and other provisions of the WUP are written into BC Hydro's water license to operate the facility.

The Stave River flows south from the Coast Mountains in British Columbia through the Stave and Hayward Reservoirs on into the Fraser River. The Stave Reservoir covers 61.4 square kilometers and provides the main storage for the new Stave Falls (90 MW) and Ruskin (105.6 MW) power plants. All of the Stave River facilities are located on Kwantlen First Nations traditional territory. A decision was taken in 1995 to replace the old Stave Falls power plant that was originally built between 1911 and 1925. The replacement project involved building a new intake, two power tunnels, a two-unit, 90 MW powerhouse, a tailrace channel, a tailrace berm, and a switchyard, while the original main dam and Stave and Hayward Reservoirs remained as they were.

The WUP for the Stave River was the second of the initial set of ten WUP processes initiated by BC Hydro, and it proved to be a leaning experience for all involved. The Stave process was announced in Sept 1997. The bulk of the work of the CC was undertaken in an 18-month period starting from the spring of 1998. The Report of the Consultative Committee was produced in October 1999 and submitted to BC Hydro as a consensus report. Provincial authorization of the draft WUP is nevertheless still pending (reportedly the Stave River WUP is resolving a number of license issues common to all BC Hydro facilities), though it is anticipated that future WUPs would be approved on a six-month timeframe.

The replacement power station was completed in 2000 and the plant and reservoir are currently being operated under the previous strategies, as an interim measure, until the Provincial Comptroller of Water Rights approves the new operations and revised license is issued to BC Hydro.

### What options assessments were carried out, and by whom?

The original decision to replace the old Stave Falls powerhouse with a new powerhouse was made through a separate public consultation process. Essentially, it was cheaper to install a new power station than renovate the old plant. One condition of government approval of construction of the new power plant (by issuing an Energy Project Certificate) was the requirement to develop a WUP for the Stave River hydroelectric system. The first steps in WUP process (1 to 3 in Box 1) were undertaken by BC Hydro staff engaging local stakeholder groups, government agencies and First Nations representatives. Through pre-scoping the water use interests and issues, the impacted stakeholders and interested parties were identified. Representatives of different interests were then invited to participate on the Consultative Committee. Some interested parties self-selected a representative, others (due to the time commitment required for full participation) elected to receive meeting minutes only and participate as observers at stages of their greatest interest. The CC that was constituted consisted of 24 active members and 6 observers.

Once established, the CC debated and eventually formulated eight main performance objectives to guide the operation of the facilities. These were to:

- Avoid disruption to industry operations in the reservoir and downstream flooding;
- Support recreational opportunities in the reservoirs and downstream;
- Support viable wildlife populations with reservoir stability, downstream water level stability and periodic flushing of riparian areas;
- Protect First Nations heritage values to preserve access and protect sites, and for recovery of artifacts;
- Avoid cost increases in electricity production;
- Support viability of fish populations with increased spawning and rearing capacity, reduced stranding, improved water quality, and increased reservoir productivity;
- Provide maximum flexibility to respond to change and to maximize resilience and ability to respond to market volatility, scientific uncertainties, etc., and

- To continuously improve knowledge about the systems and impacts (about key uncertainties affecting decision-making).

For each objective, performance measures were then identified which provided more detail about the objectives (e.g., quality not quantity of recreation opportunities) and specified how each operating alternative was to be evaluated. The performance measures were modeled quantitatively, wherever possible. For example, the recreation performance measures included the weighted average number of days from May to Oct that Stave Reservoir was between certain levels.

The CC, through technical sub-committees, initially identified 12 preliminary operating alternatives. A first assessment of the impact of each alternative on each objective was then made using the performance measures. The 12 preliminary alternatives were then progressively screened and refined by seeking to find improvements across all objectives. Two distinctly different operating strategies that contained a combination of measures eventually emerged. The choice between them depended mainly on the value tradeoff among the objectives related to First Nations heritage, recreation reservoir target levels and reservoir productivity for fish.

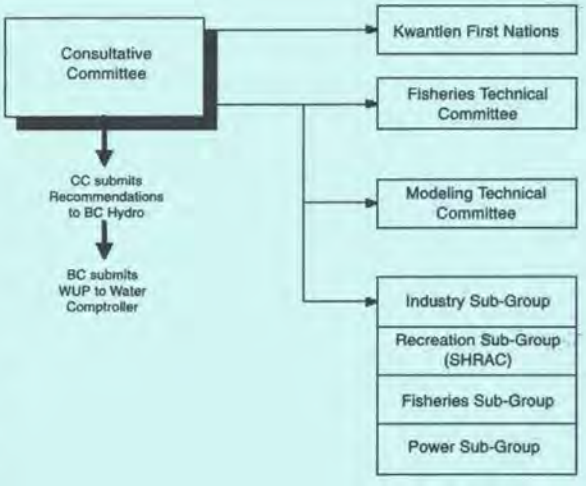
After detailed evaluation and discussion within the CC, one option was eventually selected as the preferred alternative. Apart from documenting the steps in reaching its conclusions and setting out technical details on the recommended operating strategy, the report of the CC Committee incorporated additional recommendations on:

- An on-going management plan related specifically to the proposed WUP monitoring program, which emphasized monitoring, mitigation and on-going management activities to improved decision-making for future WUP reviews considering fisheries, water quality and First Nations interests;
- A multi-stakeholder management committee to oversee how the approved WUP, once implemented, met the long-term expectations of the CC associated with the new operations. The proposed mandate of the Committee included preparing annual update reports and conducting a scientific interim review after five years to ensure the new operations did not result in any unforeseen significant negative impacts, that studies were meeting their scientific objectives, and the suitability of budgets for future work.

Further detailed recommendations were contained in the CC report, such as regarding monitoring and subsequent periodic review of the operating strategies.

## What other steps were taken to enhance the involvement of stakeholders in drafting the Water Use Plan?

Suggestions on how to conduct CC meetings and engage the wider community were provided by BC Hydro and the provincial government. BC Hydro also published general material to inform local governments, First Nations, key interested parties and the public on how to participate in the WUP plan process. But once the process starts, the CC may elect to introduce additional measures.




## Consultative Committee structure and interactions

In the Stave River case, the CC decided to streamline the process by creating a number of smaller sub-groups and technical committees who deliberated over specific issues and later reported to the main group. Figure 1 illustrates the structure the Stave River CC decided to adopt for its interactions. These sub-groups were technical in nature, providing analysis and impact information/professional judgment; they were not charged with making value trade-offs or recommending operating regimes.

Specialists from, or brought in by, the process sponsor worked with each sub-committee. Performance measures were developed through discussion. Subsequently, various models were used to assess and predict the impacts of alternative operating strategies

on the objectives and performance measures (e.g. using a habitat model, power values model, operations model, and performance measures model).

When requested by the CC, independent expert professional advice and peer reviewers funded by BC Hydro were made available to the sub-committees. For example, peer reviewers were requested by the Modeling Technical Committee for independent advice on whether the methods used to model BC Hydro operations and power production, as well as the results, adequately represented what the CC was asking. This quality assurance provision, while it did not lead to changes in the results, improved the CC's understanding of the assumptions and the confidence of participants in the analysis on which they based their recommendations.

## Endorse? Accept? or Block?

At the suggestion of the facilitator, the technique the CC ultimately adopted to indicate their agreement, or disagreement with the final two alternatives was a choice of: endorse, accept or block.

**Endorse** meant the member endorsed the proposed alternative either fully or with minor reservations

**Accept** meant the member accepted the proposed alternative. They might disagree that the alternative represents the best possible solution, but their minimum needs are met. They may want their views formerly recorded, but they acceptance and support the decision of the group.

**Block** meant the member could not support the proposed alternative. Their minimum needs are not met.

In this system, endorse and accept were both taken to constitute consensus. The proportion of people falling in the 'accept' and 'endorse' categories measured the strength of the consensus. If any member in the group found it necessary to block, then consensus was not achieved. In the end, 80% of the Consultative Committee endorsed the draft WUP and 20% accepted it. The CC was thus able to issue their Report as a consensus recommendation.

## Consulting with local constituencies and the public

As the process unfolded a variety of newsletters, articles, and open houses were used to communicate progress on the draft plan development to interested constituencies and the public. In Stave River case, the CC and sub-committee meetings were open to observers. The rules of conduct, determined by the CC members themselves, were that observers could not interrupt discussions, and could only address the CC by scheduling a presentation, being invited to speak, or speaking to a CC representative during session breaks. The level of interest in observer status depended on the issue being discussed, and there was open public debate at intervals during the process.

Key throughout all meetings was an understanding that there was respect for all viewpoints, a desire to learn about other interests, and a willingness to listen as well as to be heard.

Consultations with local First Nation began during the early stages of the project to replace the Stave Falls power plant. This resulted in building relationships and identifying key concerns related to the watershed and BC Hydro activities in general. Agreements associated with training and employment opportunities specifically related to archaeological investigations had already been undertaken and were in progress when the consultation for the WUP began. Historical grievances associated with the original construction of the Stave and Ruskin power plants were reviewed through a separate consultation process.

First Nations were initially reluctant to engage directly in multi-stakeholder processes because of what they felt was a lack of sensitivity to their unique situation and special status with the province and federal governments. Therefore, starting early in the WUP process, consultations with the Kwantlen's First Nations were conducted in parallel to the main CC process involving BC Hydro and the independent facilitator. A number of meetings were held to clarify Kwantlen's objectives, to establish performance measures and identify key information gaps. At Kwantlen's request, studies were conducted in the spring/summer of 1998 to examine the impact of reservoir-induced erosion on heritage sites. The Kwantlen also sat on several working groups and sub-committees of the main Consultative Committee. After a cross-cultural training session for WUP participants in February of 1999, Kwantlen joined the main table of the Consultative Committee and participated in all discussions leading to the consensus agreement of June 24, 1999.

## How did the options assessments and stakeholder involvement improve development outcomes?

Through interest-based discussion and collaborative learning, a consensus agreement was reached which all

the CC participants supported. This balanced the water use interests reflected in the eight objectives, as defined by the stakeholders (e.g. fisheries, recreation, power production, First Nations heritage sites, industrial operations and wildlife management). The CC Report noted that the recommended operating strategy provided gains with respect to all eight objectives, relative to current operations of the Stave reservoir and previous operation of the old powerhouse.

BC Hydro estimated the operating regime set out in the draft WUP would provide a net gain of $ 0.12 million per year, the difference between the annual gains in power generation ($ 0.5 million) and annual costs of implementing the management plan measures ($0.39 million). This included the benefit of replacing the powerhouse.

When the original WUP process was set up, it was acknowledged that there was a limit to the funds and time available to conduct new scientific research, and that impact modeling and studies needed to be completed within a prescribed time frame and prioritized. Essentially the CC recommendations would be made on the best available knowledge and adaptive management would follow. Despite the consensus recommendation, members of the CC felt there were key scientific uncertainties and information gaps that needed further study. As a result, the consensus agreement on the new operating strategy was contingent on the implementation of further analysis and scientific study. This included a monitoring plan to address key biophysical uncertainties and steps to ensure that improved information was available for the next review of the WUP.

## What lessons are offered?

At present, draft WUPs for all ten priority BC Hydro facilities have been completed. There was a high degree of consensus (eight of the ten CC reports were consensus reports), and improvements in all priority environmental and social interests were achieved. In four WUP plans, consensus recommendations led to an increase in power production from the existing facilities, while satisfying other performance objectives.

A number of lessons emerged from the Stave River WUP processes that also reflect the experiences of other WUP processes of BC Hydro. These include:

- The interest of local communities in participating proactively in WUP processes varies from community to community. It depends on factors such as the size of the facility, the number of stakeholders active in the watershed who believe operations can be improved to better manage environmental and social impacts, and the range of interests affected. Many local communities are vitally interested in having a voice in how tradeoffs are made in operating dams and reservoirs.
- Involving all water use interests proactively in identifying issues and finding new ways to improve the management and overall development performance of dams and hydropower facilities generates enormous creativity, innovation and positive outcomes.
- Structured processes are essential to facilitate consensus and reach a decision. The structure not only helps stay on track and move step-by-step toward a defined product, but also provides the forum within which information can be successfully assimilated and new ideas can be explored. Shortcuts can be dangerous, not only in undermining consensus, but also in creating premature consensus. The process manager must ensure sufficient and timely provision of independent facilitation, technical support, and access to independent peer review where appropriate.

# Ceara State Integrated Water Resource Management Project

## A World Bank Case Study

This case illustrates how options assessment and stakeholder involvement informed decisions about the ongoing development of a network of strategic dams and reservoirs and the integrated management of inter-basin transfers in Ceará State, in northeast Brazil. In the 1990s, the State embarked on progressive reforms to move from highly centralized decision-making to participatory forms of water management, and adopted new procedures to balance and prioritize demand-side and supply-side interventions.

### What was the context?

Ceará State is located in the semi-arid region known as the "Drought Polygon" or "Polygono da Seca" in the northeast of Brazil, one of the poorest regions in the country. The mean annual precipitation is around 700 mm and, in some regions, it is less than 300 mm. Historically, the area has been subject to long and severe droughts. Even in average hydrological conditions, the rivers in the seven basins in the State flow intermittently for only three to four months. In the remaining months, riverbeds are dry.

Compounding the vulnerability to drought, most of the State's territory is underlain by rock with shallow soil cover, minimizing natural retention of surface flows and groundwater storage, especially in the interior. The main groundwater resources located in the coastal areas are fragile and under pressure from a combination of overexploitation, pollution and saltwater intrusion.

Insufficient and low quality water supply during both annual and cyclical droughts restrains the economy and investment. It also poses additional human cost in terms of health support and social support for the steady migration of unemployed from the interior to towns and urban centers, all exacerbated by drought.

Prior to the 1990s, a number of large federally funded water storage facilities had been constructed to provide various services, especially municipal water supply and irrigation.[1] Some of these reservoirs were connected by an "integration axis." This is a system of riverbeds, canals, water mains, tunnels and other structures to move water back and forth between key reservoirs in basins that are water-surplus or deficit, depending on the rainfall patterns across the State, in a particular year. However, criteria for selecting the sites for these reservoirs were not explicit and many argued that decisions were politically motivated. Moreover, the conjunctive operation and use of these large facilities was seen to be sub-optimal and operations were based upon year-to-year planning with limited consideration of longer-range needs or conservation to alleviate future droughts. Consequently, many reservoirs were frequently empty at critical periods of drought.

Ceará became one of the first States in the northeast to pass its own State Water Resources Act after creating a State Secretariat for Water Resources (SRH) in 1987. SRH started drafting a new water law and formulating new policies and a long-range plan to reform the legal, institutional and physical frameworks for water management. Key strategic challenges were to: (i) set in place capacity to manage water demand in the urban and irrigation sectors; (ii) rationalize water allocation; (iii) develop greater flexibility to manage water supplies on an inter-basin level, including improving the integrated management of existing facilities for both seasonal and multi-annual storage; (iv) introduce environmental criteria in infrastructure management and inter-basin transfers; and (v) identify new infrastructure to improve bulk water storage and supply management.

The World Bank supported these water reforms through a number of initiatives including the PROURB Project (Programa de Desenvolvimento Urbano e Gestão de Recursos Hídricos [1994-2001]). Under this Project, 14 small and medium storage dams and key water supply facilities were constructed to provide water supplies to rural communities and towns in areas of deepest poverty in the interior of the State. PROURB also supported the State's effort, started in 1993, to register all existing water users by river basin as a first step toward control of water use, issue water use rights, put in place water rights enforcement capacity, and introduce bulk water tariffs and demand-side management programs. Support was also provided for the formation of user organizations and river basin committees within each basin to assist in the

1 120 large reservoirs were connected to the integration axis, together providing close to 90% of statewide water storage capacity, including multi-annual storage. In total Ceará has more than 8,000 reservoirs of all sizes for irrigation, municipal and local water supply constructed and managed by a variety of private, state and municipal level organizations.

determination of water management strategies within these basins.

The Programa de Gerenciamento e Integração dos Recursos Hídricos: 1998-2006 (PROGERIRH) was the next step in the Bank's support of the State's water reforms and long-range plan. It essentially enlarged on the scope of PROURB. To take stock of progress and consolidate efforts underway, Ceará implemented a Pilot Project beginning in 1997. This combined an examination of experiences with the ongoing PROURB with studies for the preparation of the larger PROGERIRH Project.

PROGERIRH provided further support for capacity development, the harmonization of environmental policies with water management policies, and adoption of more efficient water use and management technologies. Support was also stepped up for education and information programs for the public and training of water users in efficient water use. New programs for sub-catchment management and coastal groundwater management were also introduced.

A large part of PROGERIRH involved support for the next cycle of upgrading strategic infrastructure. This included further construction of storage reservoirs in small and medium-sized towns, and additions to the strategic reservoir network and integration axis. Existing infrastructure (water conveyance structures and dams) was rehabilitated to improve safety, supply efficiency and permit more flexible operation. Natural resource databases were enhanced and hydro-meteorological and environmental monitoring capacities were strengthened by providing equipment and training to improve the quality and timely flow of information to managers and basin committees. These actions were taken to help apply new criteria for water releases from dams to improve environmental flows and optimize inter-basin transfers.

## What options assessments were carried out for reservoir components of the supply management plan, and by whom?

The first systematic assessment of reservoir options in the State started in 1987 when SRH prepared PLANERH (the Ceará Water Resources State Plan). A portfolio of 40 new storage reservoirs was identified when PLANERH was announced in 1992. While there was involvement of State agencies and municipal authorities in preparing PLANERH, a departure from past practices, there was limited direct involvement of non-government stakeholders and water users – whose associations were yet to be formed.

**Chronology – Selected Events**

| | |
|---|---|
| 1987 | SRH - State Water Resources Secretariat |
| 1988-1991 | Development of (PLANERH) |
| 1992 | Publication of the new water policy (SIGERH). |
| 1993 | Formation of multi-stakeholder river basin committees and water user organizations |
| 1994-2001 | PROURB - Urban Development and Water Resources Management Project |
| 1997-2002 | PROGERIRH Pilot Project and Regional Environment Assessment |
| 1998-2006 | PROGERIRH (5 components expanding on PROURB)<br>• Water Management Strengthening (policy, institutional, non-structural measures)<br>• Integration of river basins (management of interbasin transfers)<br>• Rehabilitation of existing hydraulic infrastructure;<br>• Increase in the State's network of strategic reservoirs, and<br>• Watershed management in selected micro basins and coastal groundwater management. |

The proposed reservoirs in the PLANERH portfolio were put through two processes of evaluation and prioritization before they became eligible for World Bank financing under PROURB and PROGERIRH.

## PROURB - Urban Development and Water Resources Management Project (1994-2001)

Initially four dams at an advanced state of preparation (design and EIA) were evaluated and accepted under PROURB. The remaining dams were evaluated in a three-stage screening and ranking process, the first two stages having an eliminatory character and the third having a ranking objective. The process was open in the sense that enlargement of the original PLANERH portfolio was permitted. This occurred when regions submitted new proposals for the inclusion of dams in the State Plan, while the ranking was taking place.

The result was a list of 32 dams eligible for financing under the PROURB, subject to project specific evaluations and EIAs. Table 1 shows a summary of the steps, which were completed in October 1996. The results were published. But similar to PLANERH, stakeholder consultations on the screening and ranking were primarily among state agencies, though during the

Table 1: Three stages in the selection of reservoirs under PROURB (1996)

| Phases | Character/Purpose | Method/Criterion | Number of reservoirs assessed | Number of reservoirs accepted as Eligible |
|---|---|---|---|---|
| 1 | Eliminatory | Environment Impacts | 32 (excluded 3) | 29 |
| 2 | Eliminatory | Water Demand Priority | 29 (excluded 3 added 8) | 34 |
| 3 | Ranking | Multi-criteria Matrix | 34 (excluded 2) | 32 |

Criteria that were developed by SHR in consultation with other government agencies and consulting with different stakeholder interests separately included: economic feasibility; social priority; hydrological possibilities; environmental impact; and impact on local and regional economy.

PROURB S&R, SHR had separate meetings with different stakeholder groups to discuss and develop the evaluation criteria.

Based on the ranking prepared by SRH and subsequent project-level evaluation studies with public consultation as part of the EIAs, 14 storage dams and their corresponding water mains were constructed under PROURB. The highest ranked dams were taken up first, but the number of dams financed was budget-limited.

## PROGERIRH (1997 – on going)

The preparation of PROGERIRH started in 1997, largely under the PROGERIRH Pilot Project that funded a series of studies as input to the preparation for each component of PROGERIRH. As part of this, SRH appointed a multi-disciplinary unit (UPEP) to act as a consulting unit to coordinate a new ranking exercise and to coordinate the various studies. UPEP was made up of specialists in technical, social, environment and economical areas drawn from several public and private organizations. In parallel, a Regional Environment Assessment (REA) was undertaken to consider the cumulative social and environmental impact of reservoirs in a basin context and to refine the environmental and social selection criteria for the operation of existing and new reservoirs. The REA supported efforts by SRH to introduce environmental criteria and procedures for managing water releases from reservoirs (including inter-basin transfers) and regional watershed management priorities. Under PROGERIRH, the State wanted to develop up to 20 more reservoirs identified in the evolving long-range plan (PLANERH). Initially, eight projects from those designated as eligible for PROURB, but not built due to budget limitations, were advanced for detailed study and implementation. SHR started a new screening and ranking process to choose a further 12 reservoir options. Building on the PROURB exercise, new parameters were defined and assigned a weight (by SHR) based on the recommendations from the UPEP unit. Each reservoir was then scored (rated) against each parameter, receiving a grade varying from zero (the lowest classification – i.e. highest cost or most adverse impact) to five (the highest grade). The weighted average of those grades defined the overall rank of that dam. The five main ranking parameters of aspects were:

- Political Aspects: giving priority to areas in conformity with the State economic development plans;
- Social Aspects: reflecting the degree of social hardship due to water deficit and resettlement involved in each project;
- Environment Aspects: bring in criteria from Cumulative Environment Impact Study prepared by SRH;
- Economic Aspects: a series of factors used in the benefit-cost evaluation of the project, reflecting the assessed benefits, total cost of the project, comparative cost per unit of water supplied, operation costs, and the relative degree uncertainty of the cost estimates;
- Technical Aspects: various factors including the relative importance and role of the reservoir in an integrated system, engineering features of the dam site, and hydrological efficiency.

An updated portfolio of 29 reservoirs was produced. The 12 highest-ranked projects proceeded to detailed project-specific study for possible financing under PROGERIRH, with eight projects already advanced.

In parallel, evaluations of eight new inter-basin link component (axis) studies were also carried out. The Sertão Central – Metropolitanas Integration Axis, which was at an advanced state of preparation, was selected as the priority project. A ranking matrix procedure was then used to evaluate five different schemes for the Castanhão Integration Axis to meet water demand in the Fortaleza Metropolitan Region. The rehabilitation

priorities for existing dams and other conveyance facilities were identified in a separate set of studies taking into account the selection of new reservoirs, the conditions of existing the water facilities, and the opportunities to improve inter-basin transfer flexibility and local service delivery.

### What steps were taken to enhance stakeholder involvement in the decision-making processes?

The mechanisms for stakeholder involvement evolved and broadly improved with each successive cycle of planning (e.g. starting with the preparation of PLANERA in the late 1980s and progressing through PROGERIRH starting in the 1997). Initially, stakeholder involvement was largely limited to State agencies and the regional authorities. The water user groups and basin committees were gradually introduced as they became functional. The situation was also that most regions were competing to have a water storage dam located in their area. Thus for many stakeholders, the exercise of selecting reservoirs was to establish investment priorities across the State. More rapid progress was made increasing the involvement of water users; communities and non-government stakeholders in decision-making processes for the design and construction phases of reservoir projects; and especially in establishing the policies to manage inter-basin transfers through the vehicle of the multi-stakeholder basin committees and user associations.

### Selection, design and implementation of reservoir projects

During the PROGERIRH Pilot Project, state organizations and non-government stakeholder groups were informally consulted on the design of sub-programs for PROGERIRH and, to a lesser extent, on the ranking of reservoir options. The occasions where all stakeholders were invited to interact together were still rare, and oriented more to presenting the status of work in progress and explaining decisions already taken than to invite early discussion and debate of the options. SRH held a number of meetings with members of the River Basin Committees (as they became functional) and with mayors of municipalities crossed by the integration axes.

SRH held a major public meeting that brought all stakeholders together to discuss the provisional PROGERIRH components and the REA findings. Media, NGO and civil society groups and several State organizations involved in water management were invited. There was reportedly no major controversy about the selection of reservoirs, though there were no specific mechanisms to judge the level of opposition to inter-basin transfers. The main concerns raised by stakeholders in these sessions related to how the projects would be maintained, and the adequacy of the environment mitigation and monitoring of downstream impacts.

Concerns were raised about the potential impacts of drainage and sewage effluents flowing into rivers, the environmental effects of converting intermitted rivers to perennial flows where regulated releases would be made during periods when river bed would have otherwise been dry. Discussions included the size and timing of releases during normal flood periods and the effect they would have on existing estuarine dynamics and marsh ecosystems that had already adapted to intermittent flow regimes and floods. Representatives of coastal settlements expressed concern about the lack of knowledge of the possible adverse impacts on coastal fisheries.

During preparation of PROGERIRH steps were also taken to compensate for the deficiency in involving non-government stakeholders in the selection of strategic dams. For example, stakeholders groups who were associated with other water management programs, or with the subprograms of PROGERIRH, such as the Environment Protection Program, the Resettlement Program, the Social Mitigation Actions Project and the Human Resources Development Project, were consulted on the development of criteria for the screening and ranking of reservoirs. Procedures to increase the levels of participation in decision-making during the implementation phase of PROGERIRH were also introduced. This reflected the fact that the capacity strengthening of water user groups and basin committees was ongoing, and that many decisions were still pending – that is, not all the decisions had been taken when the loan was approved. Eligible sub-projects had to be analyzed and justified separately based on the criteria established in the Project Implementation Plan.

Often, the first opportunity for all stakeholders to interact with one another was in the project-specific environmental EIAs reviews and the related public consultations. In one case, a stakeholder work group was formed for Eixo Castanhão implementation works in response to a request from stakeholders for continuous dialogue about the within-project alternatives. For this the Grupo de Trabalho Multiparticipativo do Eixo Castanhão was created, composed of representatives of 30 organizations from different segments of society. These included religious groups and community interest groups, workers, representatives of farmer organizations, industries,

members of the River Basin Committee and the involved municipalities, as well as several state secretaries and members of the State Legislative Assembly. The group held meetings, visited the site and received technical presentations that helped to establish a two-way communication with the SHR.

### Operation of reservoirs and inter-basin transfers

In contrast to limited stakeholder involvement in the selection of reservoirs, the involvement of stakeholders in decisions about the operation of water storage and transfer facilities was more advanced. Four river basins had already created water user associations that were functional at the time PROGERIRH was prepared. These associations consisted of state agencies, unions, irrigator associations, farmer associations, fishermen, city administration clerks, cooperatives and other community representatives. There were also operational river basin committees in the Curu and Jaguaribe basins. These groups had input to the criteria for redefining the operation of the existing and proposed facilities, including releases for environmental flows and inter-basin transfers. They also embarked on the task of preparing basin-level plans within the framework of the state plan. Once functional, the water user associations and the river basin committees in other basins would similarly have a key role informing decisions on the future operation of reservoirs in their basins, and in drought planning and development of basin plans.

### How did the options assessments and stakeholder involvement improve development outcomes?

One important outcome was that priorities relating to reservoirs and their operations were established to improve water supply management and water security across the State, an outcome that was widely accepted as a central need for the State's economy and social development. Because of the physical investments that were made and the strong foundation prepared with the institutional and legal framework to involve stakeholders in the management of these assets, it is now possible to move to the next levels of participatory water management.

Government officials became more aware of what stakeholders expected in terms of participating in water management. Similarly, stakeholders gained an appreciation of how the State expected them to participate in decision-making processes. In effect, it was a learning experience for all. There also was growing confidence that stakeholders would play an expanding role with the new multi-stakeholder organizations at basin levels. More over, along with benefits of river basin integration, the increasing complexity of the system and social and environmental impacts of inter-basin transfers will bring about new sets of conflicts. The establishment of river basin committees and participation of water users will improve the capacities of stakeholders to resolve the future conflicts that will inevitably arise, and to inform decision-making.

More specific outcomes were:

- The preparation of the additional studies allowed more open debate of the inter-basin transfers and the ways in which different interests proposed that the adverse social and environmental impacts be addressed.
- The new set of databases, studies and project investigations created a platform for future options assessments, where updates can be possible. New methodologies for evaluating options can be institutionalized in public organizations, as well as in the local companies involved in consultancy work and construction, and a knowledge base is available for the new basin committees and water user organization.

### What lessons are offered?

- While it is essential to create a large portfolio of projects on which to base an options assessment, this can take a number of years. Once established, it is important to have mechanisms to constantly improve the portfolio of projects in iterative steps. It is a dynamic process involving continuous revision and improvement of criteria in each successive cycle of ranking, elimination of projects from further consideration (as early in each cycle as possible), and bringing in new projects as circumstances change and more understanding and information on each option becomes available.
- A systematic process for options assessment improves the ability to reach a decision in areas that involve significant tradeoffs or controversy, or to minimize them. In Ceara State over 24 reservoir projects were built under the PROURB PROGERIRH projects. Time was saved reaching decisions about this in a relatively large number of projects because there was a policy framework in place, a supply plan available (PLANERH) with an inventory of 40 projects; and a systematic process to identify and screen the options.
- In selecting new options to add to an integrated system, criteria that indicate how each particular option would operate in the system context are

important. The understanding of these criteria (e.g. integrated and optimized operation and cumulative impacts that take into account environment, social and physical performance) is rapidly evolving. Just as environment and social criteria have been introduced at the project-level, they need to be introduced at the system level for selection and management of options. Particular attention must be paid to update these criteria in each successive cycle of planning.

- An evolutionary approach to building the capacity of stakeholders to engage in decision-making processes is viable. Participation started with better interaction of regional and state-level agencies, then widened to include non-governmental organizations and subsequently to include water user organizations. Gauging public support during such an evolutionary approach is, however, important to ensure that the initially limited stakeholder group comes to conclusions that are widely acceptable.
- A multi-disciplinary and multi-agency study team helps to improve the quality of options assessments and the ability to bring in all perspectives. Here, the state government recognized the important role played by the UPEP as the team in charge of the preparation of PROGERIRH and of overcoming the disadvantages of over-reliance on any one public or private organization, or dominant perspective.

# Central Asia: Aral Sea Basin Multistate Water Resource Cooperation

### A World Bank Case Study

This case study illustrates the interstate stakeholder instruments that were set up to promote mutually beneficial cooperation on regional water resource management among five newly independent republics in the Aral Sea Basin in Central Asia. This followed the collapse of the former Soviet Union (FSU) in 1991.

The case study notes the efforts to introduce and broaden the involvement of national stakeholders in water management decisions within each country, while far-reaching political, economic and social transformations were underway (though at different paces in each country). It also discusses the extent to which national stakeholders began to inform the emerging national positions on regional water resource cooperation.

## What was the context?

On independence in 1991, there was an urgent requirement for new policies and instruments to coordinate water management among the five states in the Aral Sea Basin (the Republic of Kazakhstan, the Kyrgyz Republic, the Republic of Tajikistan, Turkmenistan and the Republic of Uzbekistan).[2] Previously, Moscow-based agencies set the rules for the development, management and sharing of the region's water resources. Stakeholders in Central Asian had limited influence on the Soviet decision-making processes.

The two main river systems in the Aral Sea basin are the Amu Darya and the Syr Darya. They rise in the upstream mountainous countries (Tajikistan and Kyrgyzstan) before flowing westward through the arid plains and desert areas of Turkmenistan and Uzbekistan (Amu Darya River) and of Kazakhstan (Syr Darya River) and flow into the Aral Sea. They represent three quarters of the basin's water resources.

Since the 1960s vast tracts of the Central Asian desert had been converted to water-intensive cotton and rice production, and 7.9 million hectares had been converted by 1990. Uzbekistan, the most populous country in the basin, was designated as the main cotton supplier for light industry in the Soviet command economy. The near total diversion of inflowing water to the Aral Sea for irrigation, combined with excessive use of agricultural chemicals, led to extraordinarily devastating ecological and social effects. The Aral Sea shrank to less than half its size of the 1960's, and 90% in volume, by 2003.

On independence, the policies for water storage in and regulation of the river systems became an immediate regional concern. In the Soviet era, some 39 large water reservoirs were built to regulate flows and support diversions, including 5 major reservoirs in the Syr Darya basin and 2 in the Amu Darya basin. Releases from these reservoirs, including large hydropower schemes in the upstream countries such as the Oktogul reservoir in the Kyrgyz Republic, were optimized for downstream irrigation during the summer growing season and to provide multi-annual storage for drought security. On the break-up of the Soviet system, controversy arose over conflicting needs for winter water releases for hydropower generation as desired by the upper riparians and maintaining the summer release schedule for irrigation as desired by the lower riparians.

In the Soviet era there were fixed allocations of water to each republic. For example, the Kyrgyz Republic was allocated 25% of the water originating in its territory, including both surface and groundwater. Therefore, it could internally consume up to 25% of its water resources, but had to pass 75% of the resource downstream. Without a binding interstate legal framework, these arrangements came under pressure. Each country sought to maximize water used within its boundaries. Apart from water rights, regional water and energy trade issues also became linked. In fact, a number of complicated and interlocking concerns that affected economic cooperation, peace and security in the region had to be sorted out after the breakup of the Soviet system.

## What strategic issues for interstate water resources cooperation were confronted?

On independence, new mechanisms for water resources cooperation among the five states had to be established almost overnight. Each state came with a different position and competing interests for the management and use of the water resources in the basin.

2 The five states are also known by a second name either officially or informally: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Two common, immediate needs that were agreed were to replace the central decision-making system with new instruments for interstate cooperation in water management and to diminish tensions in several potential conflict areas. These included rising tensions:

- between arid regions of Uzbekistan and Turkmenistan competing for abstraction of water from the Amu Darya to support water-intensive irrigation developments where much of their labor force was employed;
- between upper and lower riparian states on the operating policies of reservoirs to reflect tradeoffs between irrigation production and hydropower generation;
- over coordinating policies for flood protection and management throughout the basin; and
- over a number of "hot spots" in the region where water conflict was spilling over to political and ethnic clashes within counties and groups on either side of borders.

Beyond the immediate social and economic pressures, there was a need to develop specific measures for the joint management of transboundary waters and to promote mutually beneficial and sustainable water resources development and management for the longer term. In this context, selected characteristics of the riparian states and common challenges are shown in Table 1.

**Table 1: Representative water management issues and concerns in the five Central Asian States in the ASB**

<table>
<tr><th></th><th>Turkmenistan</th><th>Uzbekistan</th><th>Kazakhstan</th><th>Kyrgyzstan</th><th>Tajikistan</th></tr>
<tr><td>Dominant Water Use Interest</td><td>Irrigation</td><td>Irrigation</td><td>Irrigation</td><td>Hydropower</td><td>Hydropower</td></tr>
<tr><td rowspan="3">Common Issues/ Problems</td><td colspan="5">• Competition in regulation and /or abstraction of water from the Syr and Amu Darya systems<br>• Flood protections and management<br>• Water quality, environmental flows, protection of water resources and wetland management</td></tr>
<tr><td colspan="3">• Inefficient water use and water-intensive agriculture patterns<br>• Water scarcity in drought years<br>• Water related environmental degradation with increased waterlogging, land and water salinity as the greatest problems</td><td colspan="2">Winter season use of hydropower</td></tr>
<tr><td colspan="3">• Stabilization of water levels in the Aral Sea<br>• Addressing the combined socio-economic and environmental effects of the Aral Sea retreat</td><td colspan="2">Water resource dimensions of regional energy trade of hydropower and Kazakhstan's oil and gas.</td></tr>
<tr><td>Governance System</td><td>Centralist</td><td>Centralist</td><td>Transitional Democracy</td><td>Transitional Democracy</td><td>Transitional Democracy</td></tr>
<tr><td>Civil Society and NGO Presence</td><td>Not active</td><td>Active but with limited impact</td><td>Most active in the region</td><td>Limited</td><td>Limited</td></tr>
</table>

There were also conflicting views within the region on how to deal with the Aral Sea problem and take pressure off water resources in the basin. The republics in the lower part of the basin tended to favor proceeding with one of two inter-basin transfer schemes that involved either the diversion of Arctic Siberian rivers southward (e.g. the Irtysh and Ob'), or the transfer of water east from the Caspian to the Aral basin. A third option advocated by the international community, which was increasingly active in the development dialogue in the region in the post-1991 period, was to rationalize water supply and use within the entire basin, and especially to reduce abstractions for irrigated rice and cotton to permit the water levels of the Aral Sea to stabilize.

A ministerial level Commission was formed to "Save the Aral Sea." Initially, this was to promote the two inter-basin transfer options, which had been planned in the Soviet era. Construction of diversion from the Irtysh River had actually started in the mid 1980s, to transfer water for use in northern Kazakhstan and in the deltas of the Amu Darya and Syr Darya to further expand irrigation. Construction had been stopped by the Soviet Douma in the late 1980s, in the early days of Perestroika due to the massive cost, estimated at 20 to 25US$ billion, and to growing concerns over the environmental impacts.

Eventually it was accepted that the Aral Sea could not be restored to its former conditions, and that stabilizing the situation, including water levels and ecological and land systems, should be the immediate goal. National governments eventually agreed to cooperate on water resource management measures to achieve these goals within the framework of what later emerged as the Aral Sea Basin Program (ASBP). They nevertheless reserved their position to augment water supply in the Aral Sea basin with inter-basin diversions in the future.

## What mechanisms for inter-state water resources cooperation were established?

The only regional-level water organizations in place on independence were the Amu Darya and Syr Darya River Basin Organization (BVOs). These had been established by the former FSU in 1986, though with limited functions and jurisdiction. Immediately on independence, a ministerial-level Coordinating Committee was established to guide the two BVOs. However, this rapidly proved to be an unworkable framework for political and practical reasons, as well as legacy issues.

An interstate agreement was subsequently signed in February 1992, expressing the principles of co-operation, management, utilization and protection of water resources in the Aral Sea basin and the need for joint measures to address the Aral Sea problem. This agreement also established a new Interstate Commission for Water Coordination (ICWC). One of the ICWC's functions was to determine and approve the annual water operation strategies of reservoirs in the Aral Sea basin to manage conflicts between irrigation and hydropower. The agreement also confirmed the existing water allocations to each county as permanent water rights, adopting the formula for water sharing that evolved in Soviet times. It was an important start, but there was growing dissatisfaction, especially by the two upstream states, about maintaining the "inherited" water allocations.

When the five Central Asian states became members of the World Bank in early 1992, they collectively asked the Bank for assistance in investment in water management and infrastructure. The Bank launched a series of missions to gain a better understanding of the issues and options. Then, with support from the Bank and the donor community, the five basin states prepared the Aral Sea Basin Program (ASBP). This was approved by the five Heads of States in 1994.

Four core long-term objectives of the ASBP were defined as stabilizing the environment of the Aral basin, rehabilitating the disaster zone around the basin, improving transboundary water management and building the capacity of regional institutions.

Chronology:

| | |
|---|---|
| 1991 | Independence of Central Asian states |
| 1992 | Interstate Commission for Water Coordination (ICWC) |
| 1993 | Interstate Council of the Aral Sea (ICAS) in Tashkent |
| 1992 | International Fund of the Aral Sea (IFAS) in Almaty |
| 1993 | Sustainable Development Commission (SDC) in Ashgabat |
| 1994 | The ASBP was launched. |
| 1997 | Merging IFAS and ICAS into a new IFAS |
| 1998 | Agreement on the use of water and energy resources in the Syr Darya basin |

Within the ASBP framework, separate programs and projects were then developed around the core objectives – initially comprising 8 sub-programs and 20 projects, all partially funded by various donors. The Phase 1 projects had several areas of focus, including:

- Preparation of a regional water resources management strategy;

- Development of a regional environmental monitoring system to track water availability and consumption;
- Reduction of agricultural, industrial and municipal water pollution;
- Research and selection of engineering options for environmental restoration projects;
- Design and implementation of regional public education programs on the environment and health;
- Integrated land and water management in the upper watersheds; and
- Institutional capacity building for regional environmental management.

While the ASBP provided a successful regional framework to launch and finance projects to deal with specific problems, it was not a decision-making body. Managing transboundary water resources (e.g. allocations, and quality and pattern of use) with the full consensus of all five states remained difficult, even though a general agreement and the institutional mechanisms were essentially in place from 1992. There was a constant search to improve the effectiveness of the decision-making mechanisms.

In 1997, the Interstate Council for Addressing the Aral Sea Crisis (ICAS) merged with the International Fund of the Aral Sea (IFAS). It was envisaged by different external observers that that the Executive Committee of IFAS would provide a mechanism for overall ASBP coordination. The outside community (such as donors) also considered that IFAS might evolve into a form of water parliament, and that the Basin Water Associations for the Syr Darya and the Amu Darya would implement policies.

There were also attempts to develop sub-basin mechanisms involving selected countries. In 1998, three of the five countries (Kazakhstan, the Kyrgyz Republic, and Uzbekistan) took further steps to resolve the irrigation-power tradeoffs by adopting a framework agreement called the "Agreement between Governments of the Republic of Kazakhstan, the Kyrgyz Republic, and the Republic of Uzbekistan on the use of water and energy resources of the Syr Darya Basin". In May 1999, Tajikistan joined this agreement. Essentially the aim was to broaden the framework for cooperation on water and energy management so that within a wider framework, more tradeoffs could be possible to help resolve specific water management concerns. For example, the 1999 Agreement linked the regulation of the Toktogul reservoir in the Naryn-Syr Darya river cascade to a compensatory scheme for oil and gas transfers. Electric power generation in excess of summer demand in the Kyrgyz Republic is now sent through the Central Asian the power grid to Kazakhstan and Uzbekistan in equal portions. In return and as compensation for agreeing to a reduction in winter season generation in favor of summer releases for irrigation, the Kyrgyz Republic receives coal, gas, heavy oil, and other types of petroleum products from downstream countries, mainly Kazakhstan.

The policies for the Toktogul reservoir operation, power transfers, and quantity of resources such as oil and gas received in compensation are approved annually by bilateral and multilateral committees that operate within the 1998 Agreement framework. Decisions on day-to-day water releases are made by the BVO Syr Darya based on irrigation activities and needs in Kazakhstan and the Central Asian Unified [Electricity] Dispatch Center based on regional power dispatch schedules. However, the BVO Syr Darya has no direct authority over Toktogul operations.

The broader picture is that experience and confidence are being gained with the use of different mechanisms, but there are still many controversial issues. Consequently, the mechanisms for interstate cooperation may be seen as transitional, and adapting to the constantly evolving political and economic transformations.

## What mechanisms for national level-stakeholders helped to inform national positions on interstate cooperation?

Progress in promoting stakeholder involvement in national water management decisions has varied from country-to-country, largely depending on the pace of the larger political and economic reforms.

Both Kyrgyz Republic and the Republic of Kazakhstan are seen as leaders in market reforms and civil society development. The Kyrgyz Republic commenced a strong economic reform program with privatization of land. They focused on irrigation rehabilitation projects and established water user organizations to participate in decision making processes. Uzbekistan has undertaken investments in rehabilitation of infrastructure and has taken cautious steps towards political reforms. Adhering to Soviet style planning, Turkmenistan has been more hesitant in cooperating with other Central Asian states and the international community at large. In both Uzbekistan and Turkmenistan, major management reforms in the agriculture and water sectors that would promote stakeholder involvement are still pending.

Apart from tackling national water management challenges, there has also been the progress in building

better awareness within countries of how neighboring states view water issues, what they see as important, and the tradeoffs, as well as their interdependancy in terms of how the policies and practices adopted in each state can affect the other states in the basin.

Regional and national conferences, workshops, and seminars were organized under the ASBP framework involving governmental and, for the first time, non-governmental stakeholders. These involved a two-way information exchange between government specialists, NGOs and the public on issues of energy, water saving, legal questions and identification of priorities at regional level.

Many of the individual projects sponsored by donors under the ASBP also encouraged public participation and had public awareness components. For example, the Water and Environment Management Project (WEMP: 1998-2003), had a public awareness component in which media and environmental NGOs and the public in three states learned more about the Aral Sea crisis and its negative impact on all five countries. Local scholars, journalists, writers and NGO leaders were invited to discuss the Aral Sea problems and debate actions to improving situation. In contrast, centralism in management of the water-related issues in Turkmenistan and Uzbekistan restricted access to information and open discussions of the problems of the Aral Sea and regional cooperation are rare.

### What benefits emerged from the inter-state cooperation and building awareness of the issues among national stakeholders?

Despite the fragmentation of Central Asia and the different pace of economic and political reforms among the five countries, since 1994 the countries of the Aral Sea Basin have moved to establish interstate mechanisms to deal with urgent problems. This is demonstrated in the progressive series of agreements involving all five countries, and where this is not possible, sub-groups of the five countries. These steps also paved the way for longer-term solutions. Clearly, this shift to transboundary cooperation after the collapse of the Soviet Union helped to diminish the threat to peace in the region.

Overall, transboundary water management has not improved in the sense of a major break-through, but many important steps have been taken to build the capacity of the regional institutions. Due to public awareness campaigns, issues that were never discussed in public before, are now visible. Key issues, such as how to implement a water savings and salinity management strategy, also never discussed openly before, have been considered for the first time. In more recent projects, such as in the Syr Darya Control and Northern Aral Sea Project (2001-2006), which is undertaken by Kazakhstan within the framework of the ASBP and with the support of all riparian countries, consultations and collaboration with civil society and stakeholders have been very extensive. A range of stakeholders was engaged in dialogue on the project design and implementation from village, rayon (district), oblast (province) and central government level administrations, to irrigation, fisheries and other water users and representatives of production cooperatives. However, while public awareness leads to more informed debate, it does not necessarily lead to consensus on interstate water resources cooperation. For example, the 1992 interstate agreement forming the ICWC came under heavy public attack in the Kyrgyz Republic where it was perceived that the government had "surrendered" Kyrgyz rights to water originating from its territory.

In fact, it is too early to tell precisely how transnational water management in the Aral Sea Basin will be improved by the involvement of national-level stakeholders in interstate dialogue processes. As mentioned, the coordinating mechanisms for interstate cooperation are there and awareness of the transboundary issues involved is growing in public, government and non-government circles in some of the countries, but not all. It is also clear that progress in transnational water management will not occur in a vacuum. The enabling environment of political, economic and institutional reform within each country will have a large influence on the national positions and negotiating strategies that are adopted, and the eventual outcomes.

### What lessons were learned?

Despite many shortcomings and limitations, the efforts of the governments in Central Asia offer a number of lessons on interstate cooperation and stakeholder involvement:

- A strong regional organization is needed to harmonize basin-level planning activities and to implement regional programs that are mutually beneficial. In the Central Asian case, the ASBP mechanism was not a decision-making body, but it provided a regional institutional framework for undertaking the necessary technical and planning studies that were in the common interest of the five countries, especially initiating the baseline studies on water availability and use, water quality, and ecosystem functions and providing hydrological monitoring and data networks.
- National governments need to have mechanisms

in place to inform them of public attitudes and views on their transboundary water management positions. For example, what emerged in Central Asia were the NGOs and civil society interests in the Kyrgyz, Tajikistan and Kazakhstan that helped to place environmental and social issues on the agenda.

- To improve the scope (and options) for regional water resource cooperation, it may be appropriate to move incrementally toward agreements and to broaden the framework for negotiating trade offs, essentially what is referred to as thinking "outside the box." The Aral Sea basin experience showed that a series of progressive improvements in the mechanisms for interstate cooperation occurred. These took time. Secondly, meaningful progress was achieved when basis for agreements was also broadened. The 1998 Agreement covering the Syr Darya basin showed that agreements on the basis of regional energy trade (oil, gas and power) can help facilitate or water management agreements(in this case operating reservoirs to manage hydropower and irrigation trade offs). Options would then be identified and developed according to the agreements reached.
- The establishment and full functioning of mechanisms for interstate cooperation is a slow process that requires long-term commitment and support of development partners this is demonstrated not only in the Aral Sea basin, but for example also in the Nile and Mekong basins.

# China Loess Plateau Watershed Rehabilitation Project (Loess I and II)

## A World Bank Case Study

This case study illustrates how three Provinces in the arid Loess Plateau region of northwest China used participatory processes to identify, evaluate and implement a diverse set of options designed to improve land and water management in small tributary watersheds of the Yellow River. Improved catchment management was a central element of an integrated, multi-sector approach to raise rural incomes by increasing on-farm agricultural productivity, converting marginal lands to agriculture, improving rural water supply, and reducing severe erosion and sediment flow into the Yellow River system.

The Loess I project was initiated in 1994 in selected small tributary watersheds. Based on its success, the effort was scaled-up for wider replication across the three provinces and expanded to the autonomous region of Inner Mongolia, under Loess II (starting in 1998). Over 460 sediment control and water supply dams (mostly from 5-15m high with some up to 30 meters high) emerged from the bottom-up process as part of the mix of responses. The experience gained with the Loess projects (both ongoing) is expected to shape future government efforts to strengthen and promote integrated catchment management in the region.

| Chronology: | |
|---|---|
| 1980's | IDA financed a number of projects with watershed components (Gansu Province) that generated lessons for the Loess project |
| 1994 | Loess I Project initiated on nine tributary watersheds of the Yellow River. |
| 1996 | Testing and development of the feasibility and integration of options into a small catchment program |
| 1997 | Government request to Bank Group to scale up and expand the Loess Project (extend to more catchments in the Loess 1 area and other tributaries to the Yellow River.) |
| 1998 | Evaluation Loess I and Preparation Loess II |
| 1999 | Appraisal/Approval of Loess II expanding the program to 12 tributary watersheds in 4 Provinces and Inner Mongolia |
| 2004 | Scheduled Completion: Loess I and Loess II |
| 2004+ | Expected mainstreaming in Govt. Programs |

### What was the context?

The Loess Plateau, located in the upper and middle drainage areas of the Yellow River in northwest China, is one of the poorest areas in the country. Arid to semi-arid conditions and high population pressure combined with unsustainable agricultural practices have resulted in widespread poverty for over 400 million rural people. Progress in dry-land agriculture practiced on the Plateau has lagged well behind advancements in irrigated agriculture in other parts of China. Recognizing its significance for poverty reduction, the government made the improvement of agriculture productivity in rain-fed areas a key element of the Ninth 5-Year Plan (1995-2000).

The Loess Plateau is also the most erosive area in China. In addition to drought and water scarcity, it suffers from short-duration intense rainfall events and floods. An average sediment load of 1.6 billion tonnes enters the Yellow River system each year. One consequence is the bed level of the lower Yellow River rises above surrounding land with each annual cycle of flood and sediment deposition. To keep pace with this, the flood embankments have been raised at a rate of 1 meter every 10 years to protect the urban, industrial and agriculture areas in downstream reaches of the Yellow River, costing several billion dollars each time. Recognizing that this practice was not sustainable in the long term, the government began looking for alternative ways to address the problem.

Throughout the 1980s, a series of campaigns was mounted to terrace slopes, plant trees and shrubs to improve water retention, and build check dams to intercept sediment in flood runoff. While helpful in combating massive soil erosion, these interventions were not sufficient for the scale of the problem. Moreover, they were not well integrated with efforts to raise agricultural productivity and farm incomes, which limited local involvement, and therefore also limited the effectiveness the interventions.

By the late 1980's, trial programs of comprehensive watershed development were beginning to show that land conservation was compatible with sustainable agriculture, reducing soil erosion and raising farm incomes. This raised interest in integrated planning for small individual watersheds.

In 1994, the Loess I Project set out to identify and evaluate the technical feasibility, practicality, and farmer acceptance of a combined set of measures, and to explore institutional arrangements (support services) to deliver them efficiently, such as through better cross-sector integration of existing government programs.

The approach was to establish a portfolio of measures suitable for a variety of circumstances that could be selectively tailored to each small watershed and local preferences. The focus on integrated watershed rehabilitation at this scale created new challenges in the Chinese system. It required a high degree of cooperation among disciplines in the water resource engineering, forestry, soil and water conservation, agriculture and livestock sectors - not only at higher policy/planning levels, but also on the ground where planners and farmers needed to interact closely.

In its first three years, Loess I demonstrated the technical viability and combined effectiveness of different mixes of options. New capacities needed for planning, design and implementation at the provincial, county, township and village levels were also identified, and the incentives that farmers required to engage in the process were identified and tested. The success of Loess 1, as viewed at all levels-from farmers to the central government led the Ministry of Finance and the Ministry of Water Resources (MWR) to request World Bank support to expand the initiative. Preparation of Loess II (1999-2004) started in 1997.

The combined projects (Loess 1 and II) now cover 19,500 sq. km in 12 silt-laden tributaries of the Yellow River, where there are 3,350 administrative villages, 264 townships, 37 counties, and 12 prefectures. The aim is to benefit about 2 million rural poor in three provinces Shanxi, Shaanxi, and Gansu and in the autonomous region of Inner Mongolia. Flooding in the late 1990s further heightened the urgency in addressing the connected problems of flood, deforestation, erosion, and unsustainable land-use practices.

The Yellow River Conservancy Commission (YRCC) is the lead agency for delivery of Loess I and II. It normally manages centrally financed or joint central-provincial water resource construction works and soil and water conservation programs within the basin. The management structure of the Loess project (the mechanism for coordinating stakeholder involvement) included Project Leading Groups (PLGs) and Project Management Offices (PMOs) at the central, provincial, prefecture, and county levels.

## What options assessments were carried out, and by whom?

Box 1 indicates some of the options evaluated in Loess I that could be adapted to different watersheds. Broadly, factors such as topography and soil conditions, local agriculture practices and local institutional capacities influenced the mix of options particular catchments. The beneficiaries were also financial partners in the project, taking loans to participate in the options they selected – from provinces and districts down to and including individual farmers.

There were also various support services to choose from, including research, training, and institutional capacity building measures.

## On-farm options

To inform the choices at the farm level, farm model analysis was used to clarify the possible impact on farm incomes for different measures.

Because the beneficiaries were poor, loan repayment periods from rural credits offered with each measure

**Box 1**
**Loess I Options Evaluated (examples)**

Options included a mixture of existing and new practices, set in a more integrated catchment management framework. These included:

- sediment control dams to retain sediment runoff (some providing local flood control and storing runoff for local irrigation and village water supply);
- rainwater harvesting using small surface water diversions and water cisterns to catch runoff from roads for irrigation and water supply;
- Conjunctive use of surface and groundwater (preventing the rise or decline of the water table);
- cropland improvement measures including conversion of slope-lands to terraced lands for water retention and erosion control;
- slope-land protection measures to increase erosion control capacity with planting and protection of vegetation cover;
- groundwater and other small-scale irrigation systems where water tables permitted, and a variety of on-farm income-generation programs to diversify income sources.

were matched to their income stream and projections. Here, farmers realized addition income in different time frames. For example, increased income from terrace crops came after 3-5 years; income from commercial trees and fruit trees came after 8-13 years; and lastly, income from arbor trees came after 20 years. Choices at the farm-level were thus based on considerations of the benefits, additional income and loan terms.

### Multi-function sediment control dams

Choices regarding the system of sediment control structures in each small catchment were made in consultations between local, district and provincial levels, facilitated by the Loess Project team. These choices reflected a blend of parameters for the management of sediment in the catchment as a whole, and taking into account the interests and types of choices being made at the farm and village level.

In addition to sediment interception in gullies and conversion of marginal land to agriculture land, some dams were designed for multiple functions such as localized flood control, or to store water for irrigation and village water supply. The two main types of dams chosen were:

- Key dams: earth embankment dams usually 5-15 m. high, but some up to 30 m. high to control sediment runoff and floods in drainage basins of 3 to 5 sq. km. Once filled with sediment, the dam could be raised, or the land converted to agriculture. Depending on local conditions and degree of stabilization achieved, a new upstream dam could be considered and the process repeated to reclaim further land. In the Loess II, some 130 key dams are being constructed and 20 existing key dams rehabilitated;
- Warping dams: earth dams usually 3-10 m in height, built in gullies to intercept sediment in smaller catchment areas under 3 sq. km. The primary purpose of warping dams is to create new agriculture land from marginal land. Some 335 warping dams are being built under Loess II.

Loess I showed it took about 3 years for land to be ready for farming behind warping dams, and 8-10 years for key dams. Each dam included an outlet conduit and intake structure designed to accommodate future raising of the dam. Low dykes to stabilize recovered land around warping and key dams were included where needed. Also, numerous small rock or brushwood check dams were built to slow flows in the gullies and prevent undercutting of the gully sides.

Loess I involved no land acquisition or involuntary resettlement largely because the topography allowed flexibility in siting dams away from existing or potential settlements. Similarly, no resettlement was expected under Loess II. Dams are designed by provincial water resource bureaus according to standards developed by the Ministry of Water Resources (reviewed and approved by the World Bank). The procedures require multilevel technical reviews and approval of the siting, design and construction.

### Selection of small watersheds to participate in Loess II

Participation in the expanded Loess II program was oversubscribed and thus criteria to select the small watersheds for inclusion in the program needed to be seen as fair. The criteria adopted after discussion at various government levels included: the severity of soil erosion; the poverty level in the catchment; experience in soil and water conservation works; development potential and repayment capacity; presence of leadership and commitment at the local government level; and the proximity to science and research organizations involved in soil and water conservation. A broader aim was to provide a base of experience in different settings where government could further expand and introduce the measures in mainstream programs in future.

### Options excluded from Loess II

During the preparation of Loess II, proposals to include a broader range of rural road, drinking water supply, and social sector investments was considered and rejected. The experience in Loess I showed that integrated land and water resource development was sufficient to raise incomes and reduce sediment inflow to the Yellow River system – the primary aim of the program. Moreover, it was felt the success of Loess I was due in part to its simple design. Government already had separate programs for those other investments.

### What other steps were taken to enhance stakeholder involvement in decision-making processes?

During preparation of the Loess II, an EIA was undertaken to assess the conditions in the new watersheds to be brought under the Project. The EIA also served as a mechanism for stakeholders to assess the need for further revision of the range of options being offered, or adjust the implementation arrangements.

## Loess II project preparation

Following the Loess I model, PMOs worked with the villagers through the village committees in new watersheds to select the options for that community. In parallel, PMOs met with local government departments to identify and coordinate government support services for on-farm initiatives and to plan the network of sediment control structures for the catchment. The provincial bureau assisted with the evaluation of the key dams and warping dams in each catchment.

Other steps were taken to respond to local interest in moving rapidly to implementation and to maximize the benefits and effectiveness of local participation. For example, during the preparation of Loess II funds for small watershed land use surveys and to prepare technical designs for certain elements such as fruit storage, and irrigation and sediment retention structures was made available to prepare for rapid implementation once the Loess II funding was in place.

## Loess II project implementation – additional measures

Building on the Loess I experience, a number of additional measures were introduced to improve the ability of beneficiaries to participate effectively in Loess II. Among these:

- Additional Project Support Services: 10% of the Loess II budget was allocated for research and extension including training and study tours of Loess I sites, monitoring and evaluation, and survey and design. Research included topics in dryland farming techniques, grassland improvement, and forage and grazing management. Training covered project management, agriculture and forestry techniques, water-saving irrigation, computers, nursery management, and grassland management. The training was tailored to project managers, technicians and farmers.
- Land Contracts for NewAgriculture Land Created by Dams: As identified in Loess I, the insecurity of land tenure was key disincentive to long-term improvement in land. To overcome this, all new land created by the key and warping dams under Loess I and II was contracted out to farmer households. Land contracts signed between farmers and local governments explicitly state the terms, land use rights and obligations to afford legal protection to the farmers. Farmers received properly signed, sealed and registered contracts, copies of which were held in the township or county registries to the farmers. Under Loess I terms for land contracts varied between 10 years and 30 years, though in practice they were frequently adjusted. Under Loess II, the land contracts were required to be a minimum of 30 years.
- Financial participation and cost recovery: Unlike previous initiatives that were largely State funded the Loess program was cost-shared with beneficiaries. Village committees collected funds from farmers, and channeled these through the townships and counties to the prefectures. The provinces thus expected to recover 60% of the funds disbursed under the Project. The fees established for cost recovery at the farm-level were determined based on the farmer's capacity to pay and on the incremental income from participation in each project component. Repayment of loans by the beneficiaries does not begin before the incremental income was realized, and would not exceed 50 percent of their net incremental income. The terms actually vary among components and to some extent between prefectures.

## How did the options assessments and stakeholder involvement improve development outcomes?

The strong demand and competition among counties to participate in Loess II was a clear indication that the beneficiaries regarded the menu of options offered as highly desirable. The impacts of the various components exceeded the expectations in most respects. Broadly:

- The participatory methods engaged planners and farmers in devising successful practices that can be applied to large areas of the Loess Plateau. More sustainable and replicable water and land management practices and dryland agriculture models were successfully introduced;
- The combination of soil stabilization and check dams far exceeded the capacity of one strategy for sediment management in the basin alone. It was estimated that the combined effect of the measures under Loess II would reduce sediment inflow to the Yellow River system by 29 million tonnes annually;
- The system of key dams, warping dam and smaller check dams was able to provide a 100 percent control of coarse sediment runoff in small watersheds, and many sites with marginal land were turned into good quality agriculture land;
- Loess I showed that farm incomes had risen appreciably from the diversification of horticulture and dry land agriculture practices and improved livestock management;

Loess I and II also demonstrated the commercial viability of the various options by increasing agricultural productivity and incomes. In previous approaches, farmers and the emerging private sector had been unwilling to provide financing for these initiatives. Loess I and II showed that farmers were willing to pay where their critical concerns about drought and changes in farm gate prices were addressed. With important reforms in rural credit and banking underway, the project showed that commercial returns for rural credit were possible.

For sediment control dams and land reclamation, the timeframe when farmers realize direct benefits is longer, thus limiting the scope for cost recovery from villagers. The financing plans that had been established for key dams in Loess I were subsequently adjusted in Loess II to allow for lower farmer contributions. In Loess II, the county, province, and central governments bore a higher proportion of the costs of the sediment control structures in the catchments.

## What lessons are offered?

In the Loess Plateau context, integrated watershed development is effective means to address multiple-development concerns and can be promoted on a large scale. The rapid progress and quality of work has confirmed the validity of a strategy that relies on the joint efforts of villagers and government technicians at all levels.

Other lessons include:

- A diverse set of mutually reinforcing options is needed to address complex water resource management issues. In the rural context, there are clear advantages to be gained by involving beneficiaries and government stakeholders in identifying options, participating in the evaluation of their effectiveness, and linking the choices made at the farm level to the decisions on catchment-level measures that are undertaken by government;
- The success of initiatives improves when the options offered are clearly tied to the needs of the beneficiaries. For example, in Loess I, it was apparent that planting of grasses to stabilize soils is only attractive to farmers when combined with improved livestock management;
- It is important to keep such watershed management initiatives well structured, simple and understandable. If they are overly complex there is higher risk of failure in implementation;
- Partnerships are needed to successfully implement strategies and options that are inherently cross-sector in nature, and require joint actions by beneficiaries and government organizations;
- Integrated and participatory approaches to the evaluation of options need to continue through implementation. This can lead to more effective inter-sectoral coordination and development of institutional capacity at all levels of government.

The 1998 and more recent floods in the Yellow River basin and the huge social and economic losses that resulted showed that combine strategies in the upper and lower reaches of the basin are necessary to cope with challenges. The new strategy for small catchment management (Loess I and II) will have an immediate impact on the lives and livelihoods of people in the upper catchment areas, and a longer-term impact reducing the scale of floods confronting populations in the lower reaches of the Yellow River. Steps that take pressure off the downstream regions by reducing the possibility of major breaches in existing flood protection structures are a part of the lager strategy for basin management.

One such example is the Xiaolandgi project, a major dam on the main stem of the Yellow River in Henan province. The Xiaolangdi reservoir is designed to operate with other reservoirs (Guxian, Luhun and Sanmenxia) to mitigate floods up to once in 10,000 years in frequency, thereby reducing the possibility of breaching flood defenses. Floods of 45,000$m^3/s$ can be reduced to 27,500 $m^3/s$ and may pass through the lower reaches with a higher probability of maintaning public safety. In addition, the dam will be operated to reduce smaller floods in the floodplains, which would displace about 1.4 million people every other year. For example a 12,000 $m^3/s$ flood (once in seven years) which would displace about 1.4 million people in the floodplain would be reduced to about 6 000$m^3/s$.

# Comprehensive Options Assessment: The Pongolo

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**Key words:** irrigation, environmental flows, cooperative management, stakeholder participation, South Africa

## Geographical and socio-economic background

The Pongolopoort dam, which impounds the water of the Ponogolo River in KwaZulu Natal, South Africa, was built in the 1970s to provide water for irrigation. The dam is located where the river flows through a narrow gorge between the Lebombo and Ubombo mountain ranges, close to the border with Swaziland. Immediately downstream of the dam, a broad alluvial plain, known as the Pongolo Floodplain, extends from the dam to the confluence of the Pongolo and Usutu Rivers, close to the border with Mozambique. Within Mozambique, the river is known as the Rio del Maputo. The river gradient through the Pongolo Floodplain, which is approximately 130 km$^2$ in extent, is just 0.033 m km$^{-1}$. The floodplain is one of the most biologically diverse ecosystems in South Africa (Coke and Pott, 1970). It comprises the meandering river and a highly heterogeneous complex of lagoons, ox-bow lakes, abandoned river channels, marshes, levees and floodplain grassland, which provide habitat for a wide range of birds and animals.

Under natural conditions, the floodplain was inundated to varying extents in the summer season (December to April) every year. As water levels rose during floods, the disparate floodplain depressions (known locally as pans) became reconnected with each other and with the main river channel, creating a highly a productive environment for fish and other aquatic organisms (Coke, 1970). During periods of maximum flooding, between 90 and 100 pans, with a collective area of approximately 26km$^2$, were filled with water (Heeg and Breen, 1982). As water levels fell during the recession, the connectivity between pans decreased and different pans retained water for different lengths of time.

Traditionally, people have utilized the natural resources of the floodplain in a wide variety of ways, for both commercial and subsistence purposes. It is estimated that approximately 40,000 people are resident in the area around the floodplain and have close links to it (Heeg and Breen, 1982). The pans provide an important source of fish and fishing activities are valuable to the culture of many communities on the floodplain. Floodplain areas, their fertility enriched through intermittent inundation, are used for both recession cultivation and for grazing during the dry winter. In addition, plants on the floodplain and the forest adjoining it provide a variety of products for food, fuel, construction and traditional medicines.

The Pongolopoort dam was built during the apartheid period to provide water for white farmer upliftment through sugar cane irrigation. The intention was to "stabilize" the frontier bordering Mozambique and Swaziland through the creation of 40,000-50,000 ha of irrigation on the Makatini Flats, a highly fertile area adjacent to the floodplain on both sides of the river (Breen *et al.*, 1998). At the time, it was believed that development would automatically follow impoundment, and so no consideration was given to alternative development options. However, subsequent changes in political and socio-economic circumstances (e.g. the drop in the price of sugar) have meant that the expected development did not occur and to date, only about 3,000 ha of irrigation has been created.

The dam provides storage of 2,500 Mm$^3$, which is 2.3 times the long-term mean annual flow into the reservoir (i.e. 1,086 Mm$^3$).[3] Consequently, the dam affords considerable control over water resources. Although no

3 The large storage is required to assure supply on a river of extremely variable flow, which can be less than 690 Mm3 in one year in every four.

consideration was given to alternative development options prior to construction of the dam, the fact that the expansion of irrigation has been much less than anticipated has enabled post-construction assessment of alternative water use options.

### Institutional framework

The Pongolopoort dam was planned and constructed by what was the forerunner of the current Department of Water Affairs and Forestry (DWAF), and it has subsequently remained under the jurisdiction of this department. Hence, for the purpose of this paper the organization responsible for the operation of the dam since its construction will be referred to as DWAF. There are a number of other stakeholders with an interest in how the dam is operated. These include:

- the people utilizing the natural resources of the floodplain, the Tembe-Thonga;
- commercial farmers on the Makatini Flats and in recent years on the floodplain;
- KwaZulu Natal Wildlife who manage the Ndumu National Park at the eastern end of the floodplain;
- local fishing clubs who utilize the reservoir for recreational fishing;
- KwaZulu Natal Department of Health which is responsible for all health matters, including malaria, on the floodplain;
- Department of Agriculture & Environmental Affairs which is responsible for agricultural extension and environmental conservation on the floodplain and the Makatini Flats;
- South Africa security forces who are responsible for national security, which is particularly an issue in the border region where the dam is located;
- Mozambiquans living close to the Rio del Maputo.

The Tembe-Thonga people are divided into a number of clans or chieftainships. Clan chiefs usually appoint members of their own family as district chiefs (i.e. *Izinduna*) and choose sub-district headmen from among the families living in a sub-district. Until recently, the sub-district headmen controlled access to all natural resources, including land and fish, in the areas under their jurisdiction. However, in recent years growing population pressures, commercialization of floodplain activities, and uncertainty over the role of tribal authority have undermined this institutional arrangement, and have led to an increasingly individualistic approach and increasing "private" ownership of resources (Breen *et al.*, 1998).

### Planning level and scope of options assessment

In most circumstances an options assessment should be implemented before the construction of a dam. However, the history of the Pongolopoort dam means that the scope of the options assessment conducted to date has been limited to how the dam is operated to optimise the benefits to be gained from the water stored in the reservoir. Specifically each year consideration is given to different options for managed flood releases. It is this process which is described in following sections of this paper.

There is currently no integrated strategy for the long-term development of the floodplain or elsewhere in the catchment. Indeed, in recent years, aforestation and increased upstream abstraction has reduced inflows into the reservoir. Consideration is now being given to increasing the size of formal irrigation schemes adjacent to the floodplain and to developing tourism related activities (e.g. houseboats) in and around the reservoir. Furthermore, Mozambique wants to limit the magnitude of flood releases from the dam.[4] Consequently, a wide range of development options must now be considered in increasingly complex circumstances, but at present there is no formal process of options assessment.

### Assessment of development goals, sectoral demands, regional and local needs

At the time the dam was built, an analysis of development opportunities concluded that sustaining the productivity of the floodplain was justified in social, economic and environmental terms. In particular, this meant realizing the economic potential of the two traditional practices of floodplain fishery and flood dependent agriculture (Breen *et al.*, 1998), but it was envisaged that as irrigation-based agriculture increased on the Makatini Flats, cultivation on the floodplain would decrease. However, as reported in section 1, the anticipated large-scale irrigation development has not occurred to any significant extent.

4 There is a tripartite agreement between South Africa, Mozambique and Swaziland for utilization of the water resources of the Incomati and Maputo watercourses (which includes the Pongolo). However, at present, there is no comprehensive agreement on dam operation. Nevertheless, Mozambique has made an informal request to keep maximum flow in the Rio del Maputo at less than 450 m3s-1 and since the devastating floods of 2000 there has been a request by Mozambique to limit flood releases further.

The construction of the dam, in conjunction with changes brought about by other socio-economic adjustments, has led to a shift in sectoral demands and local needs. The much more predictable flooding regime has reduced the risk of losing crops through unexpected flooding. This has led to a marked increase in investment in cultivation on the floodplain. Institutional controls over cultivation have been reduced, and areas not previously farmed because of the high risk of inundation have been cleared and are now cultivated. Furthermore, the local subsistence economy has increasingly come under the influence of external factors; the need for contemporary goods and services (i.e. in addition to those traditionally available) has generated a requirement for money. This has led to a commercialization of the exploitation of the floodplain resources and the adoption of new technologies. For example, cotton farming, using genetically modified hybrids (which cut insecticide costs and increase yields), spread across the floodplain in the 1990s. The water requirements of the cotton farmers differ significantly from those of other floodplain activities, in particular fisheries.

## Identification and characterization of options

A participatory approach has been developed to identify and decide upon options for managed flood releases. Water committees established within different tribal regions consider all viable options as determined by DWAF and, through a complex and iterative process of negotiation and conflict resolution, develop a consensus on the preferred timing and magnitude of a managed flood. On the basis of this agreement, the water committees negotiate with other stakeholders at a "liaison committee" meeting at which a decision is made about the timing and magnitude of the managed flood release.

In theory the characterization of options attempts to balance four primary needs:

- to maintain environmental processes on the floodplain, both for livelihood support and for wildlife in the Ndumu National Park
- to support agriculture and minimize flood damage to crops
- to support the irrigation agriculture that has developed on the floodplain and on the Mkatini Flats
- to meet the concerns of Mozambique

## Assessment of alternative options

Assessment of the impacts of alternative release options is undertaken by DWAF. Since the first managed flood release in 1984,[5] DWAF has experimented and monitored the hydrological impact of more than 20 flood releases (EnviroAfrica, 2000). On the basis of insight gained from this monitoring, DWAF is able to advise on the hydrological implications (i.e. the spatial extent and duration of inundation) of different release regimes. However, there has been almost no monitoring of the floodplain ecology since the dam was built, and so the ecological implications of different flood releases remain largely unknown.

DWAF plans releases when requested by a stakeholder. Through the participatory process established, DWAF attempts to get a consensus on the need and optimum timing of a managed flood. However, in all cases, DWAF makes the final decisions (i.e. on timing, magnitude and duration of the release) and plans and manages all the operational arrangements.

## Stakeholder participation

Between 1973 (when the dam closed) and 1987, DWAF operated the dam without any consultation of stakeholders and without communication with downstream communities. In the late 1970s, research conducted by social scientists found that local communities perceived the dam as an emblem of the apartheid regime that caused them many problems, particularly through badly timed inundation of crops and grazing land.

This research, in conjunction with the realization that the irrigation was not developing to the extent anticipated, led to a re-evaluation of the way DWAF was operating the dam. In 1987, DWAF, in collaboration with local tribal authorities, established the first Water Committees. Initially eight committees were formed (this was later extended to 15) with each one representing a different tribal region. Each committee comprised five members representing fisherfolk, agriculturalists, livestock keepers, domestic water users and the community health services. The committees were supported by local development initiatives and NGOs who championed the process and provided logistical support (i.e. transport etc.) to enable the committees to meet.

5 In 1984 there was insufficient water stored in the reservoir to make flood releases.

The committees provided a conduit for information transfer between DWAF and the communities, and also a forum for negotiation both within and between different community groups. In addition, the water committees negotiated with other stakeholders on the different release options. Initially, the water committees were very effective in reconciling differences and reaching consensus. Furthermore, the committees were perceived by the communities to be successful in negotiating with other stakeholders (Bruwer and Jordan, 1994). However, since the mid-1990s the effectiveness of the committees has declined and, in recent years, the participatory process has to a large extent broken down.

The failure of the water committees has been attributed to a number of factors, but is principally due to the lack of planning of natural resource use and development on the floodplain (Breen *et al.*, 1998). In particular, during the 1990s, the Department of Agriculture made no attempt to divert commercial farming off the floodplain by promoting small-scale irrigation on the Makatini Flats. As a result, cotton farming spread throughout the floodplain and, by the mid-90s, the floodplain cotton farmers represented a strong political force. In 1997, they threatened to initiate legal proceedings against DWAF if flood releases were made at a time inappropriate for their cotton crop. In the face of such belligerence, DWAF was forced to acquiesce and no managed flood release was made despite the needs of other stakeholders (EnviroAfrica, 2000). In subsequent years, the planning process has become increasingly complex as new stakeholders, including those upstream of the dam, have wanted to become involved in the decision-making process. At the present time, DWAF continues to attempt to involve all interested and affected groups. Research is presently being conducted by the University of Natal, in conjunction with the Water Research Commission and the International Water Management Institute, to develop a pragmatic cooperative management approach that supports equitable distribution of water between different stakeholder groups (Jaganyi, *et al.*, 2003; and Jaganyi, *et al., in prep*).

## Acknowledgements

This research was funded by a grant from the Water Research Commission of South Africa. It is also a contribution to the comprehensive Assessment of Water Management in Agriculture (www.iwmi.org\assessment) which is funded in part through a grant from the Government of Netherlands.

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# Decision-making in the Hydropower Generation Expansion

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For some years now, consistent efforts have been made to adopt a more strategic approach for addressing environmental issues from the very first stages of the Brazilian power sector's planning process. There is growing awareness that, at the level of a specific project, essential decisions are difficult to reconsider because of the narrow margin available for comparing alternatives.

Due to the nature of the Brazilian power system, which is predominantly hydropower-based and has a nationwide interconnection, there are several distinct instances during the planning process in which decisions are made that involve the assessment of alternative options. Among these strategic decision instances are the selection of river basins to be inventoried; preparation of hydropower inventory studies for selecting the best alternative for the head division scheme in a particular river basin; and the drafting of Expansion Plans, with the aim of analyzing alternatives that will meet future needs for expanding the supply, involving the planning of power stations to be established in various river basins throughout the country within a period of ten years.

In 1991, a research line was created to incorporate the environmental dimension within the decision making process. This research was carried out by CEPEL (Electric Power Research Center) and Rio de Janeiro Federal University COPPE/PPE (Energy Planning Program). PPE and CEPEL have been promoting the development of methodological instruments to introduce environmental criteria into various decision-making processes, based on the premises of the Strategic Environmental Assessment.

In the case of river basin hydropower inventory studies, environmental indicators were defined in order to select the alternatives for the head division schemes, bearing in mind the synergic and cumulative regional socio-environmental processes at the river basin level. Provisions are also made for the participation of the various sectoral agents and stakeholders, so that they can have a say in the final hierarchy of the alternatives. The developed model based the selection of alternatives on a multi-criteria process, and considered the socio-environmental and the economic-energy dimensions as independent objectives, which means a much more strategic role for the socio-environmental issues in the decision making process than the usual idea of simple restriction.

In the case of expansion plans for the nationwide interconnected system, three environmental analyses levels were established: the project, the group of projects and the plan as a whole. The assessment criteria took into account the assessment of the sustainability of the natural resource base and the social sustainability, based on the premise of intergenerational and intra-generational equity. In this instance, the mechanisms to be used for comparing the expansion alternatives are still being developed, since they depend heavily on the gradual building up of an appropriate institutional context that involves structural changes in the planning process.

In both instances, the proposed mechanisms have been officially adopted by the energy sector. It is already possible to identify aspects that need improvement in order to provide adequate integration to the decision making process, as well as the articulation with other sectors¢ planning process.

It must, however, be stressed that some problems have been encountered in implementing these new routines into the planning process. First, the late nineties saw a structural change in the energy sector, with the insertion of private agents and setting aside of the planning process. Priority was given to the project level assessment. Besides, it became possible for several different agents to develop projects in the same river basin, making the application of the developed instruments more complex.

Furthermore, the legislation implementing the National Environment Policy instruments also prioritized the logic of project level assessment, special emphasis being given to the environmental licensing process and the development of the EIA and the Environmental Impact Report. Other instruments such as zoning, definition

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of quality standards and assessment of environmental impacts of plans and programs, have not been sufficiently developed. As a result, the river basin inventory studies are not being analysed by the environmental area.

On the other hand, the National Water Resources Policy promotes integrated management with environmental management, encourages participation and shows the need for drafting Water Resources Plans for river basins to regulate and rationalize their uses. There has also been pressure from organized civil society for improved analysis and justification of the decisions to establish hydropower stations, bringing a new emphasis on the discussion of sustainability and the application of these instruments.

In this regard, the environmental sector has emphasized the need for more comprehensive assessments, encouraging the use of Strategic Environmental Assessments in policies, plans and programs. As a result, the Ministry of the Environment (MMA) took on the initiative of making use of the experience, developed in the aforementioned power sector research, to define guidelines and procedures for Strategic Environmental Assessments in river basin management.

In the work produced for the MMA, a strategic environmental assessment model was developed for the integrated river basin environmental management, taking into account the synergic and cumulative effects of projects implemented by the power sector and by other sectors acting in the same river basin (for example, transports, agriculture, environment, etc.). This model provides for the broad participation of society in defining objectives and sustainability goals for the region, as a means of establishing criteria for prioritizing investments and for decision-making with regard to the plans and programs proposed for the river basin in question. It also has the advantage of having had the participation of various stakeholders in the discussion of its initial proposal during workshops. Nevertheless, it is emphasized that the role of participation should be expanded in order to include a broader range of social agents.

Finally, this presentation will be illustrated with examples from the Araguaia-Tocantins Basin test case, including the three planning levels mentioned above: river basin hydropower inventory, the expansion plan for the nationwide interconnected electricity system and integrated river basin management, taking into account the various sectors concerned.

# Development Through Self-reliance, Reviving Hope and Prosperity Through "Traditional Water Harvesting Systems" Alternative to Big Dams

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## Background

During 1930s and 1940s, the Aravali Mountain range in Rajasthan, India – one of the oldest mountain ranges in the world – had verdant forest cover. Although rainfall was nowhere near abundant compared to average annual rainfall in other parts of the country, traditional water-harvesting systems ensured an adequate supply of water throughout the year. The people's reverence for the environment and age-old conservation practices had fostered a flourishing diversity in terms of the area's flora and fauna.

That was before the mindless logging began. Human greed denuded the hills. Every year when the much-awaited rains came, most of the water was lost as surface runoff. The earth could not absorb the rainwater; as a result, groundwater aquifers could not recharge. To make matters worse, the management of water systems was completely taken over by the government. People began expecting the government to fulfil their need for water. This engendered neglect and scorn for time-tested traditions and also created a dependency syndrome among the community. The synergy between mankind and nature that was the legacy of centuries of tradition was destroyed in a matter of a few decades.

Drought became a recurring and grim reality of life in the region. People migrated to cities and towns to work as contractual labour for abysmal wages. The only people left behind were the very old, the frail, women, and children. Life was bleak and the people lost control over their lives. Education and health concerns took a backseat, as survival became the top priority. Despair reigned supreme. Then, in 1985, things started to change.

## Issues and Problems

In 1985 and 1986, one of the worst droughts in history was ravaging the Alwar district, located in the northeastern part of Rajasthan and already one of the poorest districts in the state. Climatically, the district lies within a semi-arid region receiving a meagre 620 mm of average, annual rainfall. The district has two distinct features: the Aravali mountain range, which covers a large part of the district, and the forest type, which is the best in Rajasthan. The famous Sariska National Park (a tiger reserve) is located in the district. Alwar district in Rajasthan suffered severe scarcity of water; the groundwater table had receded below the critical level and the state government declared four blocks, including Thanagazi Tehsil, as "Dark Zones," meaning areas where the groundwater table has gone down, thereby restricting further extraction of groundwater. The region that once sustained the eco-system of the Aravalli had become barren.

- Migration – Migration was at its peak. The main sources of livelihood of the community living in the area, mainly Gujjars and Meenas (the tribal communities), were subsistence agriculture, livestock rearing and forest products. As water was the prime necessity for sustenance of their livelihoods; absence or scarcity of water forced them to leave their villages in search for employment and live in the urban slums. It was rare to find young people in the villages; all of them had fled in search of employment.
- The water table became very low. Rivers and wells dried up. There was an extreme shortage even of drinking water. Women trudged long distances to fetch a mere pot full of water. They had to start very early in the morning and most of their time was spent collecting water.
- Crops failed regularly, lack of vegetation led to soil degradation, monsoon run off washed away the topsoil.
- The Sariska National Park is about 1,145 sq km in Thanagazi, Rajgarh, and Alwar tehsils. The populations of wildlife, particularly the tiger population, decreased drastically due to the water crisis . Only five tigers were present during 1985-86, according to the local village community.

## The beginning was arduous...

In 1985, five volunteers from Tarun Bharat Sangh (TBS), a grassroots, voluntary organisation led by Mr. Rajendra Singh, came to Thanagazi in Alwar district. They set up a base in Bheekampura and started educating the young and providing basic medical services to the villagers in Gopalpura.

Then one day, Rajendra Singh, the man who had come to educate the masses, learned the most valuable lessons of his own life. The teacher was Mangu Patel Meena, a tribal old man of the Gopalpura village. One day, Mangu Baba told him, "we do not want your literacy. We want water." But where was the water?

He was first to advise Singh to revive traditional water harvesting systems if he really wanted to help the people of Gopalpura and solve the problem of water crisis. Mangu explained about the rich traditions existing in this region of building "johads," which were a prime example of inexpensive, simple, traditional technology that was quite remarkable in terms of recharging the ground water of the entire region.

## Johad, a structure of community self-reliance

Johads are earthen check dams – concave shaped barriers that catch and conserve rainwater, leading to improved percolation and groundwater recharge. They are built across a slope to arrest rainwater with a high embankment on three sides while the fourth side is left open for the rainwater to enter.

The height of the embankment is such that the capacity of the johad is more than the volume of run-off coming from the catchments, based on a rough estimation of maximum possible runoff that could come into it. Therefore, the height varies from one johad to another, depending on the site, water flow, pressure, and other factors. In some cases, to ease the water pressure, a masonry structure called "Afra" (for overflow) is also made for the outlet of excess water.

The construction of johads is a labour-intensive exercise. It involves laying a rubble foundation, which is covered and pitched with soil. The water collected in a johad during the monsoon is directly used for irrigation, livestock, drinking and other domestic purposes. The advantage of this structure is that, apart from arresting and storing rainwater, it improves moisture levels in the subsoil of the fields, particularly in downstream areas that recharge groundwater and wells. During the winter season the johads, if dried, can be used for "rabbi" cultivation due to the soil moisture present in the catchment area.

Within a decade, the system has proved to be cost-effective and participatory in not only reaching out to the rural poor, especially poorest of the poor, with wide ranging implications for overall ecological regeneration in the area. In contrast, large scale structures like canals, dams and reservoirs have yet to cover more than 30 percent of the targeted population in the state. Others still depend on rain-fed agriculture and traditional systems of in-situ water conservation and harvesting. Indeed, some of these systems are based on simple technologically available locally. The johad is one such ingenious intervention where the end result is quite remarkable in terms of recharging the groundwater of the entire region. Apart from using local materials and labour, the technique has skillfully manipulated the microenvironment to serve the needs of the people over several generations.

Johad is not only a physical structure made by the rural poor through traditional knowledge and wisdom but it is also a symbol of peace, love, and unity present in the village society.

Thus inspired by Mangu Baba, the TBS youth began digging out a derelict and silted pond nearby. They dug and shoveled mud for months.

When the rains arrived, the pond was partially filled with water and the village was convinced that they were on the right track. The work continued for three long years. The results were beyond everyone's wildest estimates. Not only was the pond brimming, providing sufficient water to the residents of Gopalpura, but the wells several kilometres downstream were recharged and full of water.

A new, blue revolution was initiated from Gopalpura Village in Rajasthan through reviving the age-old practice of building johads utilising traditional knowledge and wisdom of the village community. They are managing their need with each small droplet, which comes as rain. A bigger question was how to spread and replicate this water revolution in other drought-affected villages. Again came the Mangu Baba's wisdom. He said that Gopalpura village has a social relationship with another 45 villages of the region. The network of societal relationships could be a very effective medium for spreading the message of water conservation and harvesting each single drop of rainwater in the drought-prone region of the Rajasthan. Seeing the impacts of johads in his village would motivate other villages to take up the forgotten knowledge and rich tradition of water harvesting through building of johads. With help from the residents of Gopalpura, water harvesting began in 45 villages of the region. Their achievements, in turn, inspired other villages. Thus began a chain

reaction powered by a coming home of sorts to traditional wisdom, rural technology and cooperation among villages.

Beginning with Gopalpura village in 1985, TBS has played a leadership, catalysing role and has acted as a facilitator in building more than 5000 johads and rejuvenating 2500 and more old structures with the help of village communities in 1058 villages. This area covers parts of the contiguous districts of Alwar, Dausa, Bharatpur, Swaimadhopur, Karoli, Tonk, Jaipur and Bikaner districts of Rajasthan. Besides this, some johads have also been built in the districts of Jaisalmer, Ajmer, and Udaipur. Now TBS is also initiating the water campaign in western region of Rajasthan to replicate this community-based water management work after having the experience of working 18 years in eastern Rajasthan.

## Gram Sabha: the village self-institution

Active participation of the village community has led to water being used as an entry point and regenerative input for various socio-economic and ecological developments. Each village has its own internal self-regulatory mechanism system to provide internal control and monitoring. To promote decentralised water management systems, a village Gram Sabha (village self-institution) is formed in each village wherever any development initiative is taken up to ensure full participation of the village community in planning, designing, implementation, monitoring and accountability for future sustainability More than all these, it is the contribution from the community as shramdaan (voluntary labour) in the project work through Gram Sabha, which creates a sense of ownership feeling for the work to be done. They feel from within the heart that they are doing work for themselves, which ensures the sustainability of the work done. The Gram Sabha is an informal body comprised of both adult male and female representatives from each household in the village. It is different from the Gram Sabha denoted under the Panchayat Raj Act in Rajasthan. The Gram Sabha is used as a platform for addressing common concerns through collective action and is responsible for conducting monthly meetings. It is obligatory for all households to participate in the Gram Sabha meetings, which usually are held twice a month except during the harvesting season. If necessary, an emergency meeting can be called. Each household takes an active part in the working of the Gram Sabha and all decisions are taken collectively by consensus.

Gram Sabha, as a village self-institution ensures greater mobilisation and participation of people for implementation of any community-based initiatives. This strengthens the stakes of the people, giving them a greater feeling of ownership. This ensures sustainability of the overall development of the village. Collectively, the village Gram Sabha decides where to build johads and TBS volunteers just facilitate the process from the site selection to all its physical attributes like designing, village contributions, etc.
Gram Kosh: the village fund

The Gram Sabha for sustainable resource mobilisation has established a Gram Kosh (village fund). Each villager contributes a fixed amount decided by Gram Sabha every year and the fund is used as emergency utilisation and for operational and maintenance activities of johads. For example, in Bhawta- Kolyala village, the Gram Sabha has decided that each household should contribute 5 kg of grain after the harvest for sustaining the development activities. The objective of creating a Gram Kosh is to ensure financial independence of the village institution so that it can become economically self-reliant. Such initiatives towards financial autonomy can strengthen future resource development initiatives. Also, during the drought period, it helps in providing relief to rural poor. The Gram Kosh could also be used for future capital generation for any natural resource development activities.

## Contribution of voluntary labour (Shramdaan)

One of the most critical ingredients in building leadership and management of resources is the contribution each member of the village community makes into the development initiative. It is important to understand the willingness to pay for the johad building that fulfils three major requirements: one, the individual family gets employment and water for irrigation and drinking purpose; two, livestock have water to drink; three, it gives ecological stability by increasing groundwater. Before initiating any developmental activity in the village, the cost required is discussed in Gram Sabha meetings. It takes several meetings with the village community to decide the contribution. As a matter of policy, TBS will not start building any structure until contributions (cost sharing norms) are sorted out. Contributions may come in the form of labour from poorest of the poor or in cash from the better off. This contribution determines participation and the ownership of the resource being developed. Johad construction requires mainly local resources, such as mud, pebbles, labour, etc. TBS during the initial days had a norm to have of at least 25 percent, or one-fourth, of the total cost of the project, contributed by the village community. That share has

subsequently increased to 33 percent, or one-third of the project cost, in form of labour, cash or in-kind contributions (local building materials). This contribution helps in withstanding the dependency syndrome created by the attitude of relying on government and to move ahead towards self-reliance. When we are dealing with very poor communities, it becomes very difficult to convince people to make contributions. And, of course, there are many instances when people have built structures themselves with fully voluntary contributions and TBS mainly contributed by hiring skilled labour (masonry workers), buying cement, iron, diesel fuel for tractors, and providing technical advice.

The capital cost required during the construction of johads includes:

- Cost of mud (soil) and stones, which are locally available.
- Cost of labour, most of which comes from the villagers as voluntary contributions, with the exception of any skilled masonry required during the construction.
- masonry (skilled) labour cost, mainly provided by TBS.
- tractors for lifting the soil and diesel, provided by TBS.
- concrete material, i.e., cement, bricks (if needed).

Contributions involve the concept of ownership, accountability, and belongingness towards the common property resources created. If one has the ownership feeling for the work done such as johad building, the community will ensure the long-term sustainability, safety and maintenance of the work.

## Decision-making process

Peoples' participation is a prerequisite for the sustainability of any development activity. Both male and female actively and collectively participate in the decision-making process in the Gram Sabha meeting. In these meetings, they decide about the actual construction of johads, the proposed catchment area, soil type, and other physical attributes especially regarding village funding, i.e. villager contributions to the johad building. Villagers have full control and total ownership of the johads. The role of TBS is that of a catalyst and motivator. Today, johads have come to be regarded as community common property. The water in the wells is available at an average depth of 15-20 feet despite 5 years of continuous drought existing in Rajasthan.

## Impact of johads

**1. On socio-economic issues:**

Johads have made visible impacts on the socio-economic scenario of the region. Wells are recharged and water supply is ensured for the entire year to meet the needs of people and livestock. Livestock rearing being the villagers' lifeline, increased water and fodder availability brought about an improvement in their economic status. Enough milk and milk products brought enough money to take care of family needs. Besides satisfying the primary needs for drinking water and other domestic uses, johads have increased food production, helped in conserving soil, increased the level of water in wells and increased biomass productivity.

**2. On women:**

Women in this region have suffered a lot on account of having to fetch water for their families from distances of four to five km. They also procure fodder and fuel wood and were most the people most affected by the water crisis. All these activities are referred to as women's chores, and the average time spent on them was 18 hours a day. Due to johad building, water is readily available to them and they now have time for productive work. The increased availability of water for cooking, washing and bathing has definitely improved the standard and quality of their lives.

**3. On groundwater:**

The increase in the groundwater table in this region is a cumulative effect of several interventions by TBS, including the protection of forestland, construction of several johads, field bunding on farmland, and others. Wells in the region are the main source of drinking water. A survey conducted by TBS with the help of AFPRO in 1988 suggested that out of 970 wells in 120 villages, only 170 wells were operational and the rest didn't have any water. The same team conducted another survey in 1994 and found all of the 970 wells were in use as perennial suppliers of water. Groundwater levels have risen by 20 to 50 feet above the level 10 years ago.

**4. On agricultural production:**

With johads in place, a hundred percent increase in water yields and availability has been observed. Water availability has significantly increased from an officially marked "dark zone" to a water surplus "white zone." Wastelands that were hardly cultivated before are now cultivated with higher cropping intensities. The increase in agricultural productivity has also led to an

increase in crop residue availability, which is used as fodder. Johads have provided enough water for livestock to drink.

5. **On Sariska National Park:**
Johad building changed the whole biodiversity of the Sariska National Park, especially the number of tigers which has increased to 27 from only 5 a decade ago. Migratory birds have also started visiting the park. Now, despite five years of drought, johads have come to the rescue as they are still filled with water. In this severe drought, johads have been the only source of water.

6. **Rejuvenation of five rivers**
Five monsoon rivers, namely Arvari, Ruparel, Sarsa, Bhagani–Teldeh and Jahajwali Nadi, were dead, dry watercourses in which water flowed only during the rainy days in the monsoon season. Johads rejuvenated them and made them perennial sources of water. By having a ridge-to-valley approach, hundreds of johads have been created in series, capturing each single drop of water.

## Arvari Sansad (Arvari River Parliament): The Voice of Common People

*Background*

The Arvari is a small river in the Alwar District of Rajasthan. The river had been reduced to a monsoon drain for decades. While the region was reeling under chronic drought conditions, The Arvari River dried up for years. The process of rejuvenation of this river was started in the year 1987 by constructing small johads in the rural areas of Rajasthan. The first was built in the village Bhavta. Later, one could see the benefits of these johads both quantitatively and qualitatively in the livelihoods of the villagers, even during toughest drought conditions. The johads also had a great impact on the economic conditions of the individuals by improving their standard of living. Many more villagers from different villages came forward to build these structures in their villages reviving the traditional method of harnessing the rainwater.

*Over-all impact*

- Earlier farmers were not able to cultivate even one single crop per season, but now they are able to cultivate a maximum of two crops per season. Agricultural production has increased.
- To access drinking water, females had to travel quite a distance. But now due to these water-harvesting structures, they utilize much of their time doing other productive work.
- Cattle, goats, and other animals in the villages and wild animals in the Sariska region come to these johads for drinking water.
- Because of the johads, the water table in the wells has also increased and helped in recharging of the groundwater.
- Earlier, 80 percent of men in the working age group migrated for employment as labourers, but now they all stay in the village itself and cultivate their land, which earlier use to be uncultivable.

Up to this date, more than 350 johads have been built in the catchment area of the Arvari River. Water in the johads raised the water table in the entire catchment area of the river Arvari.

From1996 onwards, the river began to flow in its full flow and became perennial. The villages also had to contend with the government. The river has been revived and fish are seen in its water. As now there was plenty of water in the Arvari River, there was natural growth of fish, which went on multiplying. Seeing this, the government wanted to get hold of the fish and gave a contract to a big private contractor for catching the fish. It is not that the local people wanted control over the fish. In contrast, they are all vegetarians and do not eat fish, but they realized that today it is fish and tomorrow it would be water. This got the people who owned the river thinking. The government, through the contractor, was intruding into community's domain and usurping its right over the use of water. Water as a resource was developed by them through their hard efforts and labour. They wanted to have the rights to utilize it.

This river parliament will make its own rules, regulations and laws seeing the people's needs and priority. The parliament will work towards the management and conservation of river water. Everybody will abide by the decisions taken by the parliament.

So the Arvari Parliament was formally formed on 26th January 1999 to manage the river and its waters judiciously. The Arvari Sansad met for the first time in Hamirpur on Republic Day, 26th January 1999. It has the representation of 72 villages. This parliament has also framed 11 rules for the use of Arvari water. The parliament meets four times a year and, if required, they could meet in an emergency situation.

The parliament has 142 members nominated by the respective village assemblies. Every village up to 500 hectares in size appoints one member. A coordination committee comprising members selected by the parliament handles the operations and ensures that the rules are observed.

For making the laws, rules and regulations for the proper management, conservation and utilization of Arvari River water, the following subjects were taken into considerations:

1. Rules regarding direct water irrigation from Arvari River.
2. Rules regarding irrigation from the wells.
3. Rules regarding crop production free from the market and middlemen, and to consider a system that fulfils the needs of local people.
4. Rules to stop the selling of water and to protect the fishes present in the river.
5. Rules to stop the selling of land, to prohibit the giving of land to outsiders, and to take decisions regarding these issues.
6. Programs to make the whole river area green and to protect the surrounding area from the damage that has been done by severe mining.
7. Rules to stop the hunting of animals and illegal cutting of trees in the Arvari River area.
8. Plans to search for the various traditional methods of water conservation and to revive all these practises, seeing the environmental need.
9. Methods to find out the reasons for over-exploitation of water, and to stop this and promote water conservation work.
10. Establishment of an active system for the management of the river.
11. Establishment of the role of the Jal Sansad (water parliament) and village Gram Sabha towards the management of the water sources present in the villages.

All together, nine such meetings have been held till now. We can see how the community has been successfully managing the river Arvari water judiciously and with optimum utilisation of water - the precious life-saving common natural resource.

## Lesson Learned

The Large benefits of Small Things: TBS's structures have provided irrigation water to an estimated 140,000 hectares. TBS calculates that around 700,000 people in Alwar and the neighbouring districts benefit from improved access to water for household use, farm animals and crops. Each structure is small-scale, but the total benefits of johad work are most certainly large-scale. Not a single family has been displaced to achieve these impressive benefits. Unlike big dams, the johads have not destroyed any rivers or submerged huge areas of forests and farmland; on the contrary, TBS's work has actually created rivers and forest.

Johad construction can be seen as one of the best possible options, cost effective and viable in any agro-climatic situation, for conserving maximum rainwater and recharging groundwater. It might vary in terms of shape and size but the technology remains the same and is easily adaptable. Such traditional technologies exist all over India, and the communities can be the best managers to conserve water through using their traditions and wisdom.

# Environmental Manual For Power Development (EM): A Tool for Comprehensive Options Assessment in the Energy Sector

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**Key Words:** energy systems, energy/environment models, life-cycle analysis, environment-cost- tradeoffs

## Geographical and socio-economic background of the region:

From 1992-1995, the so-called Environmental Manual for Power Development (EM) was developed as a computerized tool for the environmental and cost assessment of options in the energy sector of developing countries. This work was sponsored by GTZ, DGIS, and the World Bank. Between 1995 and 2001, the EM was used and applied in a variety of case studies (sponsored by GTZ, DGIS, DfID, the EU, and the World Bank) in the following countries: Botswana, Croatia, Czech Republic, China, Fiji, India, Indonesia, Mexico, Morocco, Philippines, Poland, Romania, Russia, South Africa, Vietnam and Zimbabwe.

## Institutional framework and setting: factors triggering the options assessment.

The EM was used within existing decision-making processes concerning energy systems, e.g., system expansion planning of utilities (Philippines, China), development of national strategies by ministries (India, Morocco, Philippines, Vietnam), screening of options in competitive bidding schemes (Fiji), the assessment of power pooling in Southern Africa with respect to greenhouse-gas mitigation (Botswana, South Africa, Zimbabwe), and environmental assessment of energy options, especially district heating (Croatia, Czech Republic, Poland, Romania, Russia).

## Identification/ characterisation of the options, and assessment of alternative options scenarios

The "Environmental Manual for Power Development" (EM in short) is a computerized tool for the inclusion of environmental and cost data into the decision-making for energy projects in developing countries. Since 2002, the EM has been integrated into the more general GEMIS software (Global Emissions Model of Integrated Systems), which is used worldwide.

EM/GEMIS track down the emissions and costs of e.g. the existing power supply system in a country, region, or of a specific energy project, and compares those to *alternative options* to deliver the same energy service, e.g. electricity, or process heat, or transport services.

To do so, EM/GEMIS maintain a comprehensive database on the environmental and cost impacts of energy technologies, and determines environmental impacts for so-called *life-cycles*: All impacts from mining, transport, conversion etc. can be accounted for. To consistently handle all life-cycles, the EM/GEMIS database offers a variety of *pre-defined* fuel-cycles to work with.

The EM/GEMIS database covers generic energy technologies in developing and industrialized countries, especially

- all fossil-fueled electricity and heating systems, cogeneration, renewable energies, selected energy efficiency technologies, nuclear power systems, as well as
- data for "upstream" activities like mining, fuel benefication, transport, and emission control technologies like flue-gas desulfurization, ESP, SCR, etc.

The EM/GEMIS *analyze and compare* airborne and greenhouse gas emissions, solid wastes, and land use, as well as *internal and external costs* associated with the *investment and operation* of all energy technologies, including their life-cycles (upstream fuel-cycles, material acquisition).

EM/GEMIS help to check the *compliance* of energy processes with given *air emission standards:* the database offers such standards for various countries and regions, and users can test if emissions from a process are in accordance with such regulations. If not, processes can be adjusted by *adding emission control technologies,* or changing fuel characteristics.

EM/GEMIS can run *scenarios* to compare single power plants or boilers, but also whole electricity generation or transport systems of a region or a country, and can identify the *emission and cost tradeoffs* between different options to meet future demands.

## Stakeholders participation: how stakeholders had been identified and involved in the process

Stakeholders participated as partners in the case studies.

## Applications of EM/GEMIS in Comprehensive Option Assessment for Hydropower

EM/GEMIS offer generic and country-specific data for various hydropower plants with different sizes and technologies (micro hydro, ROR, large dams). This data concerns cost and life-cycle emissions (from materials for construction, and estimated GHG emissions from operation), as well as land use (inundated area).

For system expansion planning or to evaluate utility investment strategies, the EM/GEMIS software can compare hydro projects with alternative options such as local thermal generation from fossil fuels or biomass, co-generation, wind or solar plants, and energy efficiency schemes. The results are computed for internal and external costs, emissions, solid wastes, and land use. The presentation will discuss opportunities and limits of applying EM/GEMIS in a strategic and project level options assessment process.

**EM/GEMIS Applications World-Wide: Summary Table**

| Country | Type of Application |
|---|---|
| Austria | utility planning; environmental evaluation of projects; ghg mitigation in cities/regions |
| Botswana | GHG mitigation with power pooling, utility planning |
| Brazil | environmental evaluation of energy options (biomass) |
| Czech Republic | utility planning; environmental evaluation of energy options; GHG mitigation in cities/regions |
| China | utility planning; emission reduction strategies; technology evaluation: coal briquettes |
| Colombia | GHG mitigation; CDM project assessment |
| Fiji | utility planning; environmental evaluation of competitive bidding |
| France | environmental evaluation of energy options; GHG mitigation in cities/regions |
| Germany | utility planning; environmental evaluation of energy options; GHG mitigation in cities/regions |
| India | technology evaluation: cooking; GHG Mitigation |
| Indonesia | technology evaluation: DSM |
| Italy | GHG mitigation in cities/regions |
| Kyrgyzstan | utility planning |
| Luxemburg | environmental evaluation of energy options; GHG mitigation in cities/regions |
| Mexico | emission reduction strategy for Mexico City (incl. transport) |
| Morocco | developing national emission standards for thermal power plants; local agenda 21, incl. Transport |
| Namibia | GHG mitigation, power pooling, utility planning: wind vs. gas-CC power plant |
| Philippines | national energy strategy; utility planning; GHG mitigation; Sectoral Environmental Assessment |
| Poland | investment screening; university curriculum |
| Romania + Russia | investment screening: district heating |
| South Africa | GHG mitigation with power pooling; utility planning; technology evaluation: solar stoves |
| UK + USA | GHG mitigation in cities/regions |
| Vietnam | utility planning; national energy strategy; GHG Mitigation |
| Zimbabwe | GHG mitigation with power pooling, utility planning; CDM project assessment |

# For the Nam Theun 2 Hydro Project in Laos

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**Key words:** Options Assessment, Hydropower Planning, Multi-Criteria Analysis

## Geographical and Socio-economic Background

The Nam Theun 2 (NT2) hydro project is situated in Laos. Much of its generation will be sold to Thailand. The following table presents some background data on these two Southeast Asian countries.

## Regional Energy Resources and Demand

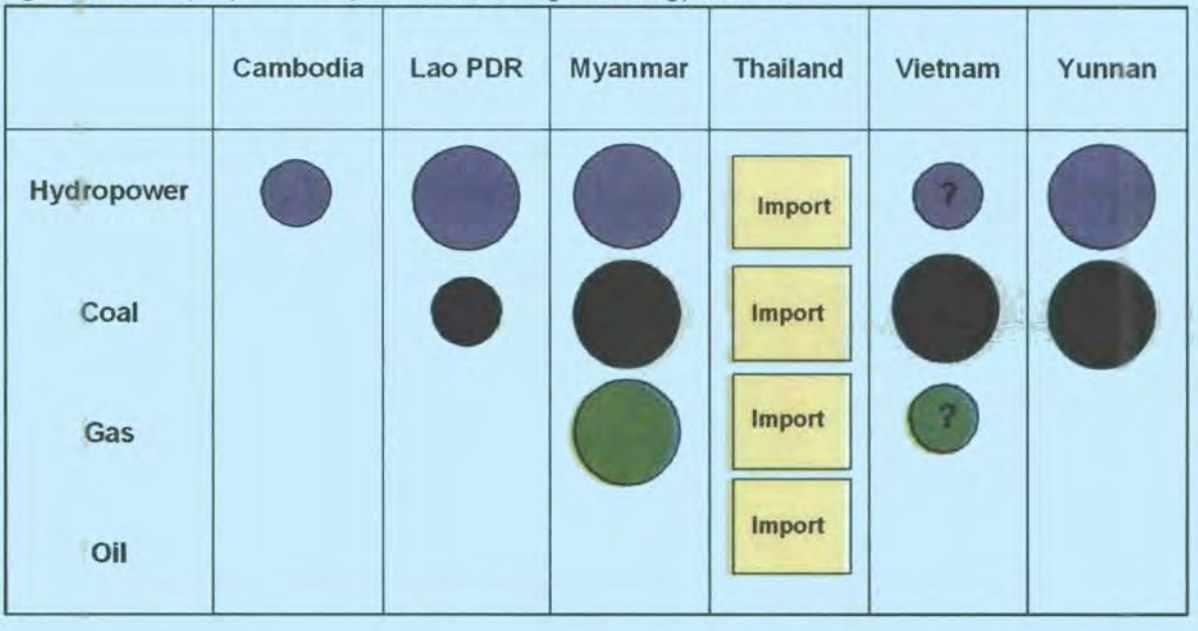
The Greater Mekong Sub-Region (GMS), comprising Cambodia, Lao PDR, Myanmar, Thailand, Vietnam and the Yunnan Province of the PRC, is endowed with substantial energy reserves, but they are unevenly distributed between the countries and lack balance in the mix of energy sources within each country.

Lao PDR, Myanmar, Yunnan, and Vietnam have the resources to be self-sufficient in energy. Thailand, on the other hand, is energy deficient and will increasingly rely on imports in spite of considerable oil, gas and lignite reserves. Cambodia is also dependent on imported energy.

Hydropower resources in Lao PDR, Myanmar, Yunnan, and to some extent, Vietnam are abundant and exceed those countries' own demand. Good quality coal

| Background Data | Laos | Thailand |
|---|---|---|
| Size (km2) | 236,800 | 514,000 |
| Population (millions) | 5.8 | 62.5 |
| GDP per Capita (classical and PPP in US$/a) | 300 / 1,630 | 1,850 / 6,600 |
| Share of Agriculture (% GDP) | 53 | 11% |
| Share of Industry (% GDP) | 22 | 40% |
| Share of Services (% of GDP) | 25 | 49% |

Figure 1: Electricity Import and Export Potential of Regional Energy Resources



deposits occur in Yunnan and Vietnam. Lignite deposits in Thailand and Lao PDR are unlikely to be exploited further due to a combination of economic and environmental reasons. There are substantial recoverable reserves of natural gas, mainly from offshore fields in Myanmar and Thailand and, to a lesser extent, Vietnam. Yet, Thailand remains a net importer of gas. Oil production in the GMS is limited.

Indicative electricity trading potential between GMS countries is illustrated in Figures 1 and 2. Existing contracts and MOUs indicate that Thailand intends to meet its energy deficit by importing hydropower from Lao PDR, Yunnan, Myanmar and possibly Cambodia, natural gas from Myanmar, and coal, oil and more gas from countries outside the GMS. Vietnam will probably become an importer of electricity as well, mainly to cover supply shortfalls expected for the southern part of the country.

By the year 2010 the following electricity demands are expected:

Figure 2: Energy Trading in the Greater Mekong Subregion


| Electricity Demand 2010 | Laos | Thailand | Vietnam |
|---|---|---|---|
| Peak Demand (MW) | 380 | 28,900 | 12,700 |
| Energy Demand (GWh/a) | 2,000 | 184,300 | 72,000 |
| Load Factor (%) | 0.59 | 0.72 | 0.64 |

The undeveloped hydropower potential for Laos is in the order of 25,000 MW, not accounting for projects on the Mekong River, which is unlikely to be developed.

## Institutional Framework and Setting

Laos has exported hydropower to Thailand since 1973, when the first stage of the 150 MW Nam Ngum project was commissioned. The power purchase agreement between the two utilities (EdL - Electricite du Laos, and EGAT - the Electricity Generating Authority of Thailand) was a document of two pages and specified the rate at which power would be sold. The tariff levels were to be renegotiated every four years. For a long number of years, the project was the most important foreign currency earner of the Lao government.

Given the long time back and that the country was on the brink of war, it is not surprising that no separate EIA and resettlement studies were done. It may well be that the mitigation measures would not be fully acceptable if viewed with today's eyes. The water quality in and downstream of the reservoir was reportedly poor during the first years of operation, but has stabilized after a few years and the Nam Ngum reservoir has become a major source of fish and a significant tourist attraction. The reservoir had not been cleared of trees prior to inundation. For many years enterprising divers have been harvesting timber, cutting them with pneumatic, underwater saws.

Since about 1996, the government of Laos has gradually revamped legislation under which new hydro projects can be developed. This process has involved laws, regulations and policy instruments for environmental and social protection, resettlement and project development, including the Lao Constitution (1991), the Forestry Law (1996), the Law on Water and Water Resources (1996), the Land Law (1997), the Electricity Law (1997) the Road Law (1999), the Environmental Protection Law (1996), the National Environmental Action Plan (2000) and the NT2 Resettlement Policy (1999). Also, in 1996, the science, technology and environment authority (STEA) was set up, residing directly under the Prime Minister's office.

Depending on the project sponsors, there may be additional environmental and social requirements and criteria which the project may have to satisfy in order to qualify for funding.

## Nam Theun 2 Project Development

In the 1970s, the Mekong River Comission Secretariat undertook a systematic survey of the hydropower resources of Lao. The NT2 project was identified as one of the best schemes, but far too big for power supply to domestic consumers. In 1980, the possibility of developing three projects along the Nam Theun River was examined. In 1984 and 1986, further investigations

for the Mekong River Commission Secretariat in respect of geo-technical investigations for the potential Nam Theun 2 dam site were undertaken.

## Detailed Studies and Investigations

In 1991, the feasibility study for the project was undertaken, under the auspices of and with funding from the World Bank. In 1994, the World Bank had been formally invited by the Government of Laos (GOL) to participate in the project, both as a country risk guarantor and a provider of funds to GOL. The preliminary environmental impact assessment was released in 1995 and, following a detailed review, the World Bank issued a list of outstanding concerns, including the need for an Alternative Study, an Economic Impact Analysis and an Environmental and Social Review. In 1996, the World Bank started to set up the Nam Theun Social and Environmental Project (NTSEP) that would finance project-related activities and be treated as part of GOL's equity interest in the project.

Concurrently, the Nam Theun 2 Electricity Consortium (NTEC) was established. NTEC commenced negotiations with EGAT in respect of a potential power purchase agreement in 1994. By 1995, NTEC had agreed with GOL to support the planning and initial development of the Nakai-Nam Theun NBCA and entered into discussions with the International Union for Conservation of Nature (IUCN) for the development of a management plan for the Nakai-Nam Theun NBCA.

Notwithstanding the temporary delay caused by the impact of the Asian financial crisis on EGAT's power requirements, the GOL, the World Bank and NTEC continued to undertake further assessment of the economic viability and potential environmental impact of the project.

Five major studies were released in 1997/1998:

- Draft Environmental Action Management Plan (updated in 2001 and 2002)
- Resettlement Action Plan (draft 1997, final 1998, updated in 2002)
- Environmental and Social Catchment Management Plan (IUCN, updated by GOL in 2002)
- Study of Alternatives
- Economic Impact Study

The study of alternatives carried out an options assessment and was to answer five strategic questions:

- Is the electricity demand in Thailand, even with maximum energy conservation, strong and robust enough to absorb the committed power exports from Lao?
- Is NT2 sufficiently attractive to compete with new power plants in Thailand?
- How does NT2 rank amongst other candidate power export schemes in Lao, considering technical, environmental, social, economic and financial criteria?
- Is the proposed configuration of NT2 the best, considering technical, environmental, social, economic and financial criteria?
- Should NT2 be recommended as one of the projects to cover Lao's power export commitment to Thailand?

As part of the public consultation process, three major workshops were organized: one to discuss the study methodology, one to eliminate from the set of options the alternatives which would be clearly inferior from a multi-criteria point of view, and the last to choose from that remaining set of options the overall, most attractive development. On average, there were some 150 participants, including representatives from all ministries concerned, local and foreign NGOs, donor and embassy representatives, and various experts from ongoing organizations and study teams in the region.

The study came to the conclusion that the power demand in Thailand would be strong enough and that once the PPA is signed the power market risk practically disappears. As a project, NT2 can easily compete with gas-fired combined cycle and coal plants, which are the two most economic types of candidate power plants for the expansion of the Thai electricity supply system. After extensive multi-criteria investigations, the study concluded that NT2 was ranked second in the list of candidate schemes for export to Thailand, after the Theun Hinboun project, for which construction had already started and which has meanwhile been commissioned.

Of the large number of NT2 alternatives investigated, including the 'no project' option, the most attractive candidate proved to be the one with the dam at Nakai, a full supply level of 538 masl, diversion of the water to the Xe Bang Fai and 680 MW installed capacity. The physical project would be complemented by an intensive mitigation program to ensure that the affected people and the environment would be better off with the project than without it. Risks associated with the recommended alternative were considered small.

The answer to the fifth question was therefore a clear 'Yes the project should be recommended for power export to Thailand' with the proviso that 'the planned

environmental and social action plans are fully implemented'.

The economic impact study concluded that the project would boost the GDP by an estimated 3.2 percent; that, because of the way it is organized, it would not lead to an increase in inflation; and that the financial risk is manageable, except for a combination of very hypothetical cases, such as a 20 percent reduction in generation combined with a 20 percent higher project construction costs.

## Project Design

In the year 2000, a concept design study was carried out and the project further optimized. The installed capacity is now fixed at 1,080 MW and this necessitated an increase of the re-regulating reservoir storage volume compared with previous studies to avoid environmental problems. From an engineering point of view, the project is not affected by any unusual topographical, geological or hydrological problems. The design is up-to-date but conventional and does not have any record-breaking features.

## Project Status in May 2003

All preparations for the implementation of NT2 are in full swing. The Concession Agreement (CA) has been signed. The Power Purchase Agreement (PPA) has been initialled and is expected to be signed before August 2003. The bids for the three civil works and two electro-mechanical equipment lots have been received and are being evaluated. The tender negotiations are under preparation and will be received around August and September 2003.

## Options Assessment

### *Thailand*

For the Thai system extensive studies investigating and promoting alternative supply technologies (such as DSM, solar power, and the right of small power

**Table 1: Primary Energy Resources for Thailand**

| Fuel | Reserves, Imports | Potential Use for Power Generation, and Assessment of Environmental Impact |
|---|---|---|
| **Lignite** | Domestic, substantial reserves | Restricted potential due to environmental opposition. Mae Moh deposits have high sulfur content. High environmental and social impact. |
| **Coal** | Imported | Major medium to long-term option. Medium to high impact. |
| **Gas** | Limited domestic reserves which will be exhausted in the next 20 years, major imports from nearby countries planned | Will become major source, marginal cost equivalent to import price. Imports are supply constrained. Clean burning compared with oil or coal, but $CO_2$ emission are considerable. Low to medium impact. |
| **Oil** | Limited domestic reserves, imports from overseas suppliers | Role of oil to be reduced, but still an important option due to plentiful supply situation. Medium to high impact. |
| **Orimulsion** | Imported from Venezuela | Asphalt-like oil substance. Proposed by one private developer as fuel for steam plant. Medium to high impact. |
| **Uranium** | Imported | Long term option, public acceptance is a problem. |
| **Hydro** | Substantial local potential, only 25% developed. Remaining sites predominantly in national parks or on Mekong River | Further development restricted due to environmental difficulties, pumped storage may be attractive. Degree of impacts depend on many factors: location, storage size and mitigation measures. |
| **Solar** | Substantial potential | No utility size plant in sight. Photo-voltaics used in market niches. Low impact. |
| **Wind** | Limited potential due to low and irregular wind speeds | Major development unlikely in spite of ever decreasing wind-mill prices. Low impact. |
| **Geothermal** | No proven potential. Thailand has small demonstration unit | No plans for utility scale development. Low to medium impact, depending on mitigation measures. |
| **Waste** | Possible source of fuel | Co-generation in waste incinerators will make a modest contribution. Medium to high impact, depending on mitigation measures |

producers (SPP) to sell surplus electricity at an attractive tariff to the grid have been done by EGAT and NEPO. The demand forecast for Thailand used for the Stuudy of Alternatives (SOA) considers the reduction of the demand as a result of the active DSM program. On the supply side, the co-generation of the SPP is duly taken into account. Table 1 summarizes the energy resources available to Thailand.

The main fuels for future use in power generation in Thailand are:

- Imported natural gas, because it is environmentally friendly and, when burned in combined cycle gas turbine units, it provides the most efficient and economic thermally generated energy.
- Imported coal, because of its low price and worldwide availability. Thailand is committed to importing only low sulfur coal to limit environmental effects.
- Imported heavy fuel oil, as a back-up fuel for gas, especially for steam power plants.
- Domestic lignite, as the main indigenous resource, largely restricted to the Mae Moh area.

Taking all economic and environmental factors into consideration, the most attractive new power plants for Thailand are gas-fired combined cycle units for base and mid load operation, and gas turbines for covering the peak and as a standby reserve. If the demand would be growing at a much faster rate, steam coal plants would be an attractive option for base load operation in Thailand, but this scenario is not considered here.

Between 2003 and 2010 12,000 MW of new generation capacity is needed in Thailand, about 10,000 MW to cover demand growth and 2,000 MW to replace old and obsolete lignite and oil-fired power plants. Hydro imports form Laos could help to cover this future demand increase.

***Laos: PP Projects for Export***

After the GOL invited private entrepreneurs to participate in the development of hydropower schemes for export, altogether 24 projects were granted a Memorandum of Understanding or Concession Agreement. In all projects the GOL had an equity share of 25 to 30 percent. The developers undertook studies to investigate the merits of their projects, including environmental and social investigations. The quality of those studies varied in level and intensity. The SOA was to identify which projects would be the most attractive from the GOL's point of view, and this included an assessment of more than 20 Nam Theun 2 development alternatives.

The analysis of each project was conducted using a common methodology and standards so that technical, environmental and economic performance measures were current and comparable.

For a number of projects, several alternatives have been investigated. Within the constraints of existing concessions commitments, a basin optimization approach has been used whereby scheme layout and calculation of benefits have taken into account environmental impact and project interdependencies such as regulation benefits from upstream projects or loss of flow due to upstream diversions. In such situations, the merit of each project was tested under different development sequences and scenarios. A high degree of automation was essential for this exercise to be carried out reliably and to a satisfactory standard.

Then scenarios of competing groups of candidate projects for export to Thailand have been formulated, each with altogether 3,000 MW capacity, as defined in the bilateral agreement.

## Multi-Criteria Evaluation of Alternative Scenarios

The program used for the multi-criteria analysis was called MOSES, which stands for 'Multi-Objective Scenario Evaluation System'.

The evaluation and planning of hydropower projects is a complex and multifaceted exercise. Project comparisons cannot be made solely on quantifiable economic and financial indicators but must consider a wide range of factors and interactions, such as those shown in Figure 3.

MOSES generates key inputs in the development of the hydropower development strategy by providing a tool by which different development scenarios can be compared. The end product of the MOSES analysis is a ranking of scenarios according to their overall suitability or preference for further development. MOSES does not assess benefits and impacts on an absolute basis but provides a convenient method for comparing a number project scenarios on a uniform and objective basis.

The basic concept of the MOSES model is common to the many variants of multi-criteria methods. Information relevant to each project is indexed according to a scale or scoring rules based on suitability of the project for development as assessed against

Figure 3: Hydropower Project Planning Arena


nominated criteria. Once scores are assigned under each criterion based on the project information, the relative importance or weight given to each criterion in the evaluation is determined and the index scores are adjusted by multiplication of the score by the corresponding weight. Results of these computations are then summed for each project and the total weighed score is then compared with that of other projects to provide a project ranking with all aspects considered on a consistent basis.

MOSES enables interested parties to evenly weigh one project against another based on an aggregate measure that accounts for economic, financial, environmental and social objectives. The structure of the MOSES system is shown in Figure 4.

Multi-criteria rating of candidate projects under the MOSES approach distinguishes three levels at which points are assigned to a project:

Figure 4: MOSES - Multi-Objective Scenario Evaluation System

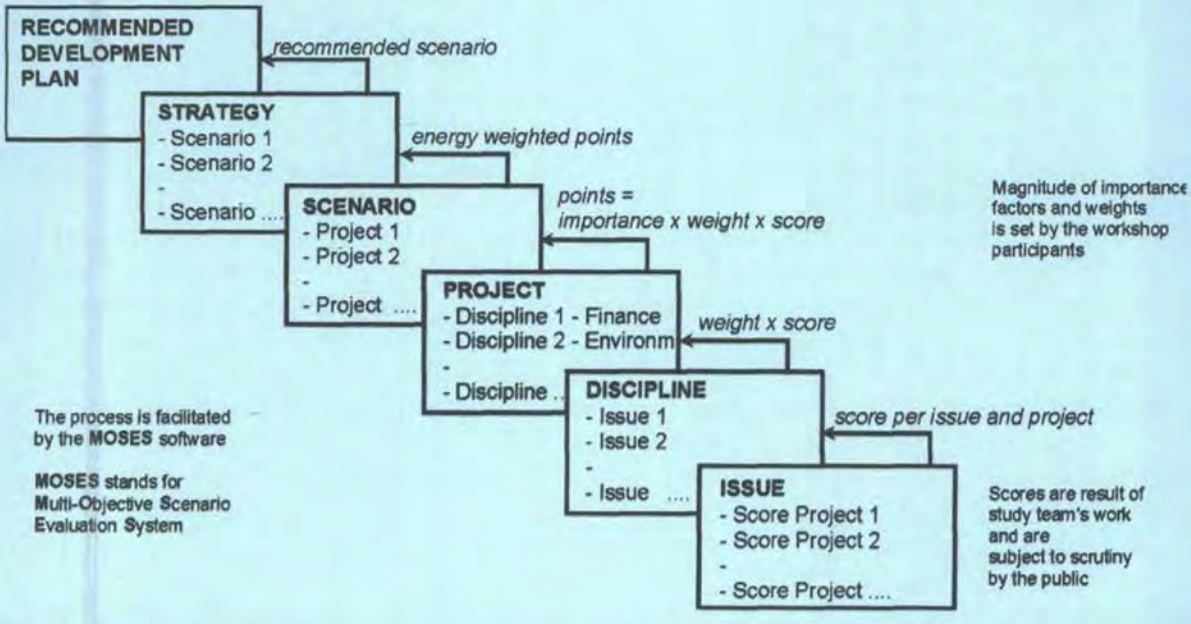


Table 2: Disciplines and Issues Used to Rate Projects and Scenarios*

| Disciplines | | Issues | Points Study Team | Points Workshop Participants |
|---|---|---|---|---|
| **Financial Aspects** | | Benefits to GOL - expressed per kWh | 40 | 35 |
| | | Benefits to GOL - first 10 years | 28 | 30 |
| | | Benefits to GOL - total | 10 | 13 |
| Importance Factor | | Debt/service ratio | 10 | 10 |
| Study Team | 32 | Financiability/financing plan | 7 | 7 |
| Workshop Participants | 30.4 | Willingness and capability of developer to meet up-front costs | 5 | 5 |
| **Social Aspects** | | Number of people affected by project | 20 | 24 |
| | | Number of people resettled | 20 | 21 |
| | | Difficulty of finding suitable sites for resettlement | 15 | 10 |
| | | Ethnic adaptability of affected people | 15 | 8 |
| | | Health impacts | 10 | 7 |
| Importance Factor | | Risk factors | 10 | 7 |
| Study Team | 18 | Public infrastructure benefit | 10 | 5 |
| Workshop Participants | 19 | *Degree of public consultation & awareness* | | 10 |
| **Ecological Aspects** | | Impacts on nature refuges and unique scenery | 20 | 20 |
| | | Impacts on wildlife | 20 | 20 |
| | | Downstream impacts on fisheries | 15 | 15 |
| | | Impacts on fish biodiversity | 15 | 15 |
| | | Cumulative effects on Mekong biodiversity and fisheries | 10 | 6 |
| | | Impact on riverine habitats and wetlands | 10 | 10 |
| Importance Factor | | Upstream impacts on fisheries | 5 | 5 |
| Study Team | 18 | Potential benefits of reservoir for birds and wildlife | 3 | 3 |
| Workshop Participants | 16 | Impacts on rare/endangered vegetation | 2 | 6 |
| **Technical Aspects** | | Hydrological risk | 20 | 20 |
| | | Geological risk | 20 | 20 |
| | | Independent Panel of Experts for design and construction | 15 | 15 |
| | | Dam safety | 10 | 10 |
| | | Risk of reservoir sedimentation | 8 | 8 |
| | | Quality and extent of field investigations | 8 | 8 |
| | | Conservativeness of design | 8 | 8 |
| Importance Factor | | Availability of construction materials | 5 | 5 |
| Study Team | 5 | Provision of bottom outlet for emergency drawdown | 4 | 4 |
| Workshop Participants | 11.5 | Period required for reservoir filling | 2 | 2 |
| **State of Preparedness** | | Negotiations With EGAT | 40 | 30 |
| | | | 30 | 30 |
| Importance Factor | | Level of technical studies and design | 15 | 20 |
| Study Team | 15 | Level of socio-environmental studies and action plan | 15 | 20 |
| Workshop Participants | 10.5 | | | |
| **Economic Aspects** | | Ability to compete with thermal plants in Thailand | 55 | 48 |
| | | Magnitude of external costs vis-à-vis GOL income | 15 | 15 |
| | | Magnitude of external benefits vis-à-vis GOL income | 7 | 10 |
| | | General infrastructure benefits - roads and bridges | 5 | 5 |
| | | General infrastructure benefits - national 500 kV grid | 5 | 5 |
| | | General infrastructure benefits - electrification | 5 | 5 |
| Importance Factor | | Employment effect, development of vocational skills | 3 | 5 |
| Study Team | 7 | Project risks (delays, cost overrun, reduced generation) | 3 | 5 |
| Workshop Participants | 7 | Potential economic effect of dam break (or fire Hong Sa) | 2 | 2 |
| **Regional Development** (project affected area) | | Use of project for irrigation | 20 | 20 |
| | | Use of project for rural electrification | 20 | 20 |
| | | Improved transport (road, waterway, lake) | 20 | 20 |
| | | Improved health service | 10 | 8 |
| | | Potential for lake fishery | 10 | 5 |
| | | Opening up of area of priority development | 9 | 5 |
| | | Use of project funds for watershed protection | 8 | 8 |
| Importance Factor | | Use of project for vocational training | 2 | 5 |
| Study Team | 5 | Potential for attraction of tourists | 1 | 1 |
| Workshop Participants | 5.6 | *Education and cultural benefits* | | 8 |
| Workshop values for Importance are weighted averages Of specialist work groups | | Sum of points per Discipline is 100 (percentage points) Issues for the lignite plant differ, and are not included in this paper. | | |

*Issues shown in Italic added by Workshop III participants

- The impacts of each project are divided first into **Disciplines** and each accorded an **Importance Factor**, ranging between 0 and 100%.
- Each Discipline is assessed according to specified **Issues** and each Issue is accorded a **Weight**, ranging between 0 and 100%.
- Each Issue is assessed against specified **Criteria** and each criterion is accorded a **Weight**, ranging between 0 and 100%. A **Score** is awarded according to the performance of a project in respect of each Issue and a weighted score is calculated according to the corresponding Weights.

Under the MOSES classifications used for IPP projects in Laos, seven disciplines are defined and, within each discipline, projects are evaluated according to four to ten major issues, as shown in Table 2.

Most important is that scoring sheets exist for each issue of each discipline, describing in detail what data need to be considered and how particular scores are arrived at. Details can be found at the World Bank's website, Nam Theun 2 Project, Study of Alternatives.

## Outcome of the Multi-Criteria Analysis

It is interesting to plot the weighted sum of financial, economic and preparedness disciplines, as indicator of the economic attractiveness of projects, against the weighted sum of social, ecological and regional development disciplines, as an overall impact parameter. The overall ranking of projects, based on their aggregate score in the MOSES analysis, is shown in figure 5. Projects which plot in the top right hand corner of the graph are the most desirable.

The graph is for all IPP projects considered for export to Thailand. As far as Nam Theun 2 is concerned it can be seen that the relative impact of the run-of-river option is, overall, positive. This is a result of the assumed good mitigation and significant impulses for regional development. Impact-wise the big NT2-NTEC solution is the least attractive of the NT2 alternatives. However it is this alternative which is outstanding from the economic point of view, surpassed only by IPP Project 1.

MOSES was then used to determine energy-weighted aggregate project scores for those IPP schemes that form a particular power export scenario. These results were normalized and the most attractive scenario was given a 100% attractiveness rating. The scenarios were subsequently ranked in order of attractiveness, as shown in figure 7.

The results clearly indicate that the big NT2-NTEC alternative was part of all of the best power export scenarios. A full range of sensitivity studies was carried out to test the robustness of this finding, applying different importance factor settings, but the large Nam Theun 2 solution proved to be a robust part of the best power export scenarios in all cases.

Figure 5: MOSES - Overall Project Level Trade-Off between Impact and Economics

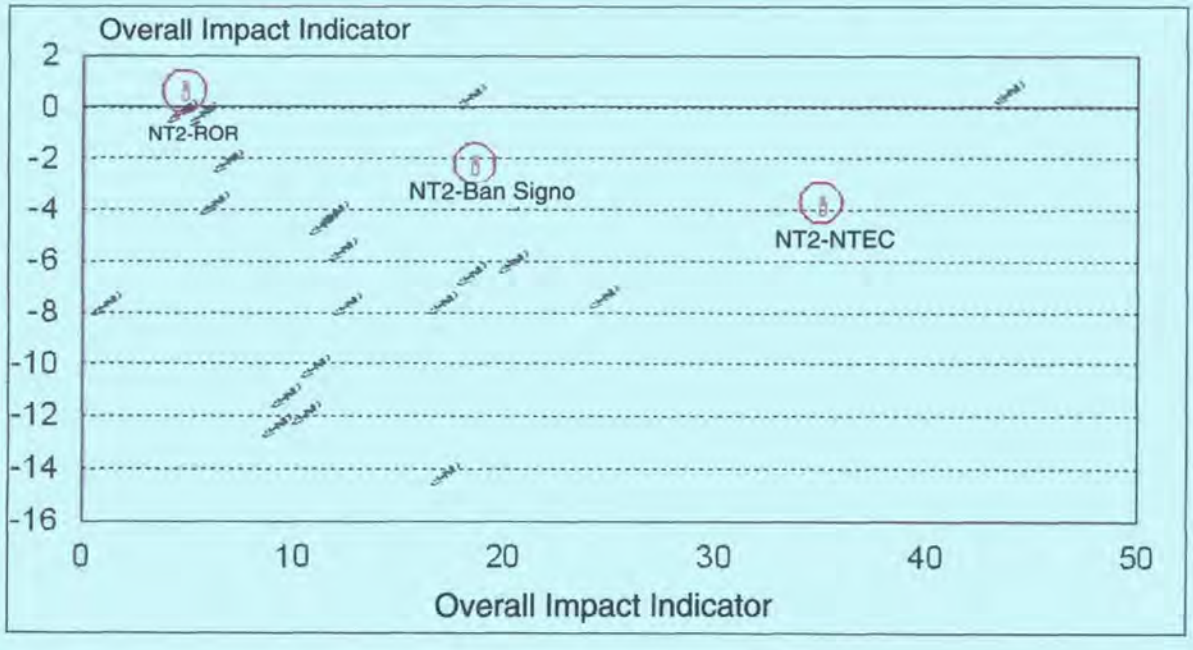
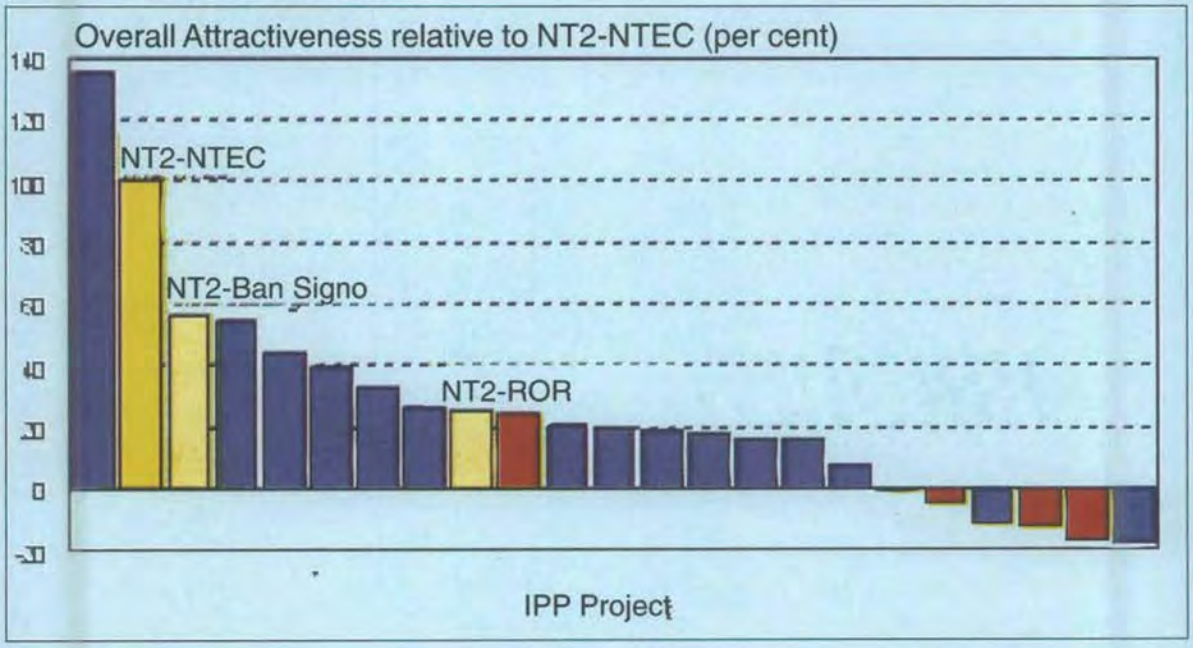
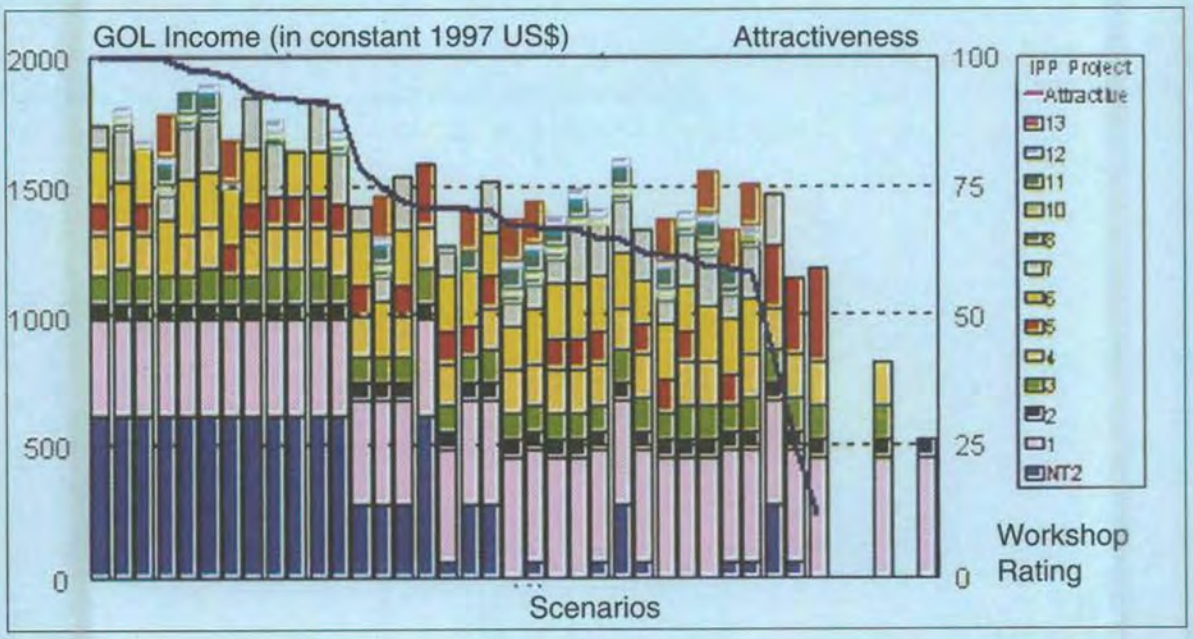


Figure 6: MOSES - Overall Project Ranking




The results also indicate that the three scenarios considered most attractive were not the ones which would generate the highest financial income to the Government of Lao PDR, a clear indication that the 'public' is quite well prepared to accept solutions which from a financial or economic point of view are suboptimal, but which offer certain advantages in terms of environmental, social, risk or other factors.

Figure 7: Final Ranking of Power Export Scenarios



# Karakaya Dam and HEPP Project: About Comprehensive Options Assessment

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Key words: development, water resources management

## Introduction

Turkey, being a crossroad between Europe and Asia, is a developing country having a considerable way to go before being developed. Water resources development projects are of utmost importance for the fulfillment of the development goals of the country.

Despite the general thought, Turkey is not a water-rich country; currently water consumption per capita is about 1700 $m^3$/year and this figure is estimated to fall below 1000 $m^3$/year by the year 2025, indicating that Turkey will become a water-deficit country in the future and will face serious water problems. Increasing demand for water as a result of increasing population and developing industrialization leads to increased stress on water resources. Since water resources are not distributed homogeneously throughout the country, there is an indispensable need for water storage structures. At this point, dams become crucial.

Water resources development projects play a very important role in the Turkish economy. Projects developed by the General Directorate of the State Hydraulic Works, the country's major institution responsible for water resources management, since its establishment in 1954 provided 60 billion USD income to the national economy. On the other hand, by the year 2002, only one-third of Turkey's water resources had been developed. This means that there is a lot of work to do in the field of country's water resources development and the remaining two-thirds of the country's water resources are planned to be developed by the year 2030.

## Water Resources in Turkey

Though generally Turkey has adequate amount of water, it is not always in the right place at the right time to meet present and anticipated needs. Turkey's territory, considering the hydrological conditions of the country, is divided into 26 drainage basins. Rivers have generally irregular regimes and natural flows cannot be taken directly as usable resources. Average annual precipitation, evaporation and surface run-off parameters of the country display great geographical variation. The drainage density is relatively higher in the Black Sea region, while the density is much lower in the regions of Konya in the central and southeastern Anatolia.

Turkey's climate is semi-arid with some extremities in temperature. Climate and precipitation figures exhibit great variance throughout the country. In the higher interior Anatolian Plateau, winters are cold with late springs, while the surrounding coastal fringes enjoy a very mild, Mediterranean climate. Average annual precipitation is 643 mm, ranging from 250 mm in the southeastern part of the country to over 3000 mm in the northeastern Black Sea coastal area. This average annual precipitation figure for Turkey corresponds to an average of 501 billion $m^3$ of water per year. Approximately 70 percent of the total precipitation falls during the period between October and April, and there is little effective rainfall during summer months.

Turkey is not a country that has excess water capacity. Although Turkey has at present more water resources than some of its neighbors, it can be regarded as a country that will find itself in a position not to meet its own needs in the near future.

Turkey's average annual runoff is approximately 186 billion $m^3$. The amount available for consumption is about 110 billion $m^3$, and almost one-fourth comes from the Euphrates (Fırat) and the Tigris (Dicle) rivers, which both have their sources in the eastern part of the country. Today, Turkey utilizes only about 40 billion $m^3$ of its capacity of 110 billion $m^3$. The remaining portion of 70 billion $m^3$ is to be allocated to its needs in the future.

It will be appropriate to underline that, contrary to the prevailing belief, Turkey is not a country rich in water resources. Furthermore, it is not the richest country of the region in water resources. In Turkey, the amount of water available per capita per year is considerably below the world average. Taking into consideration that Turkey's population is 65 million, the quantity of

available water per capita is 1700 $m^3$/year. However, it is known that countries regarded as rich in water resources, have 8-10 thousand $m^3$ water per capita per year. In other words, the available water per capita in Turkey is about one-fifth of the water-rich countries. The impression of Turkey having excess water derives from the fact that it is not at present in a position to fully utilize its water resources.

## Institutional Framework on Water Resources Management

Water resources in Turkey are managed by a variety of state and local agencies with different missions and overlapping jurisdictions. This section provides a brief overview of the legal framework and functions of the primary governmental agencies responsible for various aspects of water management in Turkey.

The basic legislation in the water sector is the Turkish constitution, which states that water resources are the natural wealth of the country and are, under the authority of the State, to be used for the benefit of the public. In this direction, the Turkish Civil Code covers water issues in two categories: as common waters and private waters. Except for some privately owned, small springs, the development of water resources, including groundwater, is in general the responsibility of the State. Nevertheless, utilization of groundwater resources is regulated by a specific law, which licenses the user upon request, within the limits of safe yield of the relevant aquifer. Groundwater use rights can neither be transferred nor sold.

A number of governmental and non-governmental organizations have direct and indirect interests in the development and conservation of water resources in Turkey. The institutional framework has three levels; namely, decisionmaking, the executive and users level. At the decision-making level, the prime ministry, the state planning organization and ministries take part. Governmental organizations under the ministries act at the executive level. There are both governmental and non-governmental organizations at the water users level for the operation and maintenance of the projects. The four main organizations responsible for development of water resources are General Directorate of State Hydraulic Works (DSI), General Directorate of Rural Services (GDRS), General Directorate of Bank of Provinces (Iller Bank), and General Directorate of Electric Power Resources Survey and Development Administration (EIE).

Among these organizations, DSI, under the Ministry of Energy and Natural Resources, is the major organization responsible for the development and management of water resources. DSI's main responsibilities cover the issues of observation, field investigation, master planning, pre-feasibility studies, feasibility studies, design, construction and management for irrigation, hydraulic energy generation, domestic water supply (for the cities with the population more than 100,000) and flood control. Development, management and conservation of groundwater resources are also exclusively the responsibility of DSI.

Optimal planning and rational management of water resources calls, first of all, for adequate and reliable data concerning, among others, the quantity and quality of water depending on time and space as well as other meteorological variables that have significant impact on both water supply and demand. In parallel with the effectual and practical procedures of water resource development projects and operation of facilities built in this respect, DSI carries out, and is responsible for, the tasks associated with the observation and measurement of a wide range of hydrometeorological and hydrological variables. These data are observed, measured and processed by DSI, including primarily water levels of lakes and groundwater, stream flow rates and sediment loads.

## Karakaya Dam and HEPP Project

In 1968, a study of the development of water resources of the lower Euphrates basin to generate hydropower and irrigate arable lands was launched. As a result of this study, it was determined that the estimated development possibilities of the Euphrates basin comprise a total power potential of about 5300 MW, producing annually 23,900 million kWh of energy, combined with the irrigation of 1,288,000 ha of land. This study was the first step of the giant Southeastern Anatolian Project (GAP).

The Southeastern Anatolian Project, shortly called GAP, is the most ambitious water development project in Turkey. It covers an area of 74,000 $km^2$, about one-tenth of the total area of Turkey, including the lower reaches of the rivers Euphrates and Tigris and the fertile plains lying between them. Nine provinces of Turkey are completely or partially included in the project area, having a population of 5,275,000, about 9.2 percent of the national total. GAP is a group of 13 projects and their subprojects, which are being developed for irrigation, hydroelectric energy generation and domestic water supply. Seven of them lie in the Euphrates river basin and the remaining six lie in the Tigris river basin. Upon full development of the project, 1.69 million ha of land will be irrigated and 23,000 GWh of hydroelectric energy

will be generated annually. The package of these multipurpose water development projects, called GAP, will stimulate the development of various other sectors as well as water resources owing to the fact that it will eventually have a profound influence on the economic and social life of the region.

Karakaya Dam and HEPP project is the second biggest project on Euphrates river basin, after Ataturk Dam and HEPP, within the framework of GAP. Karakaya Dam is a single purpose project for power generation. It is located on the main stem of the Euphrates River about 163 km downstream of Keban dam. The construction of the 173 m high arc-gravity dam with a 2 $hm^3$ concrete volume was completed in 1987 creating 9.37 $km^3$ of total storage capacity. The powerhouse at the toe of the dam has an installed capacity of 1800 MW. The average annual energy generation is 7354 GWh. The last six units of the powerhouse were put into operation at the end of 1988.

## Geographical and socio-economic background of the project region

The Euphrates River, which has the largest drainage basin in Turkey, is formed by four tributaries, the Karasu, Murat, Munzur and Peri, which rise at an altitude of about three thousand meters in the mountainous areas of eastern Turkey. Its tributary headwaters rise in the mountainous watersheds of eastern Turkey at elevations of 3000 m or more. The major tributaries trend westerly for more than 500 km along the grain of the mountainous topography to their confluence near Keban in east-central Turkey. From Keban, the Euphrates River takes a generally southerly course, cutting through the anti-Taurus mountain and foothill structures before entering the Lower Euphrates Plains region. The Euphrates continuous generally southwards along the western border of the plains region into Syria and hence across Mesopotamia to its mouth on the Persian gulf.

The Karakaya Dam and HEPP site is located 166 km downstream of Keban on the Euphrates River. The southeastern Anatolia region where Karakaya Dam is located is one of the more isolated regions of Turkey. It is separated from Adana and the Mediterranean region by the Aminus and the anti-Taurus mountains, and from the Central and East Anatolian regions by sections of the Tigris river valley. The region is dominated in the west, north and east by highly dissected mountains and in the central parts of rough, dissected plateaus; in the south along the border there are extensive areas of lowland plains.

## Assessment of Development Goals, Sectoral Demands, Regional and Local Needs

Karakaya Dam and HEPP project is one of the important projects of the Southeastern Anatolian Project (GAP), which was developed as a multipurpose regional development project by the General Directorate of State Hydraulic Works. The southeastern Anatolia region is one of the least densely populated parts of Turkey, and also socially and economically one of the most conservative. In general, landholdings are small and agricultural practices are primitive and have changed little in the past decades.

Since the1970s, when the planning of GAP was done, economic, political and social developments in Turkey haven't had much of a significant impact on the project area. Land holdings, technology, and urban-commercial functions have remained in fundamentally the same state for decades. Government subsidies, in the form of construction of rural water supply systems, medical dispensaries and clinics and schools, have influenced the lives of the people in the region only slightly. Whilst much of the rest of Turkey has progressed rapidly in nearly all economic sectors, the economy of this region has remained essentially stagnant.

Agriculture, including animal husbandry and related industries, was the only important economic activity in the region. Neither mining nor forestry appear to offer a potential base for development. Except for a small-scale state farm, there was very little irrigated agriculture within the project area. Within the project area there was a low level of economic activity based exclusively on subsistence agriculture. Few activities were contributing to the development of secondary or tertiary industries within the region excepting those directly related to agriculture and livestock. Resources other than land, water and people were lacking for any significant primary economic activity.

This economic structure of the region led the government to develop a regional development plan, namely GAP. With respect to regional considerations, the need for development is obvious. The economy is almost entirely based on agriculture but the summer drought, being very long and severe, has a negative impact on the agricultural production and the product variety. Irrigation and hydropower projects within the framework of GAP not only will develop the agricultural technology in the region but also will improve the social and economic structure of the region. GAP will increase employment opportunities in the urban areas and

reduce rural-push migration. In the future, when GAP is fully completed, not only will the economic growth rate in the region surpass the average of Turkey, but also about 3 million new job opportunities will be created in the region.

GAP is composed of 22 dams and 19 HEPPs. With these 19 HEPPs of 7465 MW installed capacity, annual energy generation is expected to be 27 268 GWh. The economic hydroelectric potential of Turkey has been estimated to be 123 385 GWH annually and the GAP itself will provide more than 22 percent of the total hydro potential.

## Identification, characterization and assessment of the options

In the planning report for Karakaya Dam and HEPP, in addition to all other issues, alternatives were evaluated. The evaluation of these alternatives included not only technical and economical considerations but also social and environmental considerations.

In order to generate tha same amount of energy that Karakaya Dam produces in one year, a thermal plant, which would have provided the alternative solution if Karakaya Dam had not been built, would have to consume an additional 1.2 million tons of fuel oil each year. The value of this fuel oil in terms of foreign exchange, excluding taxes and duties, was 280 million TL per annum. In the 1970s Turkey was importing more than half of her petroleum requirements. If no additional oil were discovered in the country, the percentage of imported oil would have increased substantially and it can be assumed that the whole of the additional oil requirements for the alternative thermal solution would be imported. In these circumstances, and with oil prices remaining at those days' level, Karakaya was assumed to lead to a saving of US$18.7 million worth of foreign exchange in every year of its operation. The Karakaya project thus seemed to help considerably in improving the national balance of payments.

Similarly, when other costs related with operation and maintenance are taken into consideration, Karakaya hydro scheme is more beneficial than other generating plants producing the same energy output per kW installed. In addition to direct economic benefits, there are also some indirect economic benefits of the project. Since the region where Karakaya dam is located was one of the least developed areas of the country, such a major construction project led to an improvement of local communication, encouraged the inflow of skilled personnel and of visitors, provided some measure of local employment and promoted more intensive commercial and industrial development. Most of these benefits cannot be assessed in financial terms but they are real and tangible and enhance the merit of the Karakaya scheme.

Environmental considerations mainly concern pollution. This is also the case for Karakaya Dam. During the planning stage, the Karakaya dam and HEPP project was compared with a thermal power plant of equivalent power generation from environmental point of view, as always done for every hydropower projects. When hydro and thermal power plants are compared, the following issues are the major concerns:

- Hydroelectric projects do not give rise to the inherent environmental impacts of thermal power plants, such as the effects of flue gas emissions on air quality and wildlife habitats, and the effects of cooling systems on aquatic ecology.
- In addition to operation and maintenance costs, costs of pollution control equipment (e.g. electrostatic precipitator, flue gas desulphurization units etc.) are higher for thermal power plants.
- A thermal power plant uses a non-renewable resource to produce energy, whereas a hydropower plant uses water, which is a renewable resource. Various estimates of fossil fuel resources indicate that they will be exhausted in about a century. However, energy is one of the primary inputs for an economy and a primary concern for human welfare. Therefore, the reconciliation of the present economic growth and the continuing productivity of resources should be maintained, which is generally referred to as sustainable development. The estimates of limited fossil fuel resources increase the importance of renewable energy resources, of which hydropower is one of the most important, for sustainable development.
- In summary, environmental impacts of hydropower plants are mostly initial and those of a thermal power plant are mostly during operation.

In the full text of this paper, Karakaya Dam and HEPP project will be compared with a coal-fired thermal power plant located in the same region and detailed calculations related to this comparison will be given. But, in summary, it can be said that Karakaya Dam and HEPP project is more viable from the environmental impact and economic points of view when compared to alternative thermal power plant projects.

# Kyrgyz Republic Irrigation Rehabilitation Project

## A World Bank Case Study

This case study illustrates how options assessment and stakeholder involvement informed decisions on the rehabilitation of irrigation infrastructure and selection of sub-projects to meet immediate needs by restoring agriculture productivity in the Kyrgyz Republic in Central Asia.

By the mid-1990s, the rural economy was in a state of near collapse in the aftermath of the breakup of the former Soviet Union. Within a comprehensive multi-sector reform framework, initial steps to restore water flows in inter-farm canal networks (up to the farm-gate) and improve the safety and optimize the performance of irrigation dams played a key role in stabilizing the agriculture situation and meeting immediate needs. These measures also represented the first steps in a longer-term transition to a more efficient and sustainable agriculture sector.

### What was the context?

The Kyrgyz Republic is one of the smallest of the republics in Central Asia that became independent in 1991. During the Soviet period, the ethnic Russian population grew to nearly a quarter of the total population of just under five million people. The country industrialized to the point where industry was 40 percent of GDP. However, a large portion of this industry was geared to producing goods, whose markets disappeared upon the breakup of Soviet Union.

Water reservoirs and dams in the Kyrgyz

1. Kyrov Dam, 2. Orto Tokoy Dam

Notwithstanding its industrial base, Kyrgyzstan was a relatively poor country in 1991, even by Central Asian standards, with large inequalities in income distribution. About 60% of its people were rural, many deriving their livelihood from farming. As explicit and implicit subsidies disappeared along with the Soviet market, the economy went into a tailspin. By 1992, at least one-third of the population fell below the poverty line - especially those in agriculture. Agriculture and agri-business accounted for 47 percent of the shrinking GDP and half the national employment by 1995. The ongoing political, economic and social transitions severely disrupted agriculture and irrigation sector performance.

Faced with multiple challenges, the Kyrgyz Republic became an early and proactive reformer, even before it joined the World Bank in 1993. As part of the combined agriculture and land reform program, the large collective farm system inherited from the Soviet era was abandoned. These former state farms and co-operatives (up to 5,000 ha in size) relied on surface irrigation, primarily from several rivers regulated by 13 large irrigation reservoirs and smaller dams. They were broken up into smaller units to prepare for privatization and individual ownership of farm plots. But the physical system of distributing water and institutional framework for irrigation that was inherited was not sufficiently adapted to the new situation. By 1995, flows in the primary and secondary irrigation canals up to the farm gate (at the collective farm level) had decreased by about 25 percent from pre-1991 levels, due to lack of maintenance, physically resulting in unchecked siltation and leakage. Irrigation deliveries to individual farms decreased substantially, and agricultural productivity declined sharply.

The social consequences and poverty implications were significant and widespread. For example, fodder, which was a major crop in the hills, was increasingly replaced by wheat as a barter commodity to raise farm income, thus diminishing local food security. Conflicts arising over land with better access to an irrigated water supply also aggravated ethnic tensions in some locations, such as in the Ferghana Valley. Stakeholders from farmers to local authorities increasingly voiced concern over the deteriorating state of irrigation infrastructure to the Ministry of Agriculture and Water Resources, which in previous times centrally managed and maintained inter-farm irrigation systems.

Immediate concerns also included dam safety. The collapse of maintenance led to growing concerns about whether gates, spillways and outlets were in good working order, and on whether safety was assured.

Amid the changes, government recognized that irrigation sector rehabilitation was an essential precondition to the success of the mid- and long-term programs for privatization of state land and its wider agriculture and rural reform programs, and sought external assistance. Among the donors, it was agreed that IDA would take the lead in supporting agriculture sector reform.

Within the framework of the first Country Assistance Strategy (CAS) prepared in 1995, discussions started with the World Bank on immediate rehabilitation needs and parallel development of a long-term strategy to achieve sustainability of the irrigation sub-sector. An Irrigation Rehabilitation Project emerged as the first step in a flexible lending program.

| Chronology | |
|---|---|
| 1991 | Independence of the Kyrgyz Republic |
| 1992 | The Kyrgyz Republic became a member of the World Bank |
| 1993 | First Constitution of the new Republic |
| 1993 | Dialogue initiated with Donors about Multi-Sector Reforms and Priorities |
| 1995 | First CAS. Agreement among donors for IDA to assume a lead role in the agriculture sector |
| 1996 | Project Concept Document for the Irrigation Sector Rehabilitation |
| 1997 | Sector Environmental Assessment and Project Preparation activities (involving evaluation and selection of immediate rehabilitation measures and an Action Program for longer-term measures) |
| 1998 | Project Appraisal and loan approval |
| 2000 | Preparation of a second project for Intra-farm Irrigation Rehabilitation and water use efficiency |
| 2004 | Scheduled completion of the Inter-Farm Infrastructure Rehabilitation Project |

The main elements of the strategy to increase the productivity of irrigated agriculture through improved water supply were identified in a Project Concept Document (1996). The approach was further elaborated in a Sector Environment Assessment in 1997, and the options were worked out in detail and priorized during Project Preparation studies.

The rehabilitation project that emerged had three main components. The first component focused on emergency repairs and selective low-cost rehabilitation of inter-farm irrigation infrastructure to restore flows in the inter-farm canal networks (to the farm gate) and improve drainage.[6] A second component involved rehabilitation and completion of dams, and improvement of monitoring systems of dams to address safety and performance concerns. A third component involved temporary financing of maintenance contracts for inter-farm irrigation infrastructure included in the sub-projects, aimed to foster private sector maintenance capacities and replace public sector practices that still followed the Soviet era model.

Beyond that, the rehabilitation project was the first step in a series of agriculture sector reform and modernization projects. Projects in the pipeline included an On-Farm Irrigation Project to help rehabilitate on-farm irrigation facilities (i.e. the network below the farm gate, between private holdings) and introduce measures for water use efficiency, an Agricultural Support Services Project, and a Rural Credit Project. These were planned after land ownership reforms and processes to establish Water Use Association to provide a mechanism for stakeholder involvement had evolved further.

The Ministry of Agriculture and Water Resources (MOAWR) was responsible for project implementation (1998 to 2004). Sub-programs are being implemented though a system of six oblast (provincial) offices covering the country, each with 5 to 10 rayon (district) offices responsible for primary and secondary irrigation systems. In parallel with the physical rehabilitation works, a discussion proceeded on the elements of National Irrigation Rehabilitation Action Plan (NIRAP) and to formulate an action plan for the long-term strategy. The action plan was to set out the Government's vision for irrigated agriculture, a longer-term program for inter-farm and intra-farm rehabilitation, a future program for financing operation and maintenance, and steps to establish Water User Associations, which would assume a key role in irrigation management and decision-making at the local level.

The Kyrgyz Republic is also one of five newly independent states cooperating in the Aral Sea Basin Development Program ASBP. Its mountainous terrain is the headwaters of the Syr Darya, one of the major rivers feeding the Aral Sea. Thus the water resource development strategy (and the irrigation sub-component) pursued in the Kyrgyz Republic has regional significance. Under water sharing agreements

6 It should be noted that the farm gate is the intake located at the head of the area covered formerly by the collective farm. Below this farm gate, distribution to individual (private) farms takes place.

among the Aral Sea Basin States (following Soviet period allocations), the Kyrgyz Republic is allocated 25 percent of the water originating in its territory.

## What options assessments were carried out, and by whom?

The Sector Environmental Assessment (SEA) was prepared by a small team of Kyrgyz and FAO experts drawn from the government and university sector working with central, provincial and local government agencies, mainly MOAWR and the Ministry of Environment (MOE). Involvement of non-government stakeholders included consultations with emerging civil society and NGOs, and the team met with farm communities. The SEA looked at the institutional, environmental and legal issues and hot spots related to the planned investments, environmental degradation, and environmental compliance.

A multi-disciplinary team similar to that assembled for the SEA was established to screen and rank sites for rehabilitation of inter-farm canal systems and to schedule priority investments according to immediate needs. As a first step, the project office requested and received proposals from the regional and local offices of MOAWR for rehabilitation of 250 sites. Initially, the 126 of these were selected by screening. Rejected sites were those comprising largely new works and expansion of existing irrigation systems instead of rehabilitation. Oblasts and rayons were requested to provide additional information on these 126 potential sites, and two subsequent screening assessments based on this information led to 83 schemes for detailed ranking. The aim was to rank order the schemes and deploy the available budget according to that order.

A two-stage ranking was then undertaken. The criteria were defined by the team in consultations with representative stakeholders at the national level (discussed later). An index of readiness for construction measuring how quickly returns could be achieved was incorporated (e.g. sub-projects that required only final design were ranked higher than those needing full survey and design) and the ranking resulted in the prioritization of 67 schemes in 48 command areas located throughout the six oblasts in the country. Ten schemes were then selected for detailed study and design to be implemented in the first year of the program, with the remaining projects to be taken up subsequently. Table 1 illustrates the sequential screening and ranking steps.

In parallel to the evaluation of schemes, dam safety assessments for the county's thirteen irrigation dams that are over 15 meter height were undertaken.[7] Possible remedial works for each facility (civil and mechanical/ electrical and monitoring) were assessed and priority works for each dam were decided based on risk assessments. All dams but one fell in the high risk category (using the ICOLD risk classification) taking into account updated hydrology assessments and the degree of vulnerability of downstream communities in the event of a dam failure. One common feature of the dams was that spillway capacities were small, as compared to standards for ICOLD and those in other countries.

**Table 1: Process for screening and ranking of project areas: Project Preparations 1996-1997**

| Options received from sites (oblasts or rayons) | First Screening Assessment | Second Screening Assessment 2 | Third Screening Assessment 3 | Coarse Ranking | Fine Ranking |
|---|---|---|---|---|---|
| | 250 Sub-projects screened | 93 Sub-projects screened | 126 Sub-projects screened | 83 67 Sub-projects command areas | Recommended 12 subprojects in 48 command areas |
| Stakeholder defined criteria | Multi-criteria options assessment | Multi-criteria options assessment | Criteria for selection included economic viability, simplicity of works, responsiveness to farming community requests, quality of local institutions, and needs of environmental protection. | | |

7 Kyrgyz has 14 large dams and water reservoirs, and 200 artificial water reservoirs: 8 dams have reservoirs more 50 MCM; 4 dams 10-50 MCM and 7 dams 1-10 MCM.

The most urgent and extensive works were required for the Karabura dam where construction was abandoned during the Soviet break-up. Here two options were evaluated. One option was to keep the dam at its current height and install a spillway to secure its safety. The second option was to raise the dam to its planned height. This would increase the storage capacity nine-fold, which in turn, would allow expansion of the existing irrigation area and provide additional water to increase yields in the existing command areas by an estimated ten percent. The EIRR of the full completion option over installing the spillway only was 20.8 percent. Rehabilitation works at Orto Tokoy dam similarly allowed more storage and irrigation supply. This dam was constructed in the late fifties, but due to a lack of a spillway, the reservoir had never been completely filled. When the outlet was rehabilitated and the spillway completed (in 2001), an additional 25 million $m^3$ was available (5.5 percent of the reservoir volume) to increase irrigation in the Chui Valley. The opposite also occurred. It was concluded that Papan Dam was unsafe. As a consequence, it was decided that the water level in the reservoir should be held below full storage level (12 meters lower) until further investigations had been carried out.

### What steps were taken to enhance the involvement of stakeholders in the selection of options to meet immediate needs and to develop longer-term strategies?

Because at the start of the process, no Water User Groups existed, stakeholder engagements were organized around meetings with emerging civil society and NGO groups in the agriculture and environment fields, with scientific and government agencies and with a limited number of farm communities and beneficiaries at the oblast level. The actual selection of schemes was made on recommendations of the study team by government but was informed by stakeholder input at different stages of the process.

During the preparation of the Sector Environment Assessment, environmental NGOs were contacted for their views on the project and the action plan. At that time, there were many small NGO groups working at the local level and only a handful at the national level. "Aleyne" and "Tabiat," who were the key national environmental NGOs, had academically trained staff that participated. In these sessions, no objections to the rehabilitation works proposed under the project were raised. Concerns were about broader land-water environment management issues such as mitigation of agro-chemical pollution and surface water contamination from pesticides and fertilizers. Such pollution was expected to increase as programs for agricultural development became successful (though with the economic collapse, fertilizer use dramatically declined). NGOs asked that these and other concerns be thoroughly addressed in the sector reform and offered their services to assist with necessary studies. They also proposed additional measures to combat soil erosion associated with existing agricultural practices, and to strengthen monitoring of impacts on aquatic habitats and downstream ecosystems to establish baselines for mitigation programs.

This opportunity for interaction among government, local environmental NGOs and the Academy of Science in assessments that informed government investments was unprecedented. While only a modest first step, it was seen to breakdown a number of barriers to two-way communications on the formulation of development initiatives, and was the first of its kind in the irrigation sector. Governmental agencies together with local environmental NGOs, the Research Institute for Irrigation and the Institute of Water Problems and Hydropower (National Academy of Science) began to look at the economic cost-benefit, environmental impacts, social costs and equity, and the viability of alternatives in an entirely new context.

Under the umbrella of the Action Plan (NIRAP), a series of workshops were also held at the oblast level in June 1997, with stakeholders from all six oblasts. The aim was to raise awareness of the rehabilitation project and its relationship to the long-term sector reform program. Oblast and rayon DWR staff, NGOs, Research Institute staff, operation and maintenance staff for irrigation dams, farm managers, and contractors attended with about 80 persons at each workshop. The project itself was not overly controversial as it enjoyed wide support from the agriculture community, and there was competition to be included as the first beneficiaries. The main concerns expressed related to the level of anticipated water users fees and the sustainability of future operation and maintenance for the rehabilitated schemes. Another topic of interest was the change in procurement procedures for civil works under the project to encourage private sector participation in operation and maintenance.

### What value did options assessment and stakeholder involvement add and what benefits were derived?

This was the first time that stakeholders were involved in mainstream development planning for the irrigation sector and processes to set priorities for public investment. The main outcomes were that the project helped to restore water flow in the primary and secondary irrigation canal systems to pre-1991 levels,

and more in some cases where the storage capacities of dams was improved; and that it secured the safety of the dams. This was expected to result in crop yield increases of about ten percent, over a four-year period after completion of the rehabilitation works. A further 17,000 ha, consisting of small areas scattered throughout the project area, which are presently not cultivated because of water shortages at the farm level, would be returned to production. By 2000, an increase of land sown led to a growth in gross production of agricultural crops and the republic surpassed the 1992 level of agricultural production of major crops, such as wheat and potato.

These improvements in water supply came at critical stage in the land reform process. Since private ownership of land was introduced in 1998, most of the 504 collective farming enterprises have been restructured and almost 2.7 million people have obtained plots of land and ownership certificates under a separate World Bank supported land registration project. The options selected for the project also targeted Naryn, Talas, Jalalabad, and Osh, the low-income provinces with the highest poverty rates. The inclusion of dams in the southern provinces in the Ferghana Valley, and Jalalabad and Osh, helped reduce water-related tension complicated by tense inter-ethnic relationships. This was important to stakeholders in these areas. Environmental specialists also considered that the project would reduce water losses and soil salinization, improve dam safety, and improve fish migration.

The experience also demonstrated the beginnings of a shift in attitude from the command and control approach to development that was predomanant during the Soviet era, toward stakeholder participation in the design of irrigation policy and initiatives. The exercise was a tentative step in reaching out to a broader range of non-government stakeholders (emerging water users groups, farming communities, civil society, and NGOs) and helped to establish confidence in more proactive stakeholder involvement in future development programs. As part of a learning process for all, stakeholders (e.g. farmers, NGOs, local governments and media) become more aware of participation as a vital element of development. At present, more than 100 Water Users Associations (WUAs) in each oblast have been set up and devolution of operation and maintenance responsibility is proceeding, though not without some difficulties adapting to the new situation. Village councils have transferred the right to operate and maintain intra-farm distribution systems to Water Users Associations.

### What lessons were offered?

One key lesson was the importance of meeting immediate needs with initiatives that have broad support and consensus, and not delay action on these while the wider framework to meet longer-term needs is sorted out and put in place. Here the immediate need was to stabilize and reverse the decline in agriculture output that had significant development and political implications. At the same time, this course of action needed to be consistent with the longer term-strategy. In this case, it helped government to prepare the ground for more comprehensive restructuring of the sector, while the enabling conditions and capacities for stakeholders to assume new roles in development planning were established.

In the context of the enormous transformation of the agriculture system in Kyrgyz Republic:

- The involvement of stakeholders in options assessment processes helped to make institutions responsible for service provision to become more aware and responsive to needs of the beneficiaries. The prevailing view in past was there were many qualified specialists in central government agencies and, as a consequence, officials felt there was little value to be added from involving water users and non-government stakeholders in sector-level decisions. Although, the steps were tentative, the involvement of grass-roots stakeholders, journalists, practitioners, academics and researcher and NGOs in the rehabilitation project helped to demonstrate to officials the considerable appetite for participatory processes to inform government decisions that affected stakeholder interests.
- Many of the new voices that were consulted for the first time felt more concrete follow-up to the recommendations they made in sessions with officials were in order, essentially to better demonstrate that their involvement and time spent engaging in processes led to a beneficial improvement in practices. This would help maintain confidence in the value and effectiveness of their participation. For example, environmental NGOs felt the findings of environmental and social assessments prepared by independent or multi-disciplinary teams needed to be better integrated in programs, and not ignored.
- It was apparent also there was a need for a clear roadmap to the new decision-making processes,

and clearly defined steps for stakeholder engagement in these processes, accompanied by better preparation and information sharing. This would improve the efficiency of stakeholder engagement. A communication plan for an options assessments exercise that set out the key decision points, timing, and what is expected from stakeholders input would help. For example, workshops and meetings with non-governmental participants need to be planned sufficiently far in advance, and participants given sufficient notification to prepare. Access to information and feedback at all stages of decision-making is needed, and steps are needed to avoid excessive bureaucracy and unnecessary formalities in accessing information.

- Improving the role of the media in reporting on options assessment and their context was also seen to be central. Due to the land privatization program, all issues related to irrigation and water cost have become important in public discussions. Nevertheless, media coverage was not seen to be coherent and helpful. In addition, newspapers were not delivered well to remote rural area. A majority of rural population had very meager information about new reforms and projects initiated in the capital.
- In the Kyrgyz Republic, the extensive irrigation, land use reforms and private ownership require the build up of water user organizations so that they can become an essential voice and partner in development and assume their new roles in the market economy. Government can never finance the intra-farm network operation and maintenance and needs to see WUGs as partners in this endeavor, and in the key decisions, particularly as they will pay fees for the services provided.

# Medium Hydropower Study Project-screening and Ranking Phase: Nepal

### A World Bank Case Study

This case study illustrates the use of a participatory screening and ranking (S&R) exercise in Nepal employing multi-criteria tools to form a balanced portfolio of high-quality, medium-scale hydropower projects suitable for domestic grid supply, and a blend of public and private investment in the power sector.

A structured, multi-stage process was employed to assemble a broad inventory of alternative sites across the country (138 sites on different river systems) and select seven projects to advance to full feasibility and EIA study. These seven projects became eligible for financing after full EIA review and approval. Stakeholder interactions and public consultations that were commenced early in the S&R process helped to provide transparency, inform debate of the options (identification and multi-criteria evaluation), and build legitimacy and confidence in the selection process and its outcome. While there were a number of shortcomings, this was the first exercise of its kind in Nepal. It was evaluated as a state-of-the-art exercise on the use of participatory approaches for a sector-level options assessment.

## What was the context?

Nepal has one of the lowest per capital incomes in South Asia. The population is divided roughly equally between the plains of the Terai and foothills and mountains of the Himalayas. Less than 14 percent of the population (just over 24 million) has access to electricity. About 89 percent of the urban population is grid-connected in contrast to less than 5 percent of rural households, who largely rely on subsistence farming.

Nepal's theoretical hydropower potential is nevertheless vast. The economically feasible potential is above 42,000 MW. While there is immense opportunity for hydropower at all scales for a mixture of grid and decentralized supply, less that 0.3 percent of the potential has been developed. Nepal has no fossil fuel resources. Forests are under intense pressure from population growth and land clearing. Hydropower development is the core element of the national energy strategy to meet commercial energy needs and modernize and diversify the economy, and to expand and sustain export earnings. In the mid-1990's tourism, carpet exports and Gurka remittances were the three largest sources of foreign earnings. These sources of income have since suffered declines.

Up to 1994, Nepal's development and the International Development Association (IDA) lending strategies for the power sector supported hydroelectric power stations executed in the public sector. The Arun III project was the latest example of this strategy. It was the first hydropower dam at the upper end of a planned cascade series of dams on the Arun river basin in eastern Nepal. It was intended to meet load growth and provide export revenue from the sale of power to India. It would more than double the existing generation in Nepal.

The Arun III project became increasingly controversial as it proceeded to detailed design. Although the project involved little resettlement, many different issues were debated including the scale of the project in the prevailing macro-economic circumstances. The Arun III controversy also fueled a wider, ongoing debate in Nepal about the relative priority for investment in small, versus medium and large-scale, hydro development, and alternative approaches to regional water resource cooperation. Many international NGOs opposed the project on a range of project-specific impact issues and as a development priority.

Following a decision by the World Bank in 1995 to defer its portion of donor lending for the $760 million project,[8] Nepal and IDA adopted an alternative strategy for power sector development.

The initial focus was on construction of "fast track," small hydro projects using local capacities and resources, primarily the Nepal Electiricity Authority (NEA), and rehabilitation and uprating of existing hydro facilities to meet short-term grid power requirements and reduce load shedding. Under the new privatization policy, a number of smaller sites were also licensed to private developers. The second track involved assembling a portfolio of high-quality, medium-sized projects, which met with public acceptance, to support an expanded program of public and private sector development to meet medium-term grid supply needs. The intention was also to provide greater strategic flexibility and reduce dependence on single large

8 The total financing requirement was US$1082 inclusive of IDC. Total project cost was US$760.1 net of taxes and duties.

projects for domestic supply. This would help avoid what was popularly referred to in Nepal as the "no options" trap. Export projects were to be pursued largely as separate initiatives.

A Sector Environment Assessment was carried out in 1996/97. This outlined Nepal's past and expected future load growth in the context of the overall energy situation, and provided a generic assessment of the supply potential of different power generation options (conventional and non-conventional – e.g. solar, biomass, wind) at different scales for grid and off-grid settings. The potential for supply-side efficiency and demand-side management was also reviewed. The Sector EA confirmed there was broad consensus that medium-scale hydropower offered the best way forward to meet expanding grid supply needs in the medium term.

The Sector EA also showed that the protracted debate over micro, small, medium and large hydropower options had to be differentiated to avoid paralysis in decision-making. In particular, is was important to separate the debate over large multipurpose projects intended for regional water resource cooperation from the question of the "best" options for domestic grid supply, or the "best" options to bring electrical services to many small, disbursed and isolated mountain settlements.

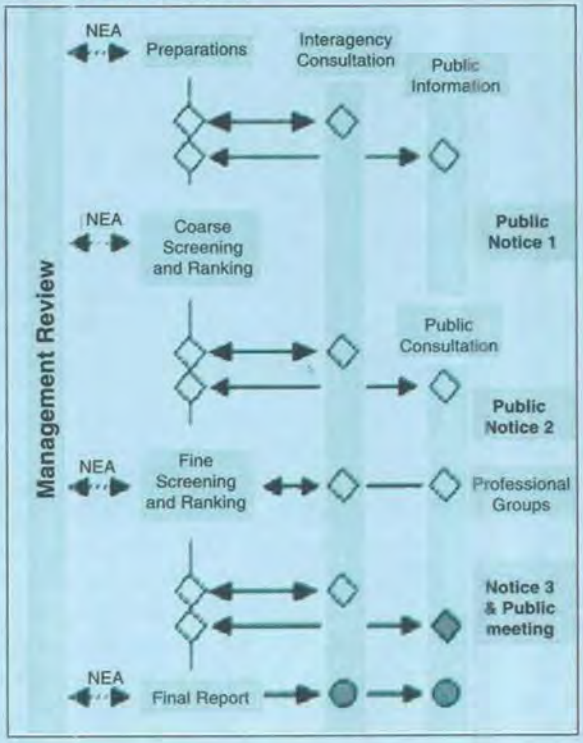
## What framework and process was developed to evaluate options and involve stakeholders?

The S&R exercise exclusively focused on developing a quality pipeline of medium-scale projects (projects in the 10-300 MW range) for domestic grid supply. The broad outlines of the approach emerged in discussion between IDA, government and NEA. This was reflected in the TOR for the exercise developed by the process manager (NEA), with input from IDA.

Essentially, the traditional hydropower screening and ranking process was broadened to include a more substantial social and environmental evaluation, site verification of data, standardized designs to compare options, and a multi-criteria framework to evaluate and rank options with a mixture of qualitative and quantitative factors. In a major departure from past practice, stakeholders were involved from the outset in identifying options and building a project inventory, specifying and weighing evaluation criteria, and reviewing the results at each key stage before proceeding to the next.

To lead the process, an inter-agency steering group was established. This included representation at senior

Figure S & R Framework




levels from eight key sector ministries, including those with responsibility for water and power, environment, social and regional development and roads programs as well as the National Planning Commission.

A multi-disciplinary professional study team was established to work on behalf of the steering group under the supervision of the process manager. This consisted of seconded professionals from NEA planning, engineering and environment departments; from other government departments; and from the private sector. International consultants, who were responsible for technical quality of the study team's work, to help introduce new tools and methods and to provide on-the-job training and capacity development, supported the team and the process manager.

The initial tasks of the Study Team were to prepare a stakeholder analysis and communication plan, compile an inventory of projects, and develop draft screening and ranking criteria. Figure 1 illustrates the framework involving stakeholders and public consultation developed in the communication plan.

Public notices were placed in the local media explaining the S&R exercise and schedule of activities. A web site and a public information office were established to provide public access to all S&R documents. In parallel, briefings that described the exercise and outlined the key decision milestones and means of input were sent to government departments and regional offices,

national NGOs, civil society, professional and private sector organizations in Nepal, as well as embassies and resident missions of donors active in the sector.

Prior to the start of the S&R, the NEA had assembled an inventory of 60 sites. Once this was published, there was an immediate call from the stakeholder community to include more site options in this inventory. This was for three main reasons: firstly, to increase the regional spread of sites; secondly, to expand the number of sites in the 50-100 MW range, a scale considered most attractive for private financing and within the capacity of domestic engineers to provide engineering services; and thirdly, to include more sites with storage and daily peaking capacity to better match Nepal's power system requirements. The study team expanded the inventory accordingly through a combination of desk studies, starting with basin studies that had been prepared by government agencies, NEA and various donors, and from mapping exercises. Sites identified directly by stakeholders were also included in the inventory (i.e. submissions received from industry, NGO, local community and local government interests in response to requests for such submissions). When the extended deadline for submissions was reached, there were 138 optional sites on the table.

To evaluate this number of sites, which was more than double the number originally anticipated, a three-stage process was adopted consisting of sequential steps of screening, coarse and fine ranking.

Screening criteria developed by the study team in consultation with stakeholders and NEA Management were discussed and approved by the Steering Group. These criteria were published before being applied (while information on projects was being gathered) and stakeholder comment was invited. The S&R team did not engage local communities at the screening stage. Rather estimates of the numbers of families to be

**Table 1: Number of options at each stage of the S&R and process and criteria applied**

| Options Inventory | Screening | Coarse Ranking | Fine Ranking |
|---|---|---|---|
| Expanded the initial inventory of 60 sites to 138 sites | Eliminated 94 sites from the 138 to base ranking on 44 sites | Coarse ranked 44 sites and selected 22 for the ranking | Fine ranked 22 sites and selected 7 projects to proceed to full feasibility/ EIA study |
| Stakeholders defined criteria and added sites proposed by stakeholders | Multi-criteria screening<br>Stakeholders reviewed criteria and results | Multi-criteria analysis framework<br>Stakeholders involved in developing criteria and criteria weights, project scoring method, and reviewing ranking<br>Results presented in a series of preference matrix for all scales of options | |
| S & R team to add options and where identified new options:<br>• Project scale 10-50 MW, 50-100 MW and 100-300 MW;<br>• Regional diversity and spread across basins in the country;<br>• Mix of run-of-river, peaking and storage options. | ***Criteria reflected***<br>• Congruence with regional development policies;<br>• Construction road<br>• Transmission access<br>• Hydrology and cost<br>• Watershed conditions<br>• Bank/national safeguard policies on social and environment aspects<br>• Indices (e.g. persons resettled and land take/ MW), biodiversity impact);<br>• Current level of study | **Techno-Economic Criteria:**<br>• Standardized design parameters<br>• Levelized power cost<br>• Power system fit<br>• Composite preference score Environment Social Criteria:<br>• Based on rapid appraisals<br>• Bio-physical and social impact sub-criterion<br>• Consultations with affected communities<br>• Composite preference score | **Environment-Social Criteria:**<br>• Preliminary EIA-level<br>• 88 impact sub-factors<br>• 22 enhancement sub-factors<br>• Consultation with affected communities<br>• Composite preference score. |

resettled, land take and cultural sensitivity factors at each site were used in applying the social screening criteria. This was a deliberate strategy so as not to create unfulfilled expectations or anxieties which could lead to speculation on land and changes in prices in the communities around 138 sites when in fact the intention was to develop a limited number of sites.

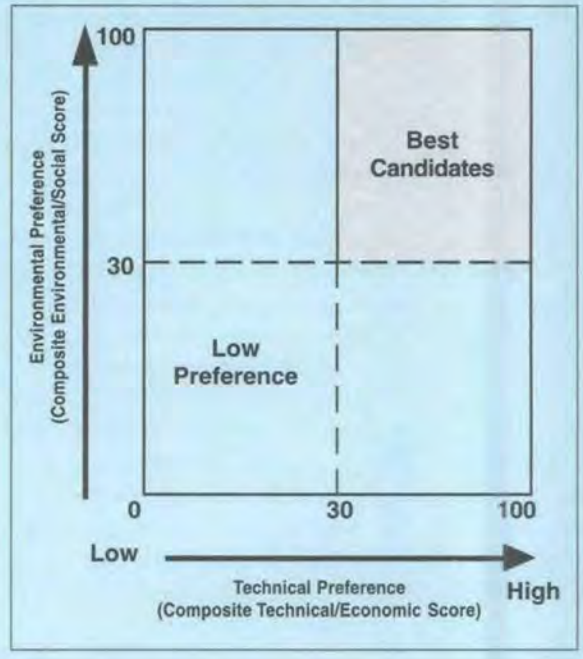
After debate of the screening analysis results, the Steering Group authorized 44 sites to proceed to coarse ranking. This list was published in national and regional newspapers and screening report was sent directly to key stakeholders inviting comment in a fixed timeframe. Table 1 illustrates the criteria applied in screening and in each successive stages of coarse and fine ranking.

At coarse ranking, reconnaissance site visits were undertaken by engineering, environment and social units of the study team. A primary task was to verify and bring the information on each site to a consistent level to enable standardized design procedures to be applied (e.g. geo-technical, hydrological, environment impacts, and resettlement and relocation data). At this stage, community leaders at 44 sites were engaged to elicit their views and the communities participated in socio-economic baseline surveys. Considerable care was taken to explain the preliminary nature of the site investigation, and that full consultations with the community would take place during the EIA study phase if a site in their area were recommended for further study. In fact, the local development impacts were most often seen as positive. Many sites involved very limited resettlement and the opportunity for local power supply and especially the access road were regarded as major local development opportunities.

Coarse ranking was based on multi-criteria analysis (see table 1). A composite environment/social and techno-economic preference rating was established for each project site. The results were plotted in preference matrices for different project size ranges as noted in the accompanying Figure 2. All the stakeholders readily understood this form of graphical presentation. Based on the coarse ranking, the steering group approved 22 sites to proceed to fine ranking. The list of project proceeding to fine screening was published in national and regional media, and sent to regional NGO and local government offices, also inviting their comment.

At the fine screening stage, the Study Team mobilized for further site visits and investigations. The data collected was sufficient to enable the team to prepare reconnaissance level project layouts with standardized methods for design, quantities and unit rates; and, to prepare environment and social impact assessments that related to the fine ranking criteria. These were in

Figure 2. S & R Ranking Preference Matrix




effect rapid appraisals and initial EIA scoping exercises. In parallel, a series of meetings and workshops were held with national-level civil society and professional groups to refine the fine screening evaluation criteria and weights. Based on these discussions, additional criteria such as risk criteria were introduced. The fine ranking was then completed and new preference matrices were prepared. Also, in parallel, the hydropower projects at fine ranking were assessed in generation expansion planning models (simulation and optimization models) to verify the system fit, timing and sequencing of the projects and least-cost attributes.

Preliminary transmission system studies were also carried out to evaluate the transmission facilities and costs associated with their incorporation in the grid.

After the Steering Group reviewed the fine screening analysis, a preliminary recommendation of seven projects and three reserve projects was made. A public consultation meeting was then held to present and discuss the fine screening analysis and preliminary recommendations. Full media coverage was provided. Informed by the results of the public consultation, the Steering Group recommended a final selection of projects.

In view of the consensus demonstrated at each step in the process, government was in a position to give its immediate approval to proceed to full feasibility and EIA study of the seven recommended projects. The individual projects required final government approval

in accordance with national EIA guidelines before being offered to the private sector or developed in the public sector.

## What did it achieve and what benefits were derived?

As a strategic, sector-level options assessment the Nepal S&R exercise contributed to:

- Developing Nepal's hydroelectric potential through building a balanced, high quality pipeline of projects selected through an information-sharing and participatory process, that recognized technical, economic, and financial as well as environmental and social impacts;
- An improved regulatory environment for private investment in the power sector and basis for competitive solicitation to private power developers;
- Capacity building of the Nepal engineering community to better position them to participate as partners in future private or public development projects; and
- The identification of priorities for licensing of additional sites for future development, consisting initially of the 24 sites in the fine screening.

The S&R also established a baseline for future options assessments. New sites could be assessed with the same S&R criteria and compared against the projects already ranked. As information on the specific projects already contained in the S&R framework improved, the scoring and ranking could be routinely updated. In this respect, the World Bank is currently working with Nepal to establish a Power Development Fund (PDF) as a long-term financing facility to catalyze inflow of private and commercial bank financing into Nepal's power sector. The Medium Hydropower S&R exercise has provided the initial projects for consideration under this facility, and a management tool to expand the portfolio.

## What lessons are offered?

One major lesson was that time and resources for participatory processes can be seriously under-estimated. Once the stakeholders become involved, the concerns they raise and their requests for more information or analysis have to be met. Sufficient time and notice are also needed for people to digest new information, for representatives to consult their constituencies, and for people to form opinions. Otherwise, the legitimacy and the benefits of meaningful participation can be compromised.

In this respect, the Nepal S&R was originally envisaged by IDA and NEA as three-month exercise. It took close to 14 months to complete. The decision to allocate additional budget and time for the process was made easier because of the active interest the process had generated among the stakeholders, and the commitment of stakeholders (including decision-makers) in moving toward a "sufficient consensus" outcome. The final cost of the Nepal S&R of approximately US$ 1.2 million represented a small portion of the investment in the facilities it identified.

Other lessons included:

- Involving stakeholders enriches the number and quality of options. As demonstrated, the number of options was more than doubled, and the options portfolio was improved in terms of scale, regional spread and project type.
- A multi-disciplinary study team operating in a neutral setting should be considered for more complex options assessments processes. This was demonstrated where the study team was able to respond to stakeholder needs as the process evolved, and stakeholders gained confidence that the process was not dominated, or perceived to be dominated, by single or traditional interests.
- National safeguard policies (and those of the World Bank) can be moved upstream in the planning processes, to inform screening and ranking activities. Projects that clearly violate safeguards can be eliminated at an early stage. During the S&R, a strong lobby emerged to include potential project sites located either within conservation areas, or within their buffer zones, or upstream where adverse alterations in flow regimes in downstream conservation areas would result. Safeguard policies were referred to resulting in the early elimination of these sites.
- Decision-makers are better informed of the degree of consensus and acceptance of projects than otherwise. The decision to simultaneously advance seven projects to full EIA and feasibility study to build a quality portfolio was without precedent in Nepal. It was only possible due to the consensus achieved and visibly demonstrated by involving stakeholders.
- Specific steps must be taken to ensure that the databases, spreadsheets and other tools developed in the options assessment processes are maintained. Toward this aim, seconded staff from the agencies responsible for power development and licensing were included as key members of the S&R team. The options evaluation

exercise itself may best be viewed as an open, live, and recurrent process. The use of the S&R to generate projects for the Nepal PDF and its availability as a management tool to increase the portfolio demonstrated this aspect.

Finally, the S&R approach that Nepal adopted provides a successful example of moving options assessment upstream in sector decision processes, thereby lifting the options debate out of project specific approval processes. The benefits to be realized in future included improved access to project financing, higher quality projects and public support with and less risk or rejection, delay or abandonment of projects.

# National Hydropower Plan (Nhp) Study, Vietnam, Stage1: A New Approach to Sustainable Hydropower Development

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**Key Words:** Integrated Assessment, Ranking Study, Development Plan, Environmental and Social Impact, Stakeholder Participation.

## Geographical and Socio-economic Background

Vietnam stretches over 1,600 km along the eastern cost of the Indochina Peninsula with an area of nearly 330,000 sq km. In 2001, Vietnam's population was estimated at nearly 80 million, making it the thirteenth most populous country in the world. Some 80 percent of the population is ethnic Vietnamese while the rest is made up of over 50 ethno-linguistic groups.

Vietnam has an estimated per capita income of just under USD 400 per year; however, income is increasing at a rate of over six percent per year. Vietnam embarked on a market-oriented economy in 1986; however, the economy did not improve to any major extent until 1993 with the influx of foreign direct investment. This lasted until 1997-98 when the Asian crises slowed down the economy, which didn't pick up again until recently. While the poverty level is still quite high, the decline over the period 1993-98 is very impressive and no other country has recorded such a sharp decline in poverty in such a short period of time.

Vietnam's economy is still an agricultural economy with 80 percent of the population living outside the main city centres and totally dependent on agriculture production for their daily living.

Three-quarters of Vietnam consists of mountains and hills, and the country has an abundance of water with the total annual water resources estimated at 880 billion $m^3$. The tropical monsoon climate, however, profoundly affects the quantity and distribution of water. Rainfall is highly uneven, causing frequent and often disastrous floods. Mean rainfall is about 2,000 mm, but most accumulates between May and November when about 70-75 percent of the annual flow is generated.

The mountainous topography and the abundance of water creates the possibility of hydropower development to cover the future energy demand for the sustainable economic development of the country, however, such development must also facilitate the provision of water to the important agricultural economy and the mitigation of disastrous floods.

## Institutional Framework and Setting

Energy demand in Vietnam in recent years has grown at a rate of 13-15 percent per annum and will continue to grow at a steady, high to moderate pace in the years to come, according to the official Vietnamese demand forecast. The most up-to-date forecast suggests that the annual energy demand will grow from the present 41 TWh to 160-200 TWh in the year 2020.

Vietnam has an estimated hydropower potential of about 14,000 to 17,000 MW, of which nearly 4,200 MW have so far been developed. The current hydropower capacity is about 50 percent of the current total installed capacity of the interconnected system of about 8,200 MW.

Electricity of Vietnam (EVN) is the state-owned organisation responsible for planning, implementation, and operation of the majority of all power generation facilities in Vietnam, as well as transmission and distribution of energy in the country.

## Planning Level and Scope

Although planning of hydroelectric developments so far been carried out in the context of overall water resource development planning in the river basins concerned, and the need for close interaction and co-ordination have long been recognised, the planning has lacked the rigorous, cross-sectoral approach that in recent years is required by international funding agencies.

In the context of the new Water Law, increased emphasis on environment and social issues and severe limitations on overall investment in the water resources sector, the government of Vietnam wishes to examine alternative strategies for meeting projected power demand, in which factors other than technical and economic issues have received full consideration. This objective of the Government has, among others, resulted in the National Hydropower Plan (NHP) study.

Stage 1 of the NHP study has covered the five main river basins in Vietnam; Da, Lo-Gam-Chay and Ca in the north, Se San in the central and Dong Nai in the south, covering some 80 percent of the total hydropower potential in the country.

## Development Goals

The objective of the NHP Study of Vietnam is to provide the government with alternative power system development strategies to meet the national long-term power demand. Objectives other than economic power development are emphasised, and evaluation of these strategies from viewpoints of laws, economic efficiency, investment requirements, macro-economic issues, and environmental and social impacts will be continuously undertaken by the government.

The overall objective of Stage 1 of the NHP Study has been to assess and rank potential hydropower projects in the five main river basins in Vietnam from the following two perspectives:

- A cross-sectoral approach that takes the form of a ranking study using an integrated assessment of the hydropower projects based on the technical and economic viability, including multipurpose aspects, and the environmental and social impacts.
- A NHP based on power system simulations used to identify a sequential development of the studied hydropower projects to meet the growing power demand, meaning that the appropriate timing and order of priority will be the governing factors.

## Methodology and Approach

The NHP Study was conducted in the following four phases:

- Coarse Screening
- Field Work
- Ranking Study
- National Hydropower Development Plan

## Coarse Screening

The principal objective of the coarse screening was to select the most promising hydropower projects for further analysis and studies (22 out of 47 projects were selected). The coarse screening considered technical and economic merits, water resource development benefits other than hydropower, and environmental and social impacts. The baseline data were drawn from existing documentation.

## Field Work

The objective of this phase was to further enhance the knowledge, and fill in information gaps identified in the coarse screening, of the selected hydropower projects by fieldwork and data collection. The fieldwork was mainly related to the environmental and social aspects.

## Ranking Study

The objective of the ranking study was to assess and rank the selected hydropower projects using an integrated assessment methodology. The assessment takes into account the following two significant and basically non-comparable indicators of the projects:

- A Technical/Economic Preference Index reflecting the technical and economic viability, including costs for environmental and social mitigation measures, and restrictions to and benefits of other water uses, and
- An Environmental/Social Preference Index reflecting the environmental and social impacts with due considerations to enhancements and mitigation measures, as well as beneficial impacts

Based on the benefit/cost ratio, the selected hydropower projects were scored according to a Technical/Economic Preference Index (TEPI) using a scale from 0 to 100, with the project having the highest ratio of benefits to costs being awarded 100 points.

The potential multipurpose benefits, such as flood control and irrigation, were included as additional benefits in the economic evaluation (B), and costs for environmental and social enhancement and mitigation measures were included in the investment costs of the projects (C).

Water allocations for other water user categories, such as abstraction of water for irrigation purposes and reservoir provisions for flood control, were reflected in the operating rules of the reservoirs and thus accounted for as restrictions in hydropower generation, implying less benefits for the projects.

The Environmental/Social Preference Index (ESPI) was based on values referring to the respective magnitude (quantity) and importance (quality) of the environmental and social impact. The magnitude of impacts relates to volumes, etc., while the importance is related to the significance of the impact.

Only the detrimental impacts after mitigation and beneficial impacts were considered, as the costs for the environmental and social mitigation measures are included in the total costs of the projects and thus influence the Technical/Economic Preference Indices.

The scoring of detrimental impacts, related to both magnitude and importance, was based on a qualified reasoning of impacts related to facts or qualified judgement for each of the parameters given below. In all, 25 environmental/social parameters were used, 10 of environmental and 15 of social characteristics.

magnitude and importance were described in qualitative terms and were differentiated in a five-degree scoring scale as follows:

The scoring values for each parameter were multiplied (magnitude x importance) and given different weights to represent different scenarios and the opinions of the stakeholders, and added into an Environmental/Social Preference Index for each selected project using a scale from 0 to 100, with the project having the lowest overall impact being awarded 100 points.

Based on the indexes, the selected hydropower projects were classified in the following way:

By applying the above category definitions the selected hydropower project could be classified in nine categories as follows:

- Projects belonging to categories AI, AII, and AIII represent the most attractive and feasible hydropower projects under consideration in respect of economy. Projects belonging to Categories AI and AII would hence be highly recommendable, and although Category AII involves some complex and partly unsustainable social and environmental features, the economic viability should be sufficiently attractive to support implementation.
- Category AIII involves projects, which on one hand would be highly attractive and beneficial in respect of economy but which, on the other hand,

| Environmental Parameters | | | Social Parameters | | |
|---|---|---|---|---|---|
| Loss of Agriculture Land | Terrestrial Flora | | People Resettled | Migration | Extension Services |
| Water Quality | Terrestrial Fauna | | Host Area Relations | Fishery | Land Use |
| Erosion/Sedimentation | Aquatic Life | | Ethnicity | Directly Affected People | Farm Output |
| Fish | Protected Areas | | Water-related Health | Partially Affected People | Secure Access to Food |
| Forestry | Fragmentation Potential | | Water Access | Ethnic Groups and History | Water Availability and Quality |

| Very High (4 points) | High (3 points) | Medium (2 points) | Low (1 point) | None (0 point) |
|---|---|---|---|---|

| Technical/Economic Category | Environmental/Social Category | | |
|---|---|---|---|
| | I<br>**ESPI > 60** | II<br>**ESPI 30 - 60** | III<br>**ESPI < 30** |
| A<br>**TEPI > 56 (B/C >1.2)** | Project A<br>Project H | Project C<br>Project L | Project P<br>Project E |
| B<br>**TEPI 47-56 (B/C 1.0 - 1.2)** | Project F<br>Project K | Project J<br>Project R | Project B<br>Project Q |
| C<br>**TEPI < 47 (B/C < 1.0)** | Project G<br>Project O | Project N<br>Project K | Project M<br>Project D |

have considerably complex and unsustainable social and environmental features connected to their development.

- Hydropower projects belonging to categories BI, BII and BIII have been evaluated as feasible options in respect to the economy. Category BI would represent projects of considerable interest. Also the projects belonging to Category BII would be of considerable interest although these projects are characterised by some complex social and environmental features, to which thorough attention needs to be paid. Projects belonging to Category BIII should be of no or low interest as the social and environmental features would be considerably complex and unsustainable, and the effects of which are deemed not to be sufficiently outbalanced by the economic viability.
- Hydropower projects belonging to Categories CI, CII and CIII have been evaluated as unfeasible options in respect to the economy. Hence it may be concluded that projects placed in Categories CII and CIII would be of no or low interest, as also social and environmental features would be at least partly complex and unsustainable. Category CI may include projects with interesting development potential, as social and environmental features would be attractive and potentially sustainable.

## National Hydropower Development Plan

The general objective of the National Hydropower Development Plan Study was to formulate and evaluate a number of conceivable development sequences of the selected hydropower projects with regards to order of priority and appropriate timing, in line with the growing power demand of the country. In these studies, alternative sources of power were considered, such as planned and hypothetical thermal power plants and possible other alternative sources. For the thermal power plants the cost of emissions of carbon dioxide was taken into account.

Seven different strategies for the future development of the generation system were evaluated, and the projects were classified in the short-term, medium-term, medium/long-term, and in the long-term/not recommended for implementation.

## Specific Assessments

*Water Resources Planning*

The specific objectives of the water resources planning were to:

- Establish the availability of surface water resources to meet the envisaged non-power development in the basins over the planning period.
- Explore non-power development opportunities related to the selected projects.
- Identify potential conflicting interests in water demand, and possible water resource constraints that might limit the planned social and economic development in the river basins.
- Estimate the values of the non-power related benefits.
- Demonstrate the relative economic benefits of hydropower and non-power water development options in contributing to socio-economic development and poverty alleviation in the basins.

## Environmental and Social Considerations

The overall objective of the Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) studies was to assess the environmental and social impacts, positive and negative, of the selected hydropower projects, and to use a consistent methodology to identify and value the impacts.

The methodology used and the accuracy of study is far from that of a specific Environmental/Social Impact Assessment Study. It is, however, considered that in order to discriminate or rank among projects, the method gives a satisfactory result. When projects are studied further, a full EIA/SIA study according to international guidelines and requirements will be mandatory.

For the field studies, a checklist was set up, describing the data collection program and other field activities. The field studies were carried out by local consultants based on terms of reference and guidance by the consultant, in the river basins (districts and communes) and at the project areas of the selected hydropower projects.

## Stakeholder Participation

Stakeholders have participated in the development of the hydropower plan at three levels as follows:

- Five stakeholder meetings mainly for representatives from ministries, state agencies and mass organisations, and attended by some 50 participants.
- Three stakeholder workshops in the river basins

with direct involvement of representatives of affected peoples at province, district and commune levels, to discuss how to involve stakeholders of the affected areas in the future studies of the projects.
- In-depth field surveys in two villages at each hydropower site using PRA methods to obtain views of local people through group discussions and interactive interviews with households.

## Implementation

The NHP Study was carried out during the period April 1999 to December 2001 under the overall supervision of the client, Electricity of Vietnam (EVN), represented by the Management Board of National Hydropower Planning Study. A steering committee, chaired by the Vice-Minister of Planning and Investment, was appointed with members from relevant Vietnamese ministries and agencies.

A study team consisting of key personnel from the joint venture companies SWECO International from Sweden, and Statkraft Gröner and Norplan from Norway in close cooperation with seven local sub-consultants carried out the study.

The study was financed by Sida (Swedish International Development Co-operation Agency) and NORAD (Norwegian Agency for Development Co-operation).

# Options Assessment for Electricity Generation

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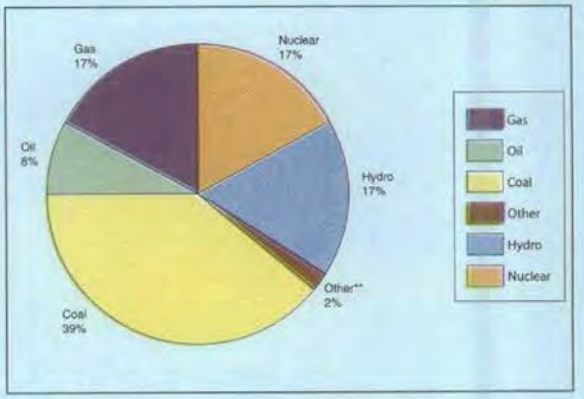
**Key Words:** Hydropower, Environment, Life Cycle Analysis, Electricity Generation

## Introduction

A country, state, or province that is planning for its future will need to decide how much electricity it will require and how it will meet this need. Generally, decisions are made at the policy, strategic, and project levels. At the policy level, the overall generation and transmission options are considered, including the conservation option. General decisions are made about the role of coal, gas, oil, nuclear, hydropower and other renewable energies, based on forecasts of future electricity demand. The share of each of these fuels, worldwide, in the year 2000 is shown in Figure 1.

The chart shows that there are only five large-scale options for generating electricity. To date, renewable options other than hydropower taken together represent two percent of total electricity generation. Wind energy production in the OECD in the year 2000

Figure 1. World Fuel Shares of Electricity Generation in 2000




** Other includes geothermal, solar, wind, combustible renewables & waste.
Source: IEA - key world energy statistics - www.iea.org/statist/keyworld2002/key2002/p_0203.htm.
15 379 TWh (billion kWh)

Table 1: Factors to be included in electricity options assessment at the policy level.

| | |
|---|---|
| Economic and financial analysis Scale | What will be the economic impact of each option, and how can it be financed? Depending on the growth of electricity demand, projects to add new capacity could be 10 MW, 100 MW or 1000 MW. |
| Social, health and cultural impacts | Which segments of the population would benefit most from additional electricity, and which segments might be adversely affected? What are the cultural impacts? |
| Environmental impacts | What are the environmental advantages and disadvantages, and how can the latter be mitigated. |
| Level of Service | Diesel, gas turbines, and hydro can easily adjust their output to the amount of electricity demanded, coal and nuclear can not. Wind and solar are intermittent and require a back up source or storage. |
| Operation, repair and maintenance – suitability to local conditions | How easy is it to operate, maintain, and repair each of the options in view of the level of technical know-how in the country. |
| Prerequisite conditions | Gas pipelines, hydraulic measurements for hydro, railway or port for coal, back-up sources for wind & solar, etc. |

was 28.9 TWh, which was 0.4 percent of total OECD electricity production. (Source: Renewables Information 2002 – IEA Statistics, Paris, 2002). Renewable options are considered attractive in view of the disadvantages of fossil fuels and nuclear power. In the year 2000, hydropower and the other renewable options combined accounted for 18.7 percent of total generation.

## Factors to be considered in Options Assessment

Some of the factors to be considered in this general choice among the options at the policy level include those described in Table 1.

In practice, many countries, and especially developing countries, do not have a free choice among the six options shown in the pie chart. They might not have a gas pipeline, the shipping costs of coal might be too high, and they might not wish to have nuclear generation. So they are only left with oil (diesel), hydro, and other renewables.

The options assessment process first eliminates the unrealistic options, and then weighs the above factors for each of the feasible options. This trading off among economic, social, and environmental factors depends strongly on the cultural values and political priorities of the country concerned, and cannot be done by a neat objective formula or a set of recommendations that do not take the local situation into account. These kinds of decisions inevitably have to be made by governments.

## Social and Environmental Impacts

The IEA Implementing Agreement for Hydropower Technologies and Programmes did a major study during its first phase (1995-2000) to evaluate two of the factors in the table above, namely social and environmental impacts, and their mitigation measures.

For the social, cultural, and health impacts, the main task was to describe the different impacts and to make recommendations on measures that can be taken to ensure that all those affected by a project are equitably treated, and that economic benefits are equitably shared. We did not compare hydropower to other generation options, since the social impacts of each option are very country specific, and global comparisons were considered impractical.

For the environmental impacts, on the other hand, a well-established methodology exists to compare among generation options. It is known as "Life Cycle Analysis", and involves making a complete inventory of all the

**Table 2: Emissions produced by 1 kWh of electricity based on life cycle analysis**

| Generation Option | Greenhouse gas emissions gm equiv $CO_2$/kWh | $SO_2$ emissions milligram /kWh | $NO_x$ emissions milligram /kWh | NMVOC miligram /kWh | Particulate matter miligram /kWh |
|---|---|---|---|---|---|
| **Hydropower** | 2 - 48 | 5 - 60 | 3 - 42 | 0 | 5 |
| **Coal – modern plant** | 790 - 1182 | 700 – 32321+ | 700 – 5273+ | 18 - 29 | 30 – 663+ |
| **Nuclear** | 2 – 59 | 3 – 50 | 2 - 100 | 0 | 2 |
| **Natural gas (combined cycle)** | 389 – 511 | 4 – 15000+ | 13+ - 1500 | 72 – 164 | 1 – 10+ |
| **Diesel** | 555-883 | 84-1550 | 316+ - 12300 | 1570 | 122-213+ |
| **Biomass forestry waste combustion** | 15 – 101 | 12 – 140 | 701 – 1950 | 0 | 217 - 320 |
| **Wind** | 7 – 124 | 21 – 87 | 14 – 50 | 0 | 5 - 35 |
| **Solar photovoltaic** | 13 – 731 | 24 – 490 | 16 – 340 | 70 | 12 – 190 |

NMVOC = non methane volatile organic compounds
Source: IEA Hydropower Agreement, *Hydropower and the Environment: Present Context and Guidelines for Future Action.* Oslo 2000. www.ieahydro.org/Environment/Hy-Envir.html – click on "Volume 1- Summary and Recommendations" to download pdf document. The table is on p. 12 of the document.

materials and energy that go into the construction of a generating plant and the mining, conversion, transportation, and use of its fuel. The sum of the environmental impacts of all these materials and processes is then divided by the number of kilowatt hours that the plant produces, so that a comparison can be made on a per kWh basis. This resulted in the emissions estimates provided in Table 2.

The numbers in the table give a range of values, because different plants can have widely different characteristics, and fossil fuels such as coal, oil, and natural gas can also have widely varying chemical compositions. The high figure for $SO_2$ emissions for natural gas applies only to so-called "sour gas" and is rather exceptional. The figures for biomass are relatively high because fuel is consumed in collecting and transporting the biomass to a generating plant. The figures for solar photovoltaic are relatively high because a large amount of electricity is required to produce a photovoltaic cell. However, the production technology for photovoltaic cells continues to improve, and the lower range of the figures is more applicable today.

The table covers many important environmental parameters and can be a useful decision making tool in options assessment at the government level. However some environmental parameters, such as bio-diversity, are difficult to define and difficult to measure and are not included. Similarly, other parameters such as increase or decrease in fish populations are too project specific to be used in global comparisons, and are therefore not included either.

## Options to Large Dams

Once a government has decided at the policy level that hydropower is a suitable option, other factors enter into consideration, mainly the other uses that can be made of water. Many large dam projects are multi-use projects and may include other benefits such as flood control, irrigation, urban water supply improvement of river navigation, etc. In such cases, alternatives have to be considered not only for electricity generation but also for flood control, irrigation, river navigation, etc. Focusing only on electricity, large dams generate large amounts of electricity and the issues of scale and level of service become very important in choosing among options.

With respect to scale, some large countries such as brazil, China, and India require thousands of megawatts of new capacity every year. Only large scale options are feasible (coal, natural gas, oil, or nuclear). Other renewable sources such as geothermal, biomass, or wind might make a fractional contribution, but fall short by one or two orders of magnitude of producing the required amount of electricity. Other, much smaller countries might be in the opposite situation. A large dam might produce much more electricity than is needed. Unless this electricity can be exported or bought by a newly developed industry such as an aluminum smelter, other, smaller scale generating options might be preferable. The option of replacing one large dam with several smaller ones, or with smaller diesel or geothermal facilities, will usually have severe economic disadvantages. However, in some exceptional situations, it might have social and environmental advantages that justify the extra costs.

With respect to level of service, i.e. meeting the customers' demand for electricity at all times of the day, natural gas, diesel, and hydropower have particular advantages. They can easily adjust the amount of electricity produced up or down to match the amount required by consumers. Wind and solar electricity are intermittent sources and require some form of back up, usually diesel, or some form of storage, usually a hydropower reservoir. In many OECD countries where wind energy has had very high growth rates in recent years (more than 20 %), the back up or storage already existed somewhere in the grid, and did not have to be paid for by the wind energy developers. Currently, wind energy is slightly more expensive than other alternatives, and requires start-up subsidies from governments. If the back up or storage has to be paid for by a wind energy developer, it would raise capital costs by around 70 %.

## Conclusion

There are at most five large-scale options for supplying electricity to a grid, and in addition geothermal, biomass or wind can also supply smaller amounts. In many countries, several of these options are unrealistic and decision makers may be left with a choice of only two or three options. At least seven factors need to be considered in assessing the options; one of them is the environmental impact of different generating technologies. The IEA Hydropower Agreement has done a Life Cycle Analysis comparison among the generating technologies, and produced a table showing their environmental impacts. This table may be a useful tool when dealing with the environmental component of the options assessment process.

# Options Assessment for Large Dam Projects at Policy Levels

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**Key Words**: national planning, poverty reduction, sustainable livelihoods

## Institutional framework and setting

One of the strategic priorities expressed in the report of the World Commission on Dams is a fully comprehensive options assessment, which starts at the policy planning level. However, current practice is still to undertake this assessment at the project level, therefore focusing the options assessment at a level too far downstream - when the development choices have already been made. There is a need for the options assessment to be made at policy level, looking at how big dams feed into countries' Poverty Reduction Strategy Papers (PRSPs), development planning, energy sector targets and other sector targets in education, health and water.

There are case studies available about options assessment at the project level, but very limited analysis of options assessments at national and district level planning. There is need for a clearer understanding of the links between big dam projects and wider development objectives and also an understanding of how decisions resulting from such assessments could be realised in planning.

## Planning level and scope involved by the options assessment

This paper will cover a number of elements required for a full policy level options assessment, in compliance with the WCD report. In particular, it demonstrates how big dam projects can be assessed in relation to government PRSPs and development objectives, and how such assessments could be implemented in terms of resources, public and private funding and the roles of the stakeholders in the process. Two case examples, Nepal and Mozambique, are used to illustrate the need for and effectiveness of policy level options assessment.

## Why do a policy level options assessment?

The decision on the development of a dam has to be taken within the planning context of a country or region. This means placing dams development within energy and water sector plans. These plans, in turn, should aim to fulfil the economic development goals of the country or region. In developing countries, economic development goals are set out in their Poverty Reduction Strategy Papers. Therefore, it is essential that the role of dam development be stated clearly in terms of the economic development goals of the region. This could be in terms of net employment generation, sustainability of balance of payments, macroeconomic sustainability, government and foreign investment, technology sustainability within the country; protection of the country's natural resource base and effect of number of people living in poverty, as defined by the Millennium Development Goals described below.

In addition, one of the main objections to dam development is that there are alternative options for achieving the same development goal, for example, small-scale irrigation schemes such as rain water harvesting, or local renewable energy schemes. By fully considering the alternative options for providing the same economic goal at the policy level, the alternative options can be compared fairly.

## The Role of Dams in Poverty Reduction Strategy Papers (PRSPs)

The United Nations has established the Millennium Development Goals (MDGs) as the development milestone for developing countries. The MDGs are focused on reducing extreme poverty. Box 1 illustrates how energy inputs are required to achieve the MDGs over lap, a similar table could be drawn up as to the need for water to achieve the goals.

Each nation must plan for implementation of these goals, in the form of a national Poverty Reduction Strategy. Bilateral aid to countries will be focused on implementing the PRSPs. Energy and water must be considered as essential components of achieving these goals.

## Assessment of development goals

One tool that is very useful for comparing the socio-economic impact of the options is the sustainable livelihoods (SL) approach. The SL approach is used by an increasing number of multilateral donor agencies and NGOs as a way to guide the complexity and dynamism of poverty into strategic and policy planning. The approach has been found useful in supporting systematic analysis of poverty and its causes. It promotes a wider and better-informed view of the opportunities for development activities and their likely impacts. The SL approach places people and the priorities that they define firmly at the centre of analysis and objective setting.

There is also a Sustainable Livelihoods Framework that can be used as a tool and checklist when analysing different development activities and their impacts. It is a practical analytical tool for understanding livelihoods systems and strategies and can help understand and manage the complexities of livelihoods. The framework makes explicit the relationships between poverty and vulnerability. The framework used by the UK's Department for International Development (DFID) is shown in Figure 1.

The framework is not a linear model; the arrows do not denote a direction of causality but instead indicate the dynamic nature of the different types of relationships.

Livelihood is defined as "the capabilities, assets (including both material and social resources) and activities required for a means of living." A livelihood is sustainable when it "can cope with and recover from stresses and shocks and maintain and enhance its capabilities and assets both now and into the future, while not undermining the resource base."[9]

In practice, a SL approach means attempting to categorise livelihood into a set of assets, namely human assets, natural assets, financial assets, social assets and physical assets. Generating additional income, increasing well being, assuring a more sustainable natural resource base and reducing vulnerability should, then, enhance livelihood outcomes. The SL approach views vulnerability in terms of shocks, trends

**Box 1: Energy is central to achieving the Millennium Development Goals**

**Halving extreme poverty**: freeing up time spent gathering fuel, increasing income and employment through enterprises that need energy (such as workshops, sawmills, welding and metalworking, etc).

**Halving the number of people living with hunger**: approximately 95 per cent of the food we eat has to be cooked, and most foods need energy for processing of some kind. Hunger is related to poverty, so efforts to eradicate poverty should help eradicate hunger. Energy is needed to process food (such as grinding cereals) and to produce food (such as water for irrigating agricultural land).

**Achieving universal education**: extended study opportunities in the evening, access to information and communication technologies and long distance learning materials.

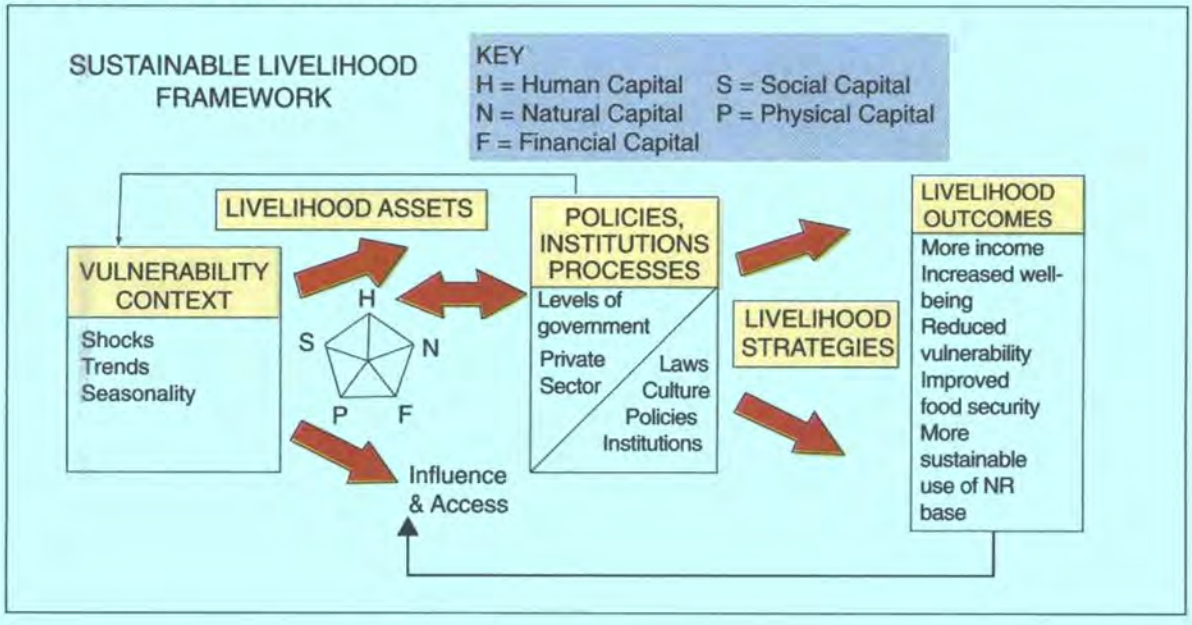
**Promoting gender equality**: reducing drudgery of arduous tasks such as grinding and food preparation, increased opportunity for enterprise, opportunities for evening education due to lighting for night classes.

**Reducing mortality/ improving health**: through reducing indoor air pollution from household smoke, better health facilities through vaccination, refrigeration services and modern hospital equipment.

**Ensuring environmental sustainability**: conventional energy is a contributor to greenhouse gas emissions but newer cleaner technologies can provide a sustainable alternative

9 The Department for International Development (DFID) (1999), Sustainable *Livelihood Guidance Sheets*. DFID, London UK.

Figure 1. Sustainable Livelihood Framework




and seasonality. Amid all these factors, the workings of policies, institutions and processes (PIPS) are also taken into account.

The SL framework allows the comparison of different development options in terms of their effect on people's livelihoods, for instance a large dam on food security and a sustainable forestry project in providing firewood for cooking. It is also possible to use a multi-criteria analysis model with the SL framework and look at the trade-offs between projects.

## Nepal Case Example

In 1995, the World Bank and the Government of Nepal pulled out of the development of the 200MW Arun Dam project. In this case the arguments against the dam were not environmental or the impact on the local community. The main arguments were that:

- The concentration of public funds on one large project, which would exclude the development of other hydro projects, would mean no new electric power coming on-line for ten years. Also, all the risk would be in one project.
- There was a growing hydropower industry in Nepal. The Arun Dam would use foreign engineering and equipment, so the livelihoods of people in the local industry would be at risk.

The alternative put forward for Nepal was a series of smaller scale hydro projects using locally manufactured equipment and building local capacity in the hydro and power sector. In the eight years since Arun was cancelled, the alternatives are being put in place. They are being built by the local private sector, and also by the Nepal Electricity Authority (NEA) projects (grid-connected) built or under construction range from 183 kW to 144 MW.

## Mozambique Case Example

Mozambique has a huge potential for large hydropower. However, the vast majority of the population does not have access to grid electricity. Studies have show that grid connection for people outside the main urban centres will be hugely expensive. Therefore, centralised supply of power for the short to medium term will not benefit the majority of the people of Mozambique. There are, however, a number of decentralised options for supplying rural communities and small towns, including small-scale hydropower, solar power, wave power and improved biofuels.

Therefore, large hydropower development in Mozambique cannot be justified in terms of achieving poverty reduction goals. Instead, the development of large hydropower to supply urban centres and neighbouring countries should be established in such

a way that the profit from exploitation of the rich natural resources of Mozambique would stay in the country.

### Stakeholder participation: Who should be involved?

Stakeholder negotiation is a central theme in the WCD and also the PRSP process. Therefore merging the stakeholder negotiations approach advocated in the WCD report with the stakeholder involvement in PRSP development should be quite straight forward, and could even enhance the PRSP process.

### Implementation of the whole process

One difficulty will be in determining when planning is part of the dam development process and where it is part of the wider national/regional planning. We should consider who undertakes the policy level options assessment, and who pays for it. It will be important to show the private sector that they will not carry the burden of this phase of options assessment.

This is a new area within the dams development process and there is a need for more information and research in order to show best practice and produce guidelines for incorporating options assessment at the macro policy level and not just a project level.

In conclusion, at the planning level, options assessment can become an integral component of national level planning. This planning process should significantly reduce many of the political barriers which developers face by the time dams are to be assessed at a project level.

# Sourcebook on Stakeholder Involvement in Options Assessment In Water and Energy Projects

## A World Bank Case Study

In February 2003, the Board of Executive Directors of the World Bank endorsed a new Water Resources Sector Strategy aimed at providing more effective assistance to countries, using water as a vehicle for increasing growth and reducing poverty in a socially and environmentally responsible manner. Given the urgency and magnitude of water shortages in many countries, the strategy argues for investing both in management and infrastructure. Investments in dams and other infrastructure would only be made where they could also be justified on social and environmental grounds. "*To be a more effective partner, the World Bank will re-engage with high reward/high-risk hydraulic infrastructure, using a more effective business model. This 'new business model' ...puts development impact first; assesses the development impact of both engagement and non-engagement... considers the rights and risks of those directly and indirectly affected by such projects; meets social and environmental standards... and aims at transparent, crisp, time-bound and predictable decisions.*" The Strategy endorses the five core values and seven strategic priorities of the World Commission on Dams, which have been accepted by the bank.

The sourcebook has been specifically developed to provide operational guidance on how to assess a comprehensive range of options for providing power and water before committing to investments in dams, while ensuring that the needs and interests of stakeholders affected by the decisions are taken into account. The sourcebook includes:

- A description of the changing international setting, which today demands that a diverse range of options be assessed and that the needs and views of all affected stakeholders are included in doing so;
- A theoretical basis for, and an empirical assessment of, the benefits of stakeholder involvement and options assessment in the development of water and energy services;
- Four principles for stakeholder involvement and options assessment, with examples drawn from recent practice;
- An overview of the World Bank's policies and procedures with respect to water and energy development, with special reference to stakeholder involvement and options assessment in programming and planning exercises;
- Nine detailed case studies of strategic and project-level planning exercises that were selected to provide rich experiences from a wide range of country backgrounds;
- A description of the diverse range of options that are available for providing energy and water;
- A generic terms of reference to incorporate stakeholder involvement and options assessment in a sector level planning exercise; and
- A bibliography and list of training resources on options assessment exercise and stakeholder engagement.

The sourcebook recognizes the major context changes in governance and public decision-making over the last 25 years, which influence decision-making on the development and management of water resource systems:

- Shifts from governments being sole service providers to being regulators (and occasionally facilitator) enabling the private sector, communities and partnerships to play expanded new roles in service provision;
- Shifts in the way public interest is defined, to place more weight on rights and interests of people and communities affected by development activities, more focus on equity in the spread of costs and benefits from development and more emphasis on the concept of inter-generation equity in dealing with resource use;
- Shifts in the degree to which those with a stake in development are holding authorities and projects accountable for decisions on infrastructure development; and
- Shifts to emphasize good governance and transparent and participatory decision-making, which require that the range of stakeholders not only be consulted but also be empowered to participate in decisions that affect them.

Taken together, these trends have broadened the objectives of decision-making on public causes from narrowly defined technical and economic objectives to objectives aimed at meeting complex human development and environmental needs.

## Arguments for involving stakeholders and assessing diverse options

There are three broad reasons for involving stakeholders and assessing a range of water and energy options. The first reason relates to good governance. Governments seek to apply the emerging global normative framework recorded in UN Declarations on Human Rights and on Environment and Development. The second reason relates to the quality of the outcomes of the planning processes: economically viable, socially acceptable and environmentally sustainable decisions that are attractive for public or private funding. A third reason deals with the legitimacy of the decision-making: transparency and accountability in decision-making, and in the role of the decision-maker. Taken together, the benefits of stakeholder involvement and options assessment provide a risk management approach. Investing up-front in stakeholder involvement and options assessment pays off in terms of reduced risks and uncertainties during project implementation. There is now a comprehensive literature on public involvement in planning. The premise of this literature is simply that, if the public interest is to be protected and community acceptance and consent is to be obtained, then planning has to involve community input.

Critics of public involvement fear that if the community becomes involved they will demand to make the decision themselves and that chaos may rule. Recent research does not support this belief. The research shows that, while the current level of public involvement in water related decisions is less than desired, the preferred mode of involvement is a partnership between community and professionals rather than community domination of decision-making. The research shows that the professionals (organizational) also prefer such an arrangement. The research has also defined what was meant by a partnership. In essence, this involved the community setting the criteria (facilitated by the planner) that should be met by the planner and the planner deciding on the best way to meet those criteria (with input from the community). The fear of some planners that the public wishes to replace them was found to be unfounded.

Theories of justice provide a theoretical basis for involving stakeholder groups in decisions. *Distributive justice* deals with how much of a limited resource differing groups in the community deserve; *procedural justice* refers to the need to make sure that procedures for making decisions are seen to be just. If this is done, then the outcomes of the processes were more likely to be accepted by the stakeholders. Both types of justice are important in deciding whether the overall outcome is just or not.

A study of the criteria that reflected procedural justice found that adequate representation, voice, personal consideration, logic and aspects of desired outcome were all important. A long-term public involvement program in wastewater planning conducted in Australia showed that the belief that the process was procedurally just correlated with an increased commitment to future involvement with the decision-making agency. Feelings of procedural justice also led to an increased confidence that the best decisions would be made. Other studies have shown that, if people can see that the outcome is based on fairness, it is much easier to accept than otherwise. This understanding about procedural and distributive justice and fairness is relatively recent in water resources development and management and provides a theoretical basis for ensuring that changes resulting from the development and management of water resources are undertaken with the interests of those affected taken into account.

There are also strong financial reasons for involving stakeholder groups and assessing a wide range of options as early in the planning cycle as possible. These reasons are bound up in minimizing the risk of investing in water and energy projects.

Identification and mitigation of risks are at the core of project financing. Governments and public agencies that are reluctant to fully involve all stakeholders in decision-making processes very often are concerned about the cost of events outside their direct control, such as the possibility that some stakeholders might claim an unreasonable share of the project rent, for example "too high" compensation for land acquired for the project. However, the costs arising from including stakeholders in the assessment of options have only a minor effect on the rate of return of a project, while the increased risks resulting from a failure to include stakeholders can have a significant effect on financing costs.

A simple example shows that if a stakeholder involvement exercise delays the start of construction of a typical dam by two years due to the strategic options assessment preceding the feasibility/preparation phase and costs about US$9 million, the economic rate of return from the project declines by less than 2.5%. Such a minor reduction in the ERR could easily be made up through improvements in project design or smoother implementation. On the other hand, there would have been the same impact on the ERR if disputes with project affected people had slowed construction and delayed the filling of the reservoir by 4 months, from 60 months to 64 months. These results reflect, *inter alia*, the fact that delays in the start of construction activities tend to have a much smaller impact on the economic

viability of a project than delays that occur after the bulk of investments have been made.

Thus, besides concern for fair and equitable treatment of project affected people and a desire to properly mitigate environmental impacts, stakeholder involvement at all levels is a relatively low-cost way of minimizing the risk of completion delays.

## The Principles Guiding Stakeholder Involvement in Options Assessment

The sourcebook discusses four principles that should guide the involvement of stakeholder groups in the assessment of options at both the strategic (sector and basin planning) and project levels.

***Principle 1: Create an Enabling Environment for Stakeholder Involvement and Options Assessment***
This principle argues that involving stakeholder groups in options assessment for water and energy development works best if there is a supportive background environment. The environment can be improved by developing enabling policies and legislation and by reorienting existing systems for planning and by building capacities, all aimed at facilitating that major public decisions are informed by stakeholder involvement and options assessment.

- Policies and legislation can be introduced to ensure that stakeholder involvement and options assessment are systematically undertaken in major planning exercises;
- Existing planning practices can be oriented towards drawing optimum benefits from stakeholder involvement and options assessment, by using structured processes for options assessment and stakeholder involvement that start with assessing needs, that place the assessment of options 'upstream,' that integrate different perspectives and that iterate between steps; and
- Capacities can be built to institutionalize stakeholder involvement and options assessment, through steps ranging from building information banks to strengthening agencies and stakeholder organizations involved in planning exercises.

***Principle 2: Involve All Relevant Stakeholders***
Strategic and project-level planning processes should be open to all relevant stakeholders, starting from the point where needs are assessed, planning objectives are formulated, the range of options available to meet needs are identified and the assessment of the preferred option occurs. The quality and acceptability of decisions reached in a major planning exercise for water and energy development depends to a large degree on whether the appropriate stakeholders have been involved in a meaningful manner. This principle argues for identifying stakeholders based on (i) whether they could be affected by the outcomes of the planning exercise and (ii) whether they are committed to contributing to it. To foster stakeholder involvement, information and studies must be made accessible to all stakeholders. Difficult choices may have to be made and this requires an atmosphere of trust and openness. Stakeholder involvement requires considerable commitment and may require professional management, but can help resolve conflicts that may arise later in project level decisions. It takes resources and time to foster effective and meaningful participation, with extra efforts directed to poor and marginalized stakeholders, who are to be primary beneficiaries in World Bank projects.

***Principle 3: Assess All Options Strategically and Comprehensively***
The options assessment exercise needs to be planned in advance. This principle argues that all options should be put on the table and that all be assessed equally. Options include those proposed by stakeholders, options for new development and for improved management, structural and non-structural options, demand- and supply- side options, options at different scales and options aimed at addressing remaining problems from earlier development. A level playing field for the assessment comes through a step-wise – and at times iterative – assessment procedure; wherein criteria for the assessment are agreed; options are screened and ranked; options are assessed individually and jointly; and options are selected for inclusion in a preferred development plan. Careful records should be kept of the rationale behind the recommendations, in order to inform the authority making or confirming the decision fully of the background of the preferred option.

***Principle 4: Reach a Decision***
Decisions on water and energy development and on major dams are government decisions, unless explicitly delegated. Providing recommendations within the decision-making timeframes is essential if the voice of stakeholders is to be heard. Efficient assessment processes require up-front clarity about the role of the stakeholders in the options assessment exercise and clarity about the procedures, timeframes and resources. Ideally, there should be a formal and public response from the decision-making authority to the recommendations from the options assessment exercise. Agreements reached between stakeholders as part of the decision-making process should be confirmed and methods should be agreed on ensuring compliance with such agreements. Stakeholder involvement in the assessment of options will help in reaching sound and acceptable public decisions. Whether that results in sound and acceptable development outcomes is, however, not guaranteed. It

is crucial to address compliance of agreements and to monitor whether decisions, once implemented, lead to the desired outcomes. Better planning processes are crucial, but not are not ends in themselves.

## The Case Studies

The sourcebook contains 9 case studies that describe the diverse approaches to stakeholder involvement in options assessment in different regions of the world and for strategic and project scale exercises. The case studies includes two examples where there was a need to meet some immediate community needs for power and water while undertaking an assessment of longer-term options.

The sourcebook has been reviewed by an advisory panel of international experts and is being prepared for publication. It is expected to be available in the second half of 2003.

| Case Study | General Description |
|---|---|
| **China** Loess Plateau Watershed Rehabilitation | Provinces in the arid Loess Plateau region evaluated a diverse set of dam and non-dam options for land and water management in small tributary watersheds of the Yellow River, using participatory processes. There were multiple objectives such as to raise agriculture productivity and rural incomes, while reducing sediment flow into the Yellow River system. LOESS I helped prepare a menu of options, delivery capacities and stakeholder acceptance. Its success led to scaling up and wider replication of the program in LOESS II. The decision to build over 460 sediment control and water supply dams emerged from involving stakeholders and balancing bottom-up and top-down planning processes. |
| **Nepal** Medium Hydropower Screening and Ranking Project | A participatory, multi-stage screening and ranking exercise helped to identify hydropower sites for medium-term grid supply development, as a mix of public and private sector investment. Stakeholder interactions and public consultations helped to provide transparency, inform identification and evaluation of the options, and promote confidence in the selection process and its outcome. |
| **Brazil** Ceará State Integrated Water Resource Management | Options assessment and stakeholder involvement informed decisions about the development of a network of strategic reservoirs and the integrated management of inter-basin transfers, to improve water storage and supply in the semi-arid State of Ceará, in northeast Brazil. The State created an enabling environment to move to participatory forms of water management involving new water management organizations at the state, basin and local levels. |
| **Central Asia** Aral Sea Multi-state Water Resource Cooperation | Interstate processes and mechanisms promoted regional water resource cooperation in the Aral Sea Basin after the collapse of the former Soviet Union. Efforts were made to broaden the involvement of national stakeholders in water management in each country while political and economic transformations were underway, and national stakeholders began to inform State positions on regional cooperation. |
| **Zambia** Power Sector Rehabilitation Project | Strategic and project-level options assessments and stakeholder involvement informed power sector rehabilitation initiatives in Zambia. Through a strategic environmental assessment, measures for technical efficiency, social rehabilitation, environment restoration, and dam safety were incorporated in a sector-wide rehabilitation project. Parallel steps were taken to improve capacities within the power utility to adopt participatory planning processes and improve environmental and socio-economic management of power facilities. |
| **Canada** BC Hydro Stave River Water Use Plan | A structured process was undertaken to develop a water use plan for the 90 MW Stave Falls hydropower facility in British Columbia. The process involved all water use interests in the basin, through a the Consultative Committee and Public Consultations, in recommending a new operating strategy for the facility and proposing mechanisms for ongoing stakeholder involvement in performance and impact monitoring and in informing decisions for the ongoing management of the facility. |
| **Turkey** Aslantas Ceyhan Irrigation Project Ex-Post Evaluation | National and local stakeholders were involved in a comprehensive and independent ex-post evaluation of the Ceyhan Aslantas multi-purpose dam, which was built with World Bank support in the 1970-1980 period. The process elicited stakeholder views and evaluated the development effectiveness of the project, and drew a series of lessons to inform future development of new dams and management of existing dams in the basin. |
| **South Africa** Berg River Water Supply Project | Initially, approval of the Skuifraam dam, proposed to augment municipal water supply and storage for Cape Town, was withheld by the national government until demand management and alternative supply options were assessed, as required by new regulations. Subsequently, stakeholder involvement and options assessment were factored into decision-making on water security and demand-supply options. |
| **Kyrgyz Republic** Irrigation Rehabilitation Project | The Kyrgyz Republic addressed immediate needs for rehabilitation of irrigation sector infrastructure as part of a wider program to restore agricultural productivity after the collapse of the Soviet Union. A structured approach was set up to define priority investments to restore water flows in inter-farm canal networks and to ensure the safety, capacity and stability of irrigation dams. |

# South Africa Berg Water Project (Skuifraam Dam)

### A World Bank Case Study

The case illustrates how stakeholder involvement and options assessments informed government decisions to meet immediate water supply needs in the City of Cape Town (CCT) in the Western Cape Region of South Africa, in parallel with the preparation of longer-term programs to ensure a secure municipal water supply.

Approval of the Skuifraam dam,[10] a core element of the Berg Water Project supported by the CCT, was withheld by the national government until water conservation, demand management and alternative supply options were assessed and debated. While these processes proceeded, local water authorities were required to respond to drought-induced water shortages and demonstrate capacity for efficient management of existing supply across all sectors.

## What was the context?

The municipal water system for the CCT and surrounding municipalities is supplied from five large storage dams forming the Western Cape Water System (WCWS), plus a number of smaller dams, augmented by groundwater from two aquifers. The WCWS also supplies water to the agricultural (irrigation) sector as well as to other urban/industrial users in the lower Berg River. Water availability is heavily dependent on year-to-year winter rainfall patterns.

Water is also transferred into the Berg Water Management Area (Berg WMA) in which the CCT is the dominant consumer, from rivers located in the adjacent Breede WMA area through the Riviersonderend-Berg

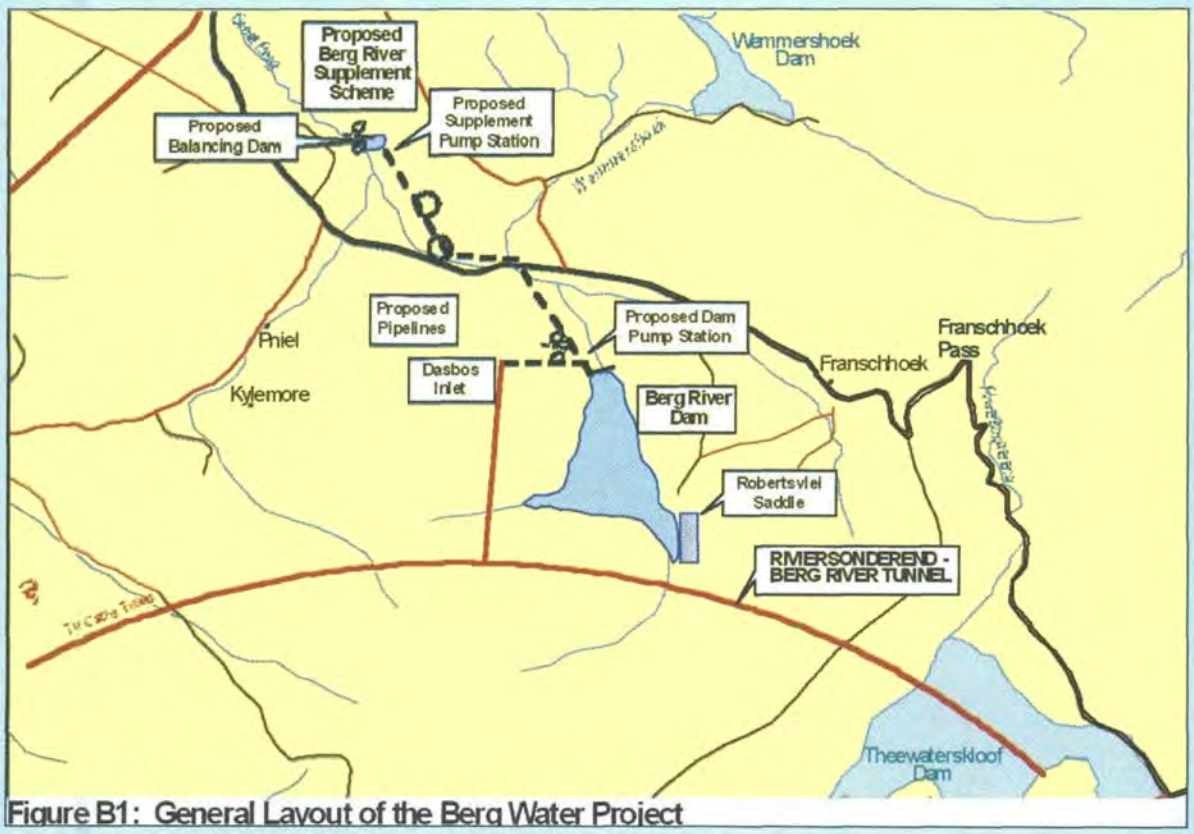



Figure B1: General Layout of the Berg Water Project

10 The name "Skuifraam" is used here as it has had a long historical usage. The term is no longer used officially and a new name for the dam is being considered.

River tunnel system. The total supply that can be mobilized with existing supply and inter-basin transfer arrangements in average rainfall conditions is about 364 million $m^3$/year. This compares to projected unrestrained needs of between 507-912 million $m^3$/year by 2020. Bulk demand growth through 1990s was three to four percent per annum, roughly in step with demographic growth.

In 1998, the Cape Metropolitan Council (CMC later to become the CCT) supported building the Skuifraam dam to augment storage and supply on the system by a further 18 percent, and sought the approval of the national government. The Department of Water Affairs and Forestry (DWAF) previously studied the scheme as a possible supply measure for the Berg WMA. The Berg River is one of the last free flowing rivers in the region and the project was strongly opposed by a coalition of environment communities and water recreation interests.

The Skuifraam proposal came just after completion of a major transformation of legislation governing water management policies and practices in South Africa – now regarded as among the most progressive in the world. For example, the National Water Act (1998) introduced legal requirements for environmental reserves in the regulation of river flows. Relevant to the Skuifraam question, the Water Services Act (108-1997) required that alternatives to dams be prioritized before the construction of new dams. New legislation introduced in the water resources and environment management fields also required, or reinforced, participatory planning and public consultation as input to all major water management decisions at local, provincial and national levels.

The Skuifraam decision, in effect, became a first major test of the workings of the new legislation in the Western Cape Province. It also triggered a much wider debate about the current and future water management policy in CCT and Berg WMA and prompted calls for a fundamental rethinking of the approach to demand and supply management. Many of these considerations are captured in the National Water Resource Strategy, which is now under preparation.[11] At this time also, water use restrictions were first imposed by CCT and on the agricultural sector (1999-2000) due to the drought and resultant water scarcity.

After the former CMC requested national approval to proceed with the dam, the minister responsible advised parliament that any decision to augment water supply in CCT should be predicated on three factors. These included a review of the demand projections, a clear indication of the commitment of the former CMC and relevant transitional local councils and district councils to demand management, and provision of better technical information on demand management potential with more detail of the budgetary support for related demand management programs. In response, to this direction (and to the drought that occurred shortly after wards) the CCT strengthened its water demand management activities with awareness and information programmes. Water tariffs were restructured and bans and restrictions introduced on certain water uses, such as lawn watering.

The CCT's position was that new supply was needed on top of demand management. Skuifraam was regarded as the most feasible new supply alternative. Because it

| Chronology – Key Events | |
|---|---|
| 1989-1985 | Western Cape System Analysis: Study of current and future water needs, available resources and augmentation options by DWAF. |
| 1995-1996 | DWAF Public Participation Process with 1100 people. Public conference Goudini in with 100 representatives. Task team short-listed BWP (Skuifraam) and water demand management for further study. Draft EIA report presented for public comment. |
| 1997 | Water Services Act (108) |
| 1994 | National Water Act, National Environment Management Act |
| 1998 | Skuifraam Dam recommended for approval by CMC endorsed by DWAF |
| 1998 | Minister defers decision until CCT water authorities show progress in managing the demand for water. |
| 1999 | Drought and restrictions introduced in water use. Initiation of accelerated DSM program by CTC |
| 1998-2001 | Options Studies and Public Debate on options in 3 parallel processes (Municipal WSPD, Berg WMA Planning, and EIA of the Skuifraam Dam) |
| Sept 2001 | Approval in principle of the Skuifraam Dam by the minister |
| May 2002 | Cabinet Decision to proceed with Berg River Water Supply Scheme |
| 2007 | Scheduled commissioning of the BWP and dam |

11 See www.dwaf.gov.za

could not be completed before 2006-07, an aggressive program of demand management, water re-use and water conservation was required to meet immediate needs and sustain the city until then. The immediate need was also for more equitable allocation, and to expand water supply to poor areas that were under-serviced and often the first to suffer from shortages.

Stakeholders opposed to the Skuifraam dam argued that a dam option was unnecessary, costly, and environmentally damaging and that a package of water recovery and recycling measures could be mobilized to provide new supply for immediate and future needs instead. They argued that the demand management measures introduced by the CTC were not aggressive and were limited in scope, pointing to achievements of smaller water-stressed municipalities in the region that had mounted programs to reduce peak water demands. While the context may have been different, the Cape Town Metropolitan area was seen to be lagging behind. Further, they argued building Skuifraam would not change the inequities of water use prevalent in the Western Cape, while paying for it would impose high water charges on low-income consumers.

After an extensive program of studies, consultations, open debate and public hearings organized around the three separate processes that dealt directly and indirectly with the Skuifraam question [i.e., a new Municipal level Water Service Development Plan (WSPD), the Berg WMA plan process, and the Skuifraam dam EIA], the minister gave approval in principle to proceed with the project in 2001. This would go hand-in-hand with a more aggressive water management programme. The minister noted also that the reduction in water demand resulting from the initial series of demand management measure in the 1999-2001 period had delayed the need for additional water augmentation schemes, other than the Berg Water Project. After subsequent parliamentary subcommittee debate, in May 2002 the cabinet authorized the Berg Water Project to proceed.

The site for the 70-meter high Skuifraam dam is on the upper reaches of the Berg River near Franschhoek, about 70 km from Cape Town. It will create a reservoir with a gross storage capacity of 126.4 million $m^3$. No resettlement is involved. The Berg River estuary is a biologically significant and diverse wetland. The EIA noted that changing flow regimes would impact downstream wetlands and coastal fisheries. The scheme is expected to cost about US$150 million at 2002 price levels and exchange rates, though the estimates remain contested. The parastatal Trans-Caledon Tunnel Authority (TCTA) will implement the project and raise the funds from the private sector without a government guarantee. Two agreements were signed on 15 April 2003 between DWAF and CCT relating to bulk water supply and between DWAF and TCTA in respect of implementation that include transfer of revenue from water sales to TCTA for the project. The Water Services Act requires full cost recovery where possible; thus, water users will pay for the scheme through what is called the Berg Water Capital Charge on the bulk tariff.

## What options assessments were carried out, and by whom?

Information and analysis of options were exchanged between the three parallel processes that were looking at ways to meet immediate and future needs for water services. Many of the same parties were involved in each process. The CCT set about evaluating options for water service provision as part of its municipal plan (WSPD), which, under the new Water Services Act, each municipality was required to develop. Parallel evaluations of water supply and management alternatives for the wider Berg WMA were undertaken in national DWAF-led processes, and the EIA of the Skuifraam dam followed steps for within-project options assessments prescribed in the Environmental Conservation Act (1989) and the new National Environment Management Act (NEMA 1998).

### ○ Municipal Water Service Development Plan (WSDP) for Cape Town

As prescribed in legislation, each WSDP had to incorporate new water demand projections, identify infrastructure requirements, provide a water balance, and review the environmental management issues associated with current and future water service provision. As the initial set of conservations measures and restrictions were introduced to address immediate water shortages, the CCT commissioned an Integrated Water Resource Planning Study to evaluate the principle demand management and supply alternatives.

In addition to recommending the Skuifraam dam to augment supply and storage, the integrated study recommended three additional "packages" of options:

- Package 1: Pressure control, removal of automatic flushing urinals, user education, tariffs metering and credit control, leakage repair.
- Package 2: Private borehole, water efficient fittings and grey water recycling.
- Package 3: Voëlvlei Augmentation Scheme, Table Mountain Group Aquifer pilot

The objective of the water demand management policy and strategy of CCT was also to reduce the projected demand for water by 20 percent by the year 2010.[12]

Meetings of various committees of locally elected officials, expert working group meetings, consultations with interest groups and public hearings around the separate studies were part of the WSDP process. In these engagements, pressure from stakeholders arguing in favor of non-dam options helped to ensure that the scope of options assessment studies stayed broad, and reflected what the Water Services Act had envisaged. Proponents of non-dam options felt the CMC needed to look more closely at the experience of other (smaller) local authorities and emulate their approach, such as the small seaside holiday town of Hermanus where a 12-point water demand management program had achieved a 30 percent reduction in peak water demands. They advocated intensified and accelerated water recycling programs, introducing by-laws on grey water reuse and recycling of the city's treated sewage water (at that time pumped out to sea). Other proposals were for a series of drought management measures with staged restrictions in water use that reflected the severity of the drought.

- **Berg WMA Options - led by DWAF**

The DWAF-led study process considered alternative supply options for the Berg WMA in the context of overall demand-supply balances and inter-basin water transfers between the WMAs. Supply options assessed included the possibility of deep groundwater supply from the Table Mountain Group (TMG) aquifers, further transfer of water into the Berg WMA from the Breede River, and desalination of seawater as a longer-term option. Increasing storage capacity by raising the height of the five existing dams was also considered. The criteria used for evaluation of options for supply augmentation broadly included economic, environment and social factors, as well as risk and reliability factors. The DWAF studies also took into account the new requirement to provide ecological reserves from existing and potential surface water regulations.

The Skuifraam dam emerged as the preferred supply scheme in the context of the Berg WMA requirements, in combination with water conservation and water demand management. In addition to the dam, the Berg Water Project included pumping stations to supply pipelines connected to the Riviersonderend-Berg River tunnel system, and separate facilities to transfer water from downstream tributaries entering the Berg River back up into the Skuifraam reservoir for storage.

### Skuifraam dam EIA Alternatives Assessment

Within-project alternatives for the Skuifraam dam were assessed in the EIA process. Issues such as the design and siting of major structures, construction schedules and the environmental mitigation, management and monitoring provisions were taken up. Here, for example, instream flow requirements (IFR) downstream of the proposed dam site undertaken during the feasibility study were evaluated, and provisions for both low flow and flood releases were made in the design (e.g. sizing of outlet works) and operating strategies. Pro-environment stakeholders were concerned about the environment impacts on downstream wetlands and downstream coastal fisheries.

## What other steps were taken to enhance stakeholder involvement in the decision-making processes?

The framework and mechanisms for stakeholder involvement reflected the legislation and regulations governing each process in which options were evaluated. For example, the Water Services Act required the WSPD to be taken through a full public participation process, with the public, stakeholders and water services authorities/providers given an opportunity to comment at each step in the plan formulation. DWAF responded to provisions in the National Water Act (1998), which required stakeholder involvement in the Berg WMA analysis as well as the extensive public participation process in connection with the National Water Resource Strategy, and it published its Generic Public Participation Guidelines (2001).

In addition to the government-led processes, different stakeholder interests launched advocacy campaigns to proactively engage NGO networks and focus public attention on specific issues regarding the options being considered and their impacts. For example, while advocating demand management and water recycling options, those opposed to the Skuifraam dam initially called for suspension of planning until, "the CMC conformed with the demand-side management requirements of South African Law."

Media interest in the Skuifraam debate was high, especially local coverage at key decision points and, to

12 See www.capetown.gov.za/water/wsdp

some extent, of events leading up to decisions. This increased public awareness of the issues in debate. In that respect, the open debate in the media was also a factor in the decision reached by the CMC to include the Berg Water Project in the draft WSDP that was submitted to the national government, through DWAF, for approval.

One additional, unique input also provided an external reference point for the options assessment and stakeholder involvement. The World Commission on Dams (WCD) was based in Cape Town. Many government and NGO stakeholders who were parties in the Skuifraam studies and debate also actively participated in the WCD process. The minister responsible for Water Affairs and Forestry (at that time) Professor Kader Asmal was also the Chairman of the WCD. After the final WCD report was issued in November 2000, the Skuifraam Dam and the wider decision-making process was compared with the WCD strategic priorities and guidelines. The result was presented at the last WCD Forum held in Cape Town in February 2001. The government position was that option assessments in the planning, environmental assessment and public consultation processes compared favorably, and in certain instances exceed the practices promoted by the WCD Report.

## How did the options assessments and stakeholder involvement improve development outcomes?

Options assessments figured prominently in the debate on the meeting immediate needs. At the same time they were a central aspect informing decision-making on the mix of non-structural and structural measures to improve water security, and meet the needs for water services in the medium-term.

An immediate benefit was that Cape Town adopted a more aggressive demand management program and achieved greater (short-term) water security than it might have done otherwise. It can be argued that sustained pressure from stakeholders, within the framework of the new enabling legislation, encouraged adoption of a full slate of feasible demand-supply options. In 2000, the drought in the Western Cape continued. With water restrictions in place, demand was reduced by 14 percent. In 2001, demand was lower by a further three percent as some of the "voluntary" demand management measures, such as responses to the new tariff structures, started to take effect (this in addition to the effect of attributable to bans and restrictions). Targets for a further 20 percent reduction in long-term demand were also set. Because of strong political direction for participatory options assessment and the debate this prompted, more resources were directed by the Water Authorities to demand management, water recycling and non-conventional supply options than would otherwise be the case.

Involving stakeholders in identifying, assessing and debating the options was seen to contribute to a number of other positive outcomes. For instance:

- The public debate about options, which was a new phenomenon, contributed to increased awareness among the general public and water users of the water situation they faced, what they could expect in future, and the rationale underlying the public decisions on the management of water demand and supply;
- A clear decision on the Skuifraam dam, informed by the options debate and the stakeholder interests and perspectives that were expressed, either as input to the options studies, and in open public debate, was taken. Government was placed in a better position to take a decision and to account for the decision;
- Public awareness and understanding of the reason for higher water tariffs increased (the Berg Water Capital Charge), which, over the medium-term, would also make water conservation more effective, and
- The foundations were laid for ongoing collaboration among key stakeholder groups leading to informed public debate of key water services provision issues for the Cape Town area, centered on the ongoing implementation and revision of municipal the WSPD, under regulatory oversight of DWAF.

It is difficult to identify the incremental costs incurred in expanding the range of options evaluated in reaching the decision, or the cost of enhancing the involvement of stakeholders in relevant studies and public consultations. Broadly, the costs are part of participatory planning required by legislation. What can be said is that the incremental costs of more complete options assessment and stakeholder involvement did not arise.

Not all groups accept the decision to proceed with the project. In particular, the debate on the environmental impacts of the Skuifraam dam and its management continues. Concerns raised by environmental groups center on salinity and estuary impacts of the regulation and abstractions. For example, with lower flows and a future scenario of intensified withdrawals downstream of the dam when those areas develop, the salinity of river water may increase (e.g. from natural salts that leech into the river when it rains) and require expensive

treatment before use. DWAF believes the effects would be marginal. Mitigation measures identified in the EIA are to simulate the rivers pre-dam natural flow during winter rains and in the dry summer period the system would be periodically flushed with water from other systems. The media is following these issues closely. That factor, combined with active stakeholder interest, would be expected to improve research, monitoring, compliance and adaptive management of the dam.

## What lessons are offered?

The immediate needs for water services were meet by a mixture of voluntary conservation measures and restrictions in water use. The case study reinforces that demand management should be among the first options considered. Beyond that, what emerged from multi-stakeholder options assessments followed by public debate was that new supplies were eventually needed. In retrospect, the new approach to conducting more integrated and comprehensive options studies (as required under the Water Services Act - emerging from the evolutionary process of participatory planning), exposed the more narrow basis of options studies conducted in past.

Broader lessons include:

I. Legislative and regulatory provisions requiring alternatives to new dams to be prioritized before new dams are approved, in this case, helped to expand the range of options considered in planning thus creating the enabling environment for options assessment. This gave political support to identify and implement demand management measures that helped meet immediate needs. The legislation was also helpful in moving options assessment "upstream" in the planning process and institutionalizing the practice and funding for that to occur on a regular basis (e.g. the municipal WSDP).

II. Involvement and pressure from civil society and non-government stakeholders helped to expand the range of options evaluated. The lesson is that civil society should be seen by traditional supply interests as a major positive resource for new ideals, approaches and information – not as an impediment to solutions.

III. One of the concerns about demand management options is how much can they save in reality and over what timeframe. The lesson is that when uncertain over the market penetration or potential impact of demand management measures is a major concern, options can be implemented on a trial basis to help make a proper evaluation of their potential. Early and serious efforts in demand-side management can also avoid delay and disruption of decision processes, and can help avoid the worst conflicts.

Participatory approaches and comprehensive options assessments do not alter the need to make choices among alternatives, tradeoffs, or to reconcile different views of development. It is frequently necessary to adopt choices that may be unpopular among specific interest groups. What is important is that a full range of options is assessed so that decision-makers are better informed of all the perspectives.

# The Lower Orange River Management: Water Resource Management Challenges and the Methodology for Identification and Selection of Management and Development Options

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**Key Words:** International water course, water resources management, water resources objectives, options assessment, decision-making processes.

## Study Area and Background

The water resources and water use of the whole Orange River basin upstream of Van Der Kloof Dam, including the Vaal River system and the Senqu in Lesotho, are being taken into account in the study. However, the primary study area is the lower Orange River, defined as the area downstream of the Namibian border where the river forms the common border between South Africa and Namibia. The middle Orange River downstream of Van Der Kloof Dam in South Africa is being evaluated at an intermediate level of study.

The management of the Orange River faces a number of key challenges, which the study aims to address. Among these are:

- The continuous development in upper reaches of the Orange River affects the downstream flow regime.
- There is a need for protection of the environment, including the estuary, river regime and riparian zones.
- There is a need for improved assurance of supply to users.
- There is a need for a joint approach to further studies and management. Previous studies were done by South Africa and Namibia individually.

## Geographic and Social Economic Background of the Region

The primary study area in South Africa is the northern portion of the Northern Cape Province. It is a very arid, relatively sparsely populated area, except for irrigated agricultural development along the banks of the Orange River. It is an area of generally low income and economic production, except along the Orange River itself, and the mining activity in the area.

The study area in Namibia is the southern region of the country which is also arid and sparsely populated except at the mining developments, generally concentrated near the river mouth, and the isolated, commercial, irrigated agricultural developments.

## Water Resources Background of the Orange River

The Orange River Development Project, Replanning Study, which was completed by South Africa in 1998, recommended that the broad strategy for the management of the Orange River should be to:

- To promote effective and efficient utilisation of water resources on a sustainable basis; and
- To achieve the greatest social, environmental and economic benefits from each cubic metre of water used, to the overall good of all.

This included recommendations that the following be addressed:

- Before further development of the resource, steps are to be taken and actual progress made to better utilise the water already available;
- The national strategy with respect to water conservation and demand management are to be adhered to,
- A well-structured pricing policy, which is the core factor in support of the strategy to ensure the efficient and most beneficial use of water, is to be applied;
- The substantial quantity of water that can still be made available from the existing infrastructure on the Orange River, provided that efficient use of water is achieved, is to be utilised and managed; and

- The significant potential for further development of the resource is to be realised.

Other findings were:

- The projections indicate that it will be several decades before full development of the resource is approached;
- The strategic framework should be targeted at achieving improved utilisation of water and ensuring that development decisions are flexible enough to allow the full beneficial utilisation of the resource in future;
- The timing and sizing of further water resource development projects on the Orange River will be directly influenced by the growth in water requirements from the river; and
- Reliable long-term projections of future requirements are difficult to achieve therefore:
  - The effects of changes due to conservation measures is to be closely monitored and evaluated.
  - The Orange River water balance is to be regularly reviewed.

## Institutional Framework

- South Africa and Namibia established a Permanent Water Commission to co-ordinate the management of shared resources.
- The PWC recognised that the need to focus on improving management of the lower reaches of the river was a priority for both countries.
- There is now a new legislative environment and water resource strategy in the Republic of South Africa.
- The Orange River is an international boundary; therefore, there is a need for a joint study.
- A ministerial agreement between Namibia and South Africa to conduct a joint study was formalised in April 1999.

## Setting

Strategic objectives of the countries for the river and hence those which the study must address are:

- Regional economic development,
- Poverty alleviation,
- Job creation,
- Protection of the environment,
- Water resources management aligned with policies of government,
- Food Security, and
- Compliance with National Objectives and Strategies for Water Resources, which include:
  - Resource Protection
  - Resource Conservation and Use
  - Public Safety
  - Complimentary Strategies
  - Resource Management and Control
  - Management Institutions
  - System Operation
  - Financial Management
  - Monitoring and Information
  - Resource Accessibility
  - Resource Assurance
  - Resource Quantity and Quality

## Planning Level

This is the first comprehensive bi-national project between South Africa and Namibia for the management of the lower Orange River.

The study covers the following planning levels:

- Clarification, extension or recommendation of policies for management,
- The extension of regional strategic and development objectives into specific development objectives,
- Alignment with National Economic Development and Water Resource Strategies,
- The recommendation of water resource management objectives to meet strategic objectives,
- The development of fundamental water resource strategies to meet the water resource objectives,
- The extension of fundamental strategies into operational strategies to meet the water resource objectives, and
- The identification of programmes, options and projects to meet the operational strategies.

The water resource objectives and fundamental strategies cover the bi-national and river basin in extent, while the operational strategies and options are at sub-catchment and regional level.

## Scope of Study

The study is to investigate and report on the availability of water and options for improved management through the efficiency of water use and supply management measures to promote the strategic objectives of the countries involved. The study comprises the following main tasks:

- Assess the environmental water requirements.
- Identify flow regulation opportunities.

- Identify opportunities for additional development.
- Make recommendations for improved assurance of supply.
- Promote and support public participation and support.
- Evaluate water requirements and water conservation opportunities.
- Define the water resources and undertake yield analyses.
- Identify and assess management and development options.
- Perform Economic analyses.
- Evaluate environmental and social issues, impacts and benefits.
- Recommend guidelines for water sharing, cost sharing & dam options.
- Recommendations, and Main Report and TOR for feasibility level study of recommended options.

The project clearly addresses the identification of development goals within the framework described above.

The project has, as one of its main tasks, the quantification of sectoral water demands and local needs.

The process for identification of options has been very broad. The management of the Orange River faces a number of key challenges, which the study aims to address.

## Assessment of Development Goals, Sectoral Demands, Regional and Local Needs

The project clearly addresses the identification of development goals within the framework described above.

The project has as one of its main tasks the quantification of sectoral water demands and local needs. The process for identification of options has been very broad.

The characterisation of options is currently in progress and the methodology adopted will be described. The criteria, which will be used for assessing the options, are being formulated and will be discussed. They form a key component of the characterisation of the options.

## Assessment of Alternative Options Scenarios

The study proposal envisaged that the assessment of options will be undertaken using multi-criteria decision-making methodologies including:

- Weighting of the criteria,
- Assessment of the options against the criteria, and
- Prioritisation of the options.

## Stakeholder Participation

Stakeholder participation to date has comprised:

- A public meeting in each country,
- Three meetings with authorities, one in South Africa and two in Namibia,
- Two newsletters,
- Attendance at the meetings was invited by way of posters, press releases, advertisements and radio time slots.

Ongoing stakeholder participation is planned.

## Implementation

The project commenced in April 2002 and is currently in the reconnaissance stage. At the end of the reconnaissance stage in mid-2003 it is envisaged that a number of options will be recommended for study during Phase 2 of the project, the pre-feasibility assessment, by the end of 2003.

As part of Phase 2 of the project, the terms of reference will be prepared for further studies at feasibility level of the recommended options.

The funding for the project has been provided. The governments of Namibia and South Africa appointed the consultants through the PWC.

# Turkey: Export Evaluation of the Ceyhan Aslantas Multipurpose Project

**A World Bank Case Study**

This case study illustrates the process and methods used to involve local and national stakeholders in a comprehensive, ex-post evaluation of the Atlantas multi-purpose dam project on the Ceyhan River in Turkey. This multi-purpose irrigation, power supply and flood management project was developed by the national agency responsible for public sector dams in Turkey, the DSI (State Hydraulics Works), with World Bank financial support. It was commissioned in 1985.

The multi-stakeholder, ex-post evaluation which was completed in 14-months (1999-2000), looked retrospectively at the original decision to proceed with the project in 1974, and how the subsequent operation and management decisions responded to the evolving social, economic and political context in the basin. Stakeholder views were elicited on the development effectiveness of the project, and lessons were drawn to inform the development and management of other dams in the Ceyhan River Basin.

## What was the context?

The Ceyhan river basin is located in the eastern Mediterranean region of Turkey. When the Ceyhan-Aslantas Multipurpose Project (CAP) was appraised in 1973, agriculture accounted for a third of Turkey's national GNP and 60 percent of its employment. Government emphasized the improvement and extension of surface irrigation facilities in its development planning. In the Ceyhan basin, the aim was to introduce water storage schemes to replace existing run-of-river irrigation diversion works that were considered to have limited capacity and offered little security against drought. In 1966, a basin master planning study prepared by consultants for DSI identified the Aslantas dam as one of five potential multi-purpose reservoir projects for the main stem of the Ceyhan River. After further evaluation studies, the CAP was proposed to be the first storage scheme in the basin. Government subsequently sought and received a World Bank loan for 23 percent of the total project cost, which was estimated to be $US 327 million in 1973 dollars.

As developed, the CAP provides irrigation and drainage for 97,000 ha, protects a third of this irrigated area from flooding with dykes, and generates 500 GWh annually from a 138 MW power station. Physical components of the project include the 78m dam with 1,190 $Mm^3$ gross storage plus flood storage of 650 $Mm^3$, gravity and pumped irrigation systems, drainage networks and feeder roads.

Figure 1: Study Process

Source: WCD Case Studies 2000

In 1999, the World Commission on Dams (WCD) selected Turkey for a case study to profile dam-related experience in the eastern Mediterranean region. Initially, the Turkish government was hesitant to participate in a WCD supported study; however, after meetings to explain the methods and how the outputs would be used in the global WCD program, as well as the insights that Turkey would gain for its own dam management program, the government and DSI agreed to participate. The assessment, carried out by an independent study team using multi-stakeholder processes, was the first of its kind in Turkey.

Figure 1 shows the major steps in the global process that was followed for all WCD sponsored case studies, including the CAP study. In effect, the WCD and DSI were joint sponsors. One important aspect was the findings would not be provided by the WCD or DSI, rather they would be established by the stakeholders,

informed by the analysis prepared by an independent, multi-disciplinary study team consisting of Turkish professionals.

Similar to an EIA, the exercise was divided into two phases. A small team consisting of four local professionals was appointed by the WCD for the initial scoping phase. Their task was to prepare a stakeholder analysis, assemble a stakeholder group (forum) and prepare a draft scoping report on which to initiate stakeholder dialogue. The study design was based on detailed terms of reference provided by the WCD secretariat, which was common to all the case studies the WCD sponsored globally. The terms of reference were developed after extensive consultations with the WCD Commission and WCD Forum members.

The CAP scoping team worked closely with DSI and the WCD secretariat to identify a representative group of stakeholders, identified through a combination of open solicitation of interest, media advertising and direct approaches to different water use interests in the CAP area. Relevant government departments at all levels were also contacted through DSI, or by the scoping team directly on behalf of DSI and the WCD.

After the first stakeholder scoping meeting was completed, the full study team, consisting of 17 Turkish professionals, was formed. Members worked on a full- or part-time basis. This team prepared a draft report following the methodology provided by the WCD, but adapted to the CAP situation as defined in the scoping report. This study phase included parallel steps of data collection and verification, structured interviews, enquiries and invitation of submissions from interested parties, and analysis undertaken over eight months. The draft report was the basis for a second two-day stakeholder meeting. Based on this dialogue, the study team finalized the report, capturing the lessons learned and the convergent and divergent views on each lesson and the development effectiveness of the CAP.

## What options assessments were carried out, and by whom?

Six central questions were used to structure information collection and the assessment of development effectiveness and to develop the lessons (recommendations). These were:

- What were the projected versus actual benefits, costs and impacts?
- What were the unexpected impacts?
- What was the distribution of costs and benefits – who gained and who lost?
- How were decisions made?
- Did the project comply with the criteria and guidelines of the day?
- What lessons can be earned for today's context?

The response to the fourth question regarding the decision-making process considered how the options assessment had informed the original selection of the CAP Project.

Here it was noted that the Aslantas dam was identified in the 1966 Basin Plan, where increasing the area of agriculture under irrigation was the primary development objective in Turkey. Consequently, the options assessment centered on locating sites for dams with suitable geology and topography to support construction of a dam with the largest possible reservoir, in close proximity to agriculture areas. Minimizing resettlement and agriculture land-take were explicit considerations at that time in selecting the actual sites. When the CAP scheme was subsequently appraised by the World Bank, the project was evaluated based on its economic attractiveness. In the appraisal, the consideration of alternatives was restricted to the comparison of the hydropower component to an equivalent thermal power station. Here, power systems studies concluded that the hydropower scheme was more attractive than a thermal option, despite the irregular monthly distribution in power output. The irregularities in power output resulted from the fact that power generation followed the irrigation release schedules and not power demand schedules.

Stakeholders were asked to identify the main lessons to draw from the analysis and findings that would inform future operation of the CAP and development and management of water resources in the basin. Many of these lessons had direct and indirect implications for options assessments in planning. The basin context was also important to the stakeholders. Of the other four major dams identified in the 1966 basin study, the Menzelet and Sir dams had been completed in 1991, and the Kilavuzlu and Berke dams were under construction. A further 12 small- and medium- sized dams identified in the 1966 basin plan on tributaries of the Cehan River were either built, were under construction, or were planned.

## What other steps were taken to enhance stakeholders involvement in decision-making processes?

Local and national stakeholders were involved throughout the entire process in Turkey, as were international stakeholders through the WCD's global network.

Early in the scoping phase, a stakeholder analysis was used to guide and coordinate the steps to establish an active stakeholder group for the process. The group that eventually formed included interested farmers, fisherman, members of formerly resettled families, academics, government officials from various departments, consultants from various disciplines the private sector and local municipal government officials. Membership was not formal, but open. The scoping report was distributed to these people. It was also sent to other government departments, academic institutions, environmental and social non-government bodies and water user groups who preferred to be informed of progress rather than attending meetings. The scoping meeting was a one-day session, which approximately 50 persons attended. Interactions between the study team and stakeholders were maintained during the course of the study. Contacts involved stakeholders in questionnaires. Meetings were held with all the constituencies associated with the development and management of the Aslantas dam and the CAP project, and with environmental and social organizations active in the basin.

After the draft report was completed, resource packages were sent to stakeholders groups to enable them to prepare for a two-day meeting. These packages included the draft reports, additional questionnaires to evaluate responses to the report and preliminary recommendations. Logistical support (travel and per diem) was extended on a case-by-case review of need for financial support.

### Facilitation of External Stakeholders

Through the WCD network, external stakeholders had input into the case study methodology. Subsequently, all materials were posted on the WCD web site. As documents became available, these included the scoping terms of reference, the draft scoping report, the revised work plan and study team composition, and the draft and final reports. In addition, minutes of all stakeholder meetings were posted. Written comments received from external stakeholders were placed on the web and made available to the local stakeholders in Turkey so they were aware of external comments. For example, one external criticism of the exercise was that a large number of government stakeholders were involved. All external stakeholder opinions and comments that were received were incorporated as an annex in the final report.

### Reporting on Convergent and Divergent views of Stakeholders

Over 77 participants attended the 2-day review meeting held in the town of Adana in January 2000. Presentations of the key findings of the study made by members of the study team were followed by open discussion of the conclusions drawn by the study team. Facilitators were engaged for the second phase of the meeting, where 3 parallel subgroups of a more workable number of 25 persons debated 3 main issues, namely:

- the distributioner benefits and costs - who gained and who lost?
- the development effectiveness - how was this defined and how did the group assess this
- the lessons learned for different stages of the project cycle - planning, implementation and operations.

In these sessions, facilitators were used to help identify areas of agreement and disagreement. The points of agreement were noted and set aside and discussion was focused on narrowing areas of disagreement. These discussions were informed by the empirical and qualitative analysis provided by the draft report. After sufficient discussion, (as judged by the facilitator) any remaining areas of divergent views were recorded.

To elicit views on the distribution of benefits and costs from the CAP project, the participants were asked to identify which groups were gainers and losers and why. The groups so identified were then classified, and the points of discussion on who won or lost where agreement was not reached were recorded.

**Box 1: Stakeholder Assessment of the development effectiveness of CAP:**

- The agriculture production increase created by CAP raised income and welfare levels in the region.
- More people benefited from electricity.
- With the new roads constructed in the region, transportation was improved.
- Better health facilities were established.
- CAP stimulated technological change in agriculture systems with the transformation to irrigated agriculture.

**Box 2: Methods to Evaluate Lessons Learned**

A list of 17 provisional lessons was distributed to the participants. They were given 15 minutes to fill in forms that indicated the extent to which they agreed or disagreed with the lessons. Participants were then paired and exchanged forms with the person sitting across from them. The items were discussed one-by-one. The responses to lessons learned were then signed and the tally posted on pasteboard. Group discussions then focused on lessons with divergent views to see if positions could be narrowed. Participants were also requested to write any proposal on new lessons on their questionnaire forms.

To elicit views on development effectiveness, participants were asked to indicate what they understood to be a measure of development effectiveness and what was not. This was in reference also to the analysis contained in the draft report and a questionnaire. Box 1 shows the conclusions reached in one of the three sub-groups. Those who disagreed that the project was environmentally acceptable argued that its environmental impacts could not be measured due to lack of baseline data and monitoring systems in the CAP area dealing with these aspects.

Seventeen lessons learned that were proposed by the study team were then presented to the stakeholders. These were discussed in the way noted in Box 2. The lessons were reformulated and the convergent and divergent views around each of the 17 reformulated lessons were then recorded. Participants also formulated a further eight lessons, or recommendations.

## How did the stakeholder involvement improve the outcome of the exercise and contribute to better development outcomes in future?

The ex-post evaluation undertaken as a case study was the first multi-stakeholder process of its kind undertaken in Turkey. Apart from the precedent it set and the experience and model it provided, the outcome was a set of recommendations on the development and management of dams and water resource projects in the Ceyhan basin. More broadly, these were conclusions on possible ways to enhance stakeholder involvement in water resources management and dam-related planning in Turkey. The conclusions were also grounded in the assessment of the development effectiveness of the CAP project and multi-stakeholder views.

Many of the lessons can be turned into criteria for options assessment associated with dam selection and management. Showing the convergent and divergent views also captured the range of perspectives of water users, civil society, NGOs, academic and professional groups, business interests and the government agencies.

The following is a condensed list of lessons emerging and the convergent and divergent views recorded ranging from strongly agree to strongly disagree. The 17 lessons are noted as CAP 1-17 (shortened and paraphrased here). An additional eight lessons were also added by the stakeholder group, as noted.

- CAP 1 - Estimations of physical as well as price contingencies should be done more accurately

| LESSON | Strongly Disagree | Disgree | Neutral | Agree | Strongly Agree |
|---|---|---|---|---|---|
| CAP 1 | | 2 | 10 | 25 | 4 |
| CAP 2 | | 4 | 7 | 28 | 2 |
| CAP 3 | 1 | 6 | 4 | 22 | 7 |
| CAP 4 | 1 | | 3 | 27 | 11 |
| CAP 5 | | | 2 | 25 | 14 |
| CAP 6 | 2 | | 10 | 23 | 6 |
| CAP 7 | 1 | | 2 | 27 | 11 |
| CAP 8 | | 2 | 1 | 29 | 9 |
| CAP 9 | 1 | | 3 | 28 | 9 |
| CAP 10 | 1 | | 1 | 27 | 19 |
| CAP 11 | 1 | 2 | 2 | 30 | 7 |
| CAP 12 | 1 | 2 | 5 | 30 | 4 |
| CAP 13 | | | 3 | 31 | 6 |
| CAP 14 | | 5 | 6 | 26 | 4 |
| CAP 15 | 1 | 1 | 10 | 19 | 3 |
| CAP 16 | 2 | 3 | 1 | 28 | 8 |
| CAP 17 | 1 | | 2 | 27 | 12 |

than employing simple constant coefficients for all components.

- CAP 2 - Price estimations are as important, and in many cases more important, than the physical design and resource estimations of the project.
- CAP 3 - legal and institutional mechanisms for cost recovery are as important as physical developments and the arrangements should not be delayed until after the project is completed.
- CAP 4 - Decisions on reorganization of agricultural institutions should involve farmers and project staff.
- CAP 5 - Extension services need to work in close co-operation with research.
- CAP 6 - Design studies should be more comprehensive.
- CAP 7 - Operation and maintenance of HEPP is a vital aspect of overall dam management and needs an experienced team, regular supervision and monitoring.
- CAP 8 - Site selection studies should also take into consideration the existing, unique archaeological and historical sites.
- CAP 9 - Uncontrolled and unlicensed fishing has negatively affected fish populations in the reservoir.
- CAP 10 - Social and economic support should be provided and a built-in monitoring mechanism for resettlement should be operated.
- CAP 11 - Water needs have changed during the operation period due to the changing cropping patterns and the growing population. The municipal and industrial water demand rose in the Aslantas project because of the insufficiency of groundwater and forced a change the operation rule of the reservoir. Multi-purpose multi-reservoir, basin-wide operation studies should be done periodically during operations.
- CAP 12 - The cumulative effects of the upstream dams must be taken into account especially in planning stage.
- CAP 13 - Irrigation operation and maintenance is more sustainable and cheaper when locally organized user groups are responsible for delivery and cost recovery of irrigation water.
- CAP 14 - CAP stores sufficient water to offset conveyance losses. An options assessment process would have shown whether it is more sustainable to reduce conveyance and irrigation losses, rather than building a larger storage.
- CAP 15 - CAP has set an excellent example in adhering to the basin plan. There are additional projects in the master plan. Such new investments are also candidates for outside financing if they have not been officially contracted out.
- CAP 16 - Water conservation needs to be better supported and encouraged.
- CAP 17 - A specific monitoring and enforcement program is essential to learn lessons, review progress and monitor whether predicted benefits are being met and negative impacts are mitigated.

The participants identified further lessons as being:

- Land consolidation should be taken into consideration during the planning stage.
- Discharged water from irrigation should not be released to rivers and wetlands without treatment.
- Irrigation schemes should be transferred to local administrations or the private sector during the project approval stage and these groups should carry out operation and maintenance.
- For smooth of implementation of expropriation and resettlement, cadastral work must be completed before the project implementation.
- For an efficient utilization of water resources, it is essential to establish a good hydrometric observation network, which will provide regular and qualified observations.
- An action plan containing time schedule, costs and activities should be prepared for the possible displaced people before the project is started.
- Identification of settlement facilities should start parallel with the resettlement studies, and preferably, possibilities of resettling the displaced near their villages should be investigated.
- Fish passages or ladders should be considered in dam projects.

The general conclusion was that group interactions improved the collective understanding of the different water use interests in the basin. The lessons also offered guidance on the importance of options assessment and how factors need to be balanced at in all stages of decision-making on dams.

### What lessons are offered?

- Ex-post or periodic evaluations of existing dams that involve all groups of stakeholders can provide valuable insights on how to improve the management and development effectiveness of existing dams. These assessments can also serve to open up lines of communication and break down institutional barriers between water users, managers of facilities, government departments and non-government organizations working in the community.
- In turn, dialogue on the management of existing dams can improve confidence, trust and

stakeholder interest in planning exercises that concern new developments and water management strategies in the basin.

- Multi-stakeholder assessments of existing dams will not take place unless they are required in regulations or operating licenses of dams. Based on the experience in the CAP evaluation, DSI indicated that this type of exercise could be considered for other dams and basins in Turkey, but there was no legal requirement for such and would not likely occur unless actively pursued.
- The selection of consultants for periodic reviews and options assessments can be a concern to many stakeholders. Care must be taken to ensure that the study team supporting stakeholder-driven processes has a balanced perspective. This leads to greater public confidence in the process and its outcome.
- Stakeholders and governments are more comfortable interacting in a structured process, where studies are available to inform the debate that takes place, where there are rules of behavior for participants, and where the views and positions of all participants are respected.

# Zambia: Power Sector Environment Assessment Scoping and Reconnaisance Study and Power Rehabilitation Project

A World Bank Case Study

This case study illustrates how strategic and project-level options assessments and stakeholder involvement informed power sector rehabilitation initiatives in Zambia. Following a strategic environmental scoping assessment study (SEA), a "package" of technical efficiency, social rehabilitation, environment restoration, and dam safety measures were incorporated in the sector-wide rehabilitation project. Parallel steps were taken to improve capacities within the power utility (ZESCO) to adopt participatory planning processes and improve environment and socio-economic management of power facilities. Internal capacity was also strengthened to enable the utility to coordinate with the new regulatory bodies such as the National Environmental Agency, and with resource management organizations such as the Zimbabwe River Authority and Parks and Wildlife.

## What was the context?

Zambia derives most of its grid supply from hydropower. The largest electricity generation facilities are the Kafue Gorge power station (900 MW) on the Kafue River built in the 1960s, and the Kariba North power station (600 MW), that was added to the Kariba dam complex on the Zambezi River in 1976. While a large part of the Kariba North output was initially sold to Zimbabwe, Zambia was exporting power to Zimbabwe nominally surplus to its own needs, on a declining scale. By 1997, exports had declined to about 150 MW. Zambia recognized it would eventually need all its own generation for domestic supply, and new electrical supplies beyond that.

In mind of the long lead times to develop new grid supplies, Zambia began to look seriously at new hydropower options in the early 1990s. Zambia has limited coal reserves, and no gas or oil reserves. Demand for electricity services was growing in all sectors and improving the reliability of power supply was seen as essential to stimulate investment in the country's economic development. In reforms to industry, a key aim of government was to attract private capital into the mining sector. The copper industry alone accounted for 80 percent of Zambia's export earnings and close to 65 percent of total electricity consumption in the country.

| Chronology | |
|---|---|
| 1994 | New Energy Act and National Energy Policy |
| 1994 | GZR invites Bank support for Power Reform and Rehabilitation |
| 1995 | New Electricity Act |
| 1995 | Scoping SEA completed and dialogue multi-stakeholder national groups and donors initiated |
| 1996 | Project Preparation Starts |
| 1998 | Project Appraisal and Loan Approved |
| 2002 | Project Completion Scheduled |
| 2003 | Revised Completion Date |

The government (GRZ) was also aware that improvements in the efficiency and management of the existing power supply system could help avoid a short-term power deficit while new supply options with much longer lead times were pursued. The four-decade old power supply system needed extensive rehabilitation and modernization due to years of under-investment in maintenance. There had been no major World Bank or donor involvement in the power sector for 20 years, since Kariba North. The copper mines, the major client of the Zambian Electric Supply Corporation (ZESCO), were also increasingly concerned that the deteriorating supply system could lead to higher tariffs and undermine privatization of the sector.

In the mid 1990s, GRZ introduced a number of policy, institutional and regulatory reforms in the energy and power sectors (Energy Act-1994 and Electricity Act-1996). These initiatives aimed to improve public sector efficiency in the short-term, and encourage private investment in the longer-term. As a first step toward its commercialization, ZESCO signed a performance efficiency contract with the government requiring the utility to meet specified financial and technical efficiency targets. Electricity tariffs were also raised to cost recovery levels (about a 50 percent increase), though not for the mining sector.

Concurrently, new policies to expand rural, township, and urban electrification coverage were introduced. The improvement of distribution networks was regarded as a high social priority. Close to 72 percent of Zambia's

population of over 8.5 million people lived in urban, pari-urban and township areas poorly serviced by distribution networks. Overall, less than 10 percent of the population had access to electricity.

After introducing the sector reforms, the GRZ requested World Bank assistance in restructuring the power sector, with rehabilitation of the supply system a first priority. As an initial step in formulating a project, an environmental scoping SEA was completed in 1995. An action plan and reconnaissance level terms of reference for specific rehabilitation activities was produced. Full EAs were recommended for facilities where rehabilitation involved more complex social and environment management issues and tradeoffs. One specific recommendation was to rehabilitate the Gwembe-Tonga people. An estimated 57,000 of their people, 35,000 on the north bank of the Zambezi, which is now part of Zambia, had been forced to resettle when the Kariba dam and reservoir were established 40 years earlier between Northern and Southern Rhodesia during the colonial times, without adequate support for restoration of there livelihoods, and who remained in a state of deep poverty.[13]

Zambia was also in the initial stages of developing a new national environmental regulatory framework and water policy. The scoping SEA findings for the power sector were widely discussed among national agencies from all sectors, donors and local and international NGOs. This dialogue was timely as it helped to consider power sector initiatives in the context of other sector policies and initiatives, and it triggered a number of actions, including donor financial support for measures contained in the action plan.

Preparation studies leading to the project appraisal started in 1996. The physical components of the project were then separated into seven, economically distinct sub-projects for evaluation purposes. These involved three power stations (Kariba North Bank, Kafue Gorge and Victoria Falls); the main interconnected transmission system and three distribution networks, one in the capital city Lusaka, and two in mining townships in the Copperbelt (Ndola and Kitwe).

### What options assessments were carried out, and by whom?

Options assessments were carried out in the initial scoping SEA exercise and during the preparation studies leading to the project appraisal.

### Sector Environment Assessment Scoping and Reconnaissance Study (SEA)

The scoping SEA helped set the tone and strategic orientation for sector rehabilitation. It was prepared over 14 months by a small team of international consultants working with ZESCO counterparts. It did not bring new technical options to the table. Rather, it sought to improve the integration of environmental and social management elements with the physical and technical works, and identify the policy, procedural and institutional options to support this integration, both for the rehabilitation project and for future activities.

The concept of rehabilitation as an integrated package of technical, social and environmental measures to improve the overall development performance of power facilities was introduced at this time. This included looking at the rehabilitation priorities in a strategic context, a philosophy that was carried through to project preparation and implementation. For example, the scoping SEA reviewed the outcomes with past resettlement around power facilities and new resettlement with proposed hydropower projects. It found past resettlement from the Kariba dam to be the most critical resettlement issue that ZESCO faced, even though it inherited the legacy. ZESCO itself had no resettlement policy. Moreover, three of the medium-term hydropower projects under active study in Southern Province were also in the Tonga people's area (the Lower Kafue, Batoka Gorge, and the Itezhi-Tezhi). It was strategically important to resolve past problems where, apart from attending to an urgent development need for their people, it would improve confidence within communities and demonstrate to national stakeholders that equitable and fair treatment could be expected with any resettlement associated with new projects.

The Action Plan identified three overarching priorities, namely:

- to establish an Environment and Social Affairs Management Unit (ESU) in ZESCO to build internal capacity for environmental and social management;
- to develop in ZESCO a participatory consultation process to ensure involvement of all project-affected peoples and NGOs in project level activities and sector planning;
- to complete sub-basin environmental and social evaluations of major watersheds (e.g. the Kafue

13 World Commission on Dams, WCD Case Study of the Kariba Dam - Zambia and Zimbabwe, Final Report, November 2000.

and the Zambezi as major watersheds) where existing and proposed dams were located to determine environmental and social issues, and costs to bring into project management and planning.

To address continuing issues with past power sector projects in the sector rehabilitation, key recommendations included:

- A full EA and Environmental Assessment and Management Plan for the Victoria Falls Power Station Rehabilitation;
- Waste management plans for all power facilities, including the eradication of PCBs at generation and transmission stations, and
- A rehabilitation and development program for the Gwembe-Tonga people displaced by the Kariba dam in the late 1950's.

The Action Plan set out a number of specific steps to respond to new corporate responsibilities in environmental planning and management, for sectoral and cross-sectoral coordination in resource management and institutional capacity development.

## Options Assessments in the Project Preparation Phase (Studies)

The project preparation studies then built on the scoping SEA recommendations and the core physical rehabilitation options that were identified by GRZ and ZESCO. Additional technical options were also considered. For example, the possibility of raising the Itezhi-Tezhi dam and adding a second powerhouse was evaluated, but rejected on the basis of cost. Dam safety assessments for all dams over 15 meters were carried out, which led to the establishment of ongoing dam safety monitoring and training programs and development of emergency preparedness plans for the Kariba, Kafue and Itezi-Tehi dams.

The final selection of the seven main physical components of the project was informed by assessments made using accepted project economic, financial and risk analysis procedures. These included calculation of the percentage of net benefits of the total project directly going to lower income groups, assessed at nine percent. The impact of the rehabilitation options (i.e. improvements in power station output) on the cost and timing of new grid supply was assessed using generation optimization models and evaluating alterative generation expansion sequences. In all cases, the discounted costs of generation expansion decreased by five to ten percent with the inclusion of the rehabilitation components.

A distribution loss reduction sub-project was incorporated in the project for supply-side efficiency While a demand-side management program was considered, its scope was limited to training and capacity development in ZESCO. The poor financial state and imminent transfer of many industries to the private sector were cited as factors in this decision. The expansion of rural electrification networks (e.g., with grid extensions and off-grid supply with small-scale renewable options) was not included under the project because GRZ was separately raising funds for a major new rural electrification program, which set a goal of increasing rural access to 50 percent by the year 2010. Assessment of the alternatives within sub-projects was provided in the preparation studies. As recommended in the scoping SEA, two sub-projects required more substantive engagement of the local community, civil society and NGO stakeholders: Victoria Falls Power Station Rehabilitation EA and Gwembe-Tonga Rehabilitation and Development Program.

***Victoria Falls Power Station Rehabilitation EA***

The Victoria Falls powerhouse complex is located in the Mosi-Oa-Tunya National Park at Victoria Falls, which is a World Heritage Site. The powerhouse consisted of three stations with a combined capacity of 108 MW. ZESCO's initial thinking was to remove the smaller power station (8 MW) that had been built in the 1930's and rehabilitate the two larger power stations, and some stakeholders called for the removal of all.

A full EA was thus carried out to establish the rehabilitation options. Alternative refurbishment designs, operation strategies and environmental management plans for the site were evaluated. Meetings were then held with the local community, including tourist industry interests. The preferred option that emerged was to keep all three stations. The consensus view was to convert the small power station to smaller turbine units and develop it as a tourist visitor center and commercial opportunity to increase tourist revenue in the area.

***Gwembe-Tonga Rehabilitation and Development Program***

International anthropologists had undertaken a 40-year tracking study of the Gwembe-Tonga people displaced from the Kariba valley when the Kariba dam was built (1955-59). The availability of this unique data and associated studies provided valuable insights for the scoping SEA, and a baseline to prepare the rehabilitation program, which was to be implemented as a rural and regional development project. The University of Zambia was engaged to work with the communities to develop an Action Plan.

In discussion with the community leaders and local NGOs, options were selected in a beneficiary-driven manner. The main components were: rehabilitation and upgrading of 365 km of bottom road following the rim of Lake Kariba to connect three districts that had received resettled people; a local water resource program including groundwater wells and small dams to improve drinking water supply; land use improvement credits and agriculture extension activities for rainfed and irrigated agriculture, including cropping on the margins of the Kariba reservoir; health clinics and schools; and rural electrification starting with three larger villages (Chipepo, Gwembe Boma, and Sinazeze), and the area around the reservoir lakeshore.

### What further steps were taken to enhance stakeholders involvement in decisions on options and within-project alternatives?

Government and non-government stakeholders were consulted throughout the development of the Action Plan for the Scoping SEA. Similarly, when developing the reconnaissance terms of reference for rehabilitation works, members of the communities living around specific facilities were interviewed to obtain their views on the significant social and environmental rehabilitation issues they felt needed to be addressed ZESCO, supported by the government and the World Bank, then took a number of steps to encourage active stakeholder participation in the review of the scoping EA recommendations. This included setting up a web site to provide access to the scoping report, and holding consultation meetings and joint seminars with the government departments, donors and NGOs. Subsequently, during the project preparation phase, the Ministry of Energy and Water Development (MEWD) and ZESCO involved other sector agencies, academic institutions and nine other donors and, to a lesser extent, intermediary NGOs, representatives of affected community groups and local government in reviewing key elements of the rehabilitation project. Consultations were also held around specific initiatives. For example, ZESCO sponsored a workshop in Lusaka to draw on international, regional and Zambian experience in designing, implementing and operating township electrification programs and modalities for financing lost-cost distribution improvement projects. As part of the Victoria Falls Rehabilitation EA, consultation meetings hosted by ZESCO included tourism industry representatives, conservation groups and traditional rulers who led discussions and represented the public. The views expressed in this process provided the basis for deciding the power station rehabilitation options and operating strategies for the rehabilitated plant.

ZESCO set up a Project Management Unit in the area at Siavonga with other site offices for the Gwembe-Tonga project based on defined requirements of participants. The PMU reported to a steering committee chaired by the Permanent Secretary of the MEWD. This steering committee included elders and representatives of local communities and representatives of the other involved ministries (e.g. agriculture, health, transport), and local government. There were nevertheless concerns expressed and controversy over what was an appropriate composition of the steering committee and progress with the project.

### How did the options assessments and stakeholder involvement improve development outcomes?

The rehabilitation project is currently in the latter stages of implementation. The economic merits of rehabilitation as an option to improve power supply (in terms of power system economics) were borne out in the Project Appraisal. The total project investment of US$ 223 million had an ERR of 29%. Some components, such as the Kariba North station involving civil and electrical rehabilitation, had an ERR over 50%. There were other tangible benefits from improved supply reliability and the combined effect of the measures helped to avoid a short-term power deficit and contribute to investor confidence in the economy.

Involving stakeholders in the review of the scoping SEA also helped to confirm the appropriateness and acceptance of the steps contained in the Action Plan, simulate interest in the sub-projects, and pave the way for partnerships in the project, was eventually co-financed by the GRZ, the World Bank and nine other donors.

For ZESCO, the external linkages established during the scoping SEA between its newly forming environment group and the outside organizations were very important. This included new links with the Parks Department, the new Environment Department, and the hydrological unit in ZESCO.

The dialogue on the scoping SEA Action Plan contributed to a number of emerging national and donor supported initiatives concerning environment and water resource management in Zambia, particularly the regulatory, institutional and capacity building aspects. The dialogue among donors and international NGOs helped simulate interest, partnerships and investment by donors (e.g. CIDA, SIDA, NORAD, DANIDA) on follow-up to the basin planning recommendations. Today, donor co-funded

activities include a range of wetland conservation and resource utilization studies and databases to foster integrated water management of the Zambezi basin. While the scoping EA cannot claim any responsibility for these initiatives, the dialogue it spawned contributed to the consensus on how those programs moved ahead and brought ZESCO forward as a key player, essential in view of its dam portfolio and role in water management.

The engagement of stakeholders in each sub-project also helped ZESCO adopt more sustainable practices in managing power sector assets. For example, the stakeholder interactions during the Victoria Falls EA also helped ZESCO staff to look more broadly at power projects and led to joint discovery of three important perspectives that were new to them. The first was the rationale for integration of the community in development activities around power facilities. The second was inclusion of economic development aims outside of power economics through integration of tourism and heritage resources – essentially looking at the broader development effectiveness of the facility in its local context. The third achievement was to begin to develop greater appreciation and a more in-depth understanding within the utility of the complex mix of values associated with management of the Kafue River.

In this respect, it helped ZESCO start down the path of working with stakeholders in managing the environment and social impacts of its operations in the Kafue basin. For example, a warning system was installed for downstream fishermen when Itezhi-Tezhi was to be released. This helped to avoid loss of life and livelihood. The management of Kafue Gorge facility was modified to avoid flooding and economic hardship in the Kafue town district and contingency plans were established.

Although ZESCO adopted an environmental policy at the time that its Environment and Social Affairs Unit (ESU) was established, the company did not at that time adopt a parallel social policy on land acquisition and involuntary resettlement. Practices that were otherwise acceptable to international standards were slow to be codified in company policy.

The SEA recommendations did lead to addressing the social issues and resettlement with past projects. Nevertheless, the experience in implementing the Gwembe-Tonga project (ongoing) was mixed. Land mine clearing initially delayed the project start. And while many of sub-components identified by the beneficiaries are now underway, supported by a variety of international and local NGOs, other components are not, notably the rehabilitation of the Bottom Road, which was seen as fundamental to the sustainable economic development of the Gwembe Tonga. Apparent difficulties arose from the commercial nature of the lending for the road component through the South African Development Bank. ZESCO also felt that it inherited the consequences of improper resettlement from the pre-Zambia era, and while the road was also a commercial proposition, non-commercial funds were more appropriate. Along with slow progress there were additional concerns emerging over the arrangements for the longer-term funding and sustainability of the Gwembe-Tonga program, beyond the immediate rehabilitation with power sector funds.

### What lessons are offered?

- The Zambia experience indicates there is considerable scope for efficiency improvement in the generation, transmission and distribution components, particularly where regular investment in modernization has not occurred. Rehabilitation is an option that provides a high return on investment.
- Rehabilitation options are less controversial that new supply options and are supported by most stakeholders. The ability to replace or defer the need for new supply nevertheless needs to be made more explicit.
- A Sector EA (in this case a scoping and reconnaissance exercise) is valuable, low-cost management tool to identify rehabilitation opportunities and engage stakeholders in discussion of these priorities across the sector. It sets the stage for subsequent work, such as providing terms of reference for critical project-level assessments, and builds confidence for stakeholder engagement in designing these initiatives.
- Similar to any new development initiative, rehabilitation should be pursued as an integrated package of technical, social and environmental measures. Social and environment performance improvements can be successfully incorporated, along with dam safety, as a bundle of measures to improve all dimensions of the performance and to improve the development effectiveness of the facilities.
- As the road component of the Gwembe-Tonga project showed, difficulty can arise where commercial funding is allocated to the social rehabilitation components of power sector rehabilitation projects. In general, this needs to be anticipated and may be avoided by ensuring funds with the best terms are allocated to the social components. Similarly, the boundaries (and division of financial responsibility) between the power sector responsibility for social rehabilitation and ongoing regional development to sustain these initiatives need to be clearly defined.

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