

Huites irrigation project

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ABSTRACT

The case study presented here deals with a multiple purpose project for flood control, irrigation and generation of electricity. The project was evaluated within the legal framework of the environmental impact legislation enacted in 1988 and in response to specific guidelines for the water sector.

Construction of the dam and installation of the hydroelectric generating plant have since concluded. Feasibility studies for the works in the irrigation district are underway. The irrigation districts, as members of the private sector, will finance the project – a first in Mexico.

Many of the mitigating measures for the impacts identified in the natural and social environments have been implemented. The proposed follow-up and monitoring programme includes long-term activities including water quality analysis. The successful implementation of this programme will depend on the agreements among involved agencies.

INTRODUCTION

The Huites Irrigation Project centres around a conventional concrete gravity-flow storage dam, 162m high with a capacity of 4,023 million m³. Additional structures include diversion works, a spillway and a hydroelectric generation plant, as well as the main channels and the distribution networks in the irrigation district. The dam is located in north western Mexico in the states of Sonora and Sinaloa (fig.1).

The dam was designed to control floods by storing up to 1115 million m³ to protect 50,000ha of cropland, provide irrigation water to 70,000ha and 89,700ha in 1.28 cycles, and generate electricity at a rate of 875 kW.H/year with a minimum capacity of 400MW.

This project harnesses 95 per cent of the runoff from the watershed and provides virtually complete control of flooding.

The cost of the structure in 1992 was USD 212 million (Ps7.8: USD1). Construction began in that year with a record estimated completion time for the dam and the hydroelectric generating plant of 29 months.

The project was located in an agricultural region where storage and diversion dams, irrigation districts and hydroelectric plants were present.

See Topic 7

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*Mitigation and
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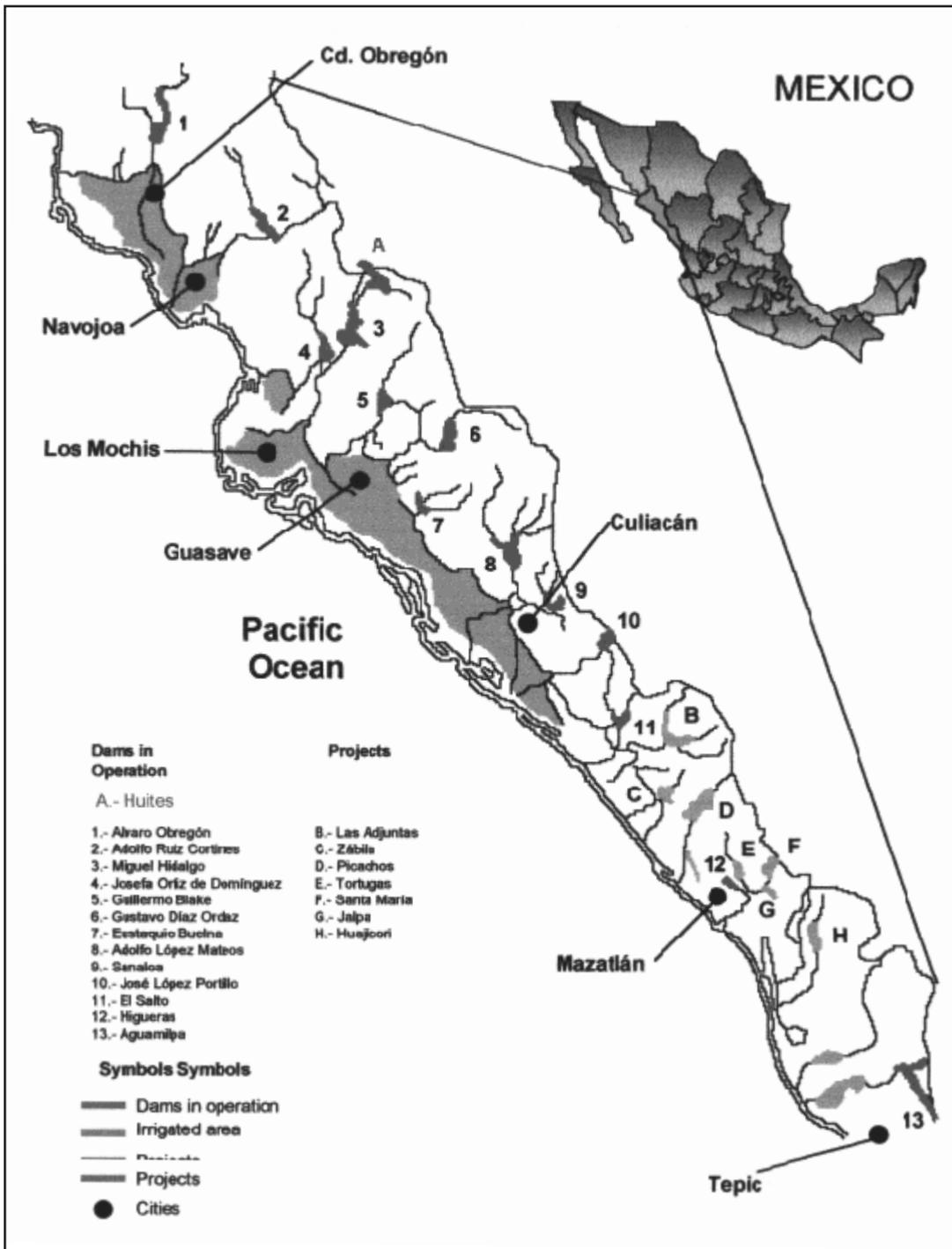


Figure 1: Project location

The Huites Dam, upstream of the existing dams, provided flood control for the runoff from the thawing snow, an enlargement of the irrigation districts and an additional source of electricity. The regional crops are wheat, soybean, sorghum, rice, safflower, maize, dry beans estimated to increase to 386 000 tonnes with a value of 250 000 million Mexican pesos that would benefit 6650 families in six municipalities in the adjoining states of Sonora and Sinaloa. Domestic consumption was to account for 68 per cent of the production and export, 32 per cent.

Irrigated agriculture in the north west provides 30 per cent of all the nation's production. This proportion would rise with the implementation of the Huites project to reach 65 per cent of the estimated potential crop area in the zone.

The project influence area is around 73 902ha of which 20 023ha (27.09%) are cropped, 1140ha (1.55%) are used for animal husbandry, 44 290ha (59.93%) are forestry areas, 1278ha (1.78%) are being cleared and 3269ha (4.42%) lie fallow. Urban centres occupy 405ha (0.55%) and hills account for 3497ha (4.73%).

The major negative impacts identified were related to the flooding of 9457ha (maximum extraordinary water level of 288.43), part of which was low deciduous forest that was the property of nine ejidos (4924ha), private parties (2050ha) and the federal government.

Other negative impacts were related to changes in soil use, hydrology and ownership, the loss of habitats for the terrestrial and aquatic fauna, and the relocation of fourteen communities with a total of 1130 inhabitants according to the 1990 census (INEGI, 1990).

NATURE AND SCOPE OF ISSUES

The technical studies for the design of this project were started in 1991 by the Hydraulic Resources Secretariat. It was initially conceived as part of a regional development plan, the Northwestern Interconnected Water Plan and later the Northwestern Interconnected Water System (SHINO), that joins watersheds through storage, deviation, conveyance and distribution works in Nayarit, Sinaloa and Sonora.

The Environmental Impact Statement was prepared in 1992, after considering the guidelines established in the regulations concerning environmental impact of the Ecological Equilibrium and Environmental Protection Law and the Cooperation Agreement between the National Ecological Institute (INK) and the National Water Commission (CNA) (INE-CNA, 1991). The CNA, in accordance with the requirements of its projects, adopted and complemented the guidelines to fulfil the requirements of the Environmental Impact Statement.

During the execution of the screening procedure proposed by the CNA, the need to prepare an Environmental Impact Statement tailored to the project

was recognized. For this purpose, the CNA hired Construcciones y Estudios, S.A., duly registered as an environmental impact consultant with the National Ecology Institute, as required under law.

In accordance with the environmental impact regulations of the Ecological Equilibrium and Environmental Protection Law (1988-1996) and the modifications proposed by the CNA, the evaluation included:

- general information about the proposing party, the project and consultants;
- a description of all phases of the project or activity;
- a description of the environment before the execution of the project;
- an analysis of the environmental parameters at present and in the future;
- identification and evaluation of the environmental impacts of each phase;
- evaluation of the modified environmental scenario;
- prevention and mitigation measures for the environmental impacts identified;
- conclusions and recommendations;
- references,
- a list of participants including professional resumes; and
- appendices.

The appendices contained a detailed description of the methods used to study each parameter (water, flora, fauna, socioeconomic aspects, etc.), and the results of the samples and design calculations, and work schedule.

One of the difficulties of the project was the wide zone of influence, including the Fuerte River basin, its tributaries, dams, irrigation districts and a projection on the Pacific coastal region, approximately 220km from the project site. The diagnosis, and the identification and evaluation of the impacts were focused on the storage area and works, and the region downstream to the coast. The reconciliation of interests of the investors was another obstacle. The participation in the project financing was 51.5 per cent from the region's irrigation districts; 22.8 per cent from state funds, and 25.7 per cent from federal funding through the National Water Commission. The federal government agreed to build the storage dam and the hydroelectric generating plant, while the growers, with the support of the state governments, promised to build the irrigation facilities.

The National Water Commission and the Federal Electricity Commission (CFE) have not completely defined the terms of transfer of the dam electric generating plant nor the responsibility for the long-term mitigation and monitoring activities.

Irregularities in land possession have arisen during the process. Proposals were made to redefine the property limits with the participation of the Agrarian Reform Secretariat and the Agrarian Attorney-General's Office. The area destined for the dam was duly expropriated and compensation paid. The information concerning the communities cited in the environmental impact statement and used to estimate the number of dwellings required for the relocation of the families was taken from the 1990 census. The mitigating measures included the recommendation to prepare a specific census of the families to be relocated, the property to be compensated and the individual preferences as to sites and means of compensation.

PROCESS AND PROCEDURAL CONTEXT

The procedure to evaluate projects of this nature, as specified in the Environmental Impact Regulation, is summarized in Figure 2. A basic requirement is that no portion of an ecological reserve be included in a project.

During the 1992 evaluation, this project formed part of the objective proposed by the Sinaloa State Urban Development Plan and the State and Local Ecological Development Plans.

The method used to identify and evaluate the impacts was developed by the Environmental Impacts of Irrigation and Drainage group and published in 1986 by the International Commission of Irrigation and Drainage (ICID). In it *ad hoc* techniques are used for the development of each phase. A check list of the major environmental components and a data list to identify the activities that will cause these effects were developed. These two elements, combined in an interaction matrix, serve to identify and rank the effects based on reversibility, duration, geographic area and direct or indirect relation to the activities.

Once the environmental impact statement has been drafted, it is reviewed by the National Institute of Ecology (INE). The INE has 90 days to authorize, impose conditions or reject the project. A project of this nature usually receives a conditioned acceptance. In this case, because of a shortage of qualified personnel, the INE required more time for the review. Under an inter-institutional agreement, the CNA and CFE sent staff to assist the INE.

The INE sent its decision after the project had started and gave conditional approval to compliance with the proposed mitigating measures. The decision included other measures including the control of the storage, handling and transport of explosives, an archeological study of the region, training in the use of agrochemical and pesticides and in industrial safety.

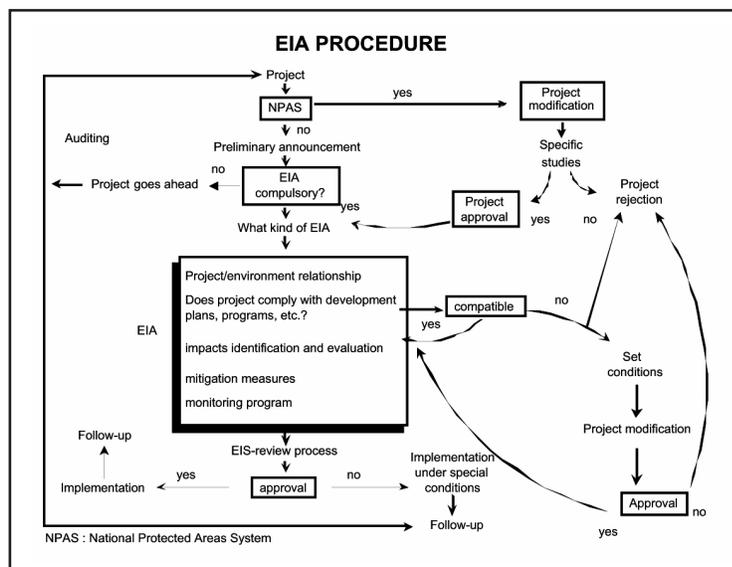


Figure 2: EIA procedures as specified by the Environmental Impact Regulation

APPROACH

The bibliographic and cartographic information for the diagnosis of soil use, vegetation and geology was obtained from the National Institute of Statistics, Geography and Census (INEGI). This data, which is generally more than 20 years old, was updated from aerial photos.

Population, dwelling and agricultural census data from 1990 were also provided by the INEGI. Economically active population, age pyramid, economic activities, educational level, public health, public services and number of persons that speak dialects were other socioeconomic parameters taken into consideration. This information was compiled through communication strategies and negotiations with the affected communities.

The project permit included the CNA's recommendation for specific field and laboratory studies to determine water quality, agrochemical and pesticide pollutant concentrations, and inventories and classification by importance of the aquatic and terrestrial communities.

The process was divided to correspond to site preparation and construction, creation of irrigation districts, dam operation and expansion of the excavation and removal of soil, road construction, creation of drains, headwork, etc.

A wide range of criteria were used relating to hydrology, pollution, soils, sediments, biology, socio-economics, health and ecological imbalances. For example, hydrology considered dry and rainy seasons, hydric balance, and extraction and waterlogging. The socioeconomic component evaluated

changes in income and social well-being, migration, relocation, participation by gender, ethnic and minority groups, the presence of historic sites and regional effects.

To rank the impacts, certain conditions and characteristics were assumed and described with respect to conservation of the environment to interpret the impact that had been identified.

The positive and negative environmental effects were compared, in the presence and absence of the project over 10 years. This period allowed for the inclusion of a large part of the impacts after initiation of operations. With the use of a scale from 1 (favourable) to 8 (unfavourable), large numerical values were associated with predominantly negative impacts.

The evaluation indicated that the region in the absence of the project would suffer significant changes, while the project would occasion only minor changes because dams were already present on the river, and the benefits were greater than the drawbacks, taking into consideration the mitigating measures.

The description of the proposed modified environmental scenario served to portray the conditions and characteristics of the landscape, climate, soils, erosion, and water flow downstream of the dam system, changes in the coastal regions resulting from modifications in the frequency of the runoff, alterations in the aquatic and terrestrial flora and fauna, and the proliferation of species adapted to the new ecosystems.

The economic benefits included strengthening of the existing ejidos and irrigation districts, with little immigration to the zone, and improved living standards for all, especially for the relocated families who would have better housing and public services.

In general, the mitigating measures included

- relocation of communities, with census and surveys to determine preferences for compensation and replacement of housing and services;
- efficient water use to maintain the water levels needed for agriculture and the aquatic fauna in the lagoons;
- soil reclamation, including control of salinity and pollution by agrochemicals and pesticides;
- rescue and conservation of genetic information of the local fauna for relocation to previously-defined sites and the rescue from islands formed in the dam;
- reforestation to reduce erosion and dispersion of agrochemicals, and to create new habitats;
- deforestation of the floor of the dam (5000 ha), and the use of the greatest part of the cut trees; and

- ecological monitoring to study the recovery mechanisms, control the entry of pollutants, and protect natural resources and public health.

The estimated cost of the mitigating measures was 9.6 per cent of the total project budget.

RESULTS AND IMPLICATIONS

When the construction of the dam concluded in 1995, personnel from the CAN and the Federal Environmental Protection Attorney General's office (PROFEPA) visited the site, from the entry to the reservoir to the dam, and graded areas to verify compliance with the mitigating measures.

Due to the shortage of personnel in the recently-created PROFEPA, and the then undefined responsibilities at the federal and state levels, guidelines for the inspection were not available. However, the CNA had transmitted quarterly reports to the INK for follow-up and discharge of the mitigating measures during construction time.

For the relocation of the communities, representatives, including ejido presidents and others named by the communities, participated in the negotiations with the authorities at 150 formal assemblies. As a result, the compensation for land and structures including homes, schools, tick control stations, churches, warehouses, fencing, and orchards was agreed upon. Specifically, the head of the household received a sum corresponding to that required for him to rebuild his home based on the number of inhabitants (four to six and more than six). Some families preferred cash settlements for the value of their home. In total, 323 dwellings were built by the heads of families.

The families were relocated in Choix, municipality of El Fuerte, where other members of the Yaqui ethnic group were living. Only four families refused to move to the selected site due to, in their words, greater expenses arising from participation in the electricity and water distribution systems. This group was relocated above the extraordinary maximum water level.

Other improvements included the building of six primary schools, two preschools, a church, roads between the communities, the planting of orchards and placing of fences; the latter two were paid for in cash based on the assessments of the National Assessment Commission. Reservoir deforestation of portion of the 6250ha required for the dam produced the boards used for fence construction in the relocated ejidos.

The relocation of the communities to a new environment resulted in a partial decentralization as witnessed by a loss of values and customs, already on the wane, in the existing ethnic group. A new cemetery was established. The remains of existing burials were left in the old one.

Other mitigating measures included the creation of terraces with the excavated soil and reforestation to prevent erosion. By December 1995, 3755

trees of six different species were planted along the dam and in the civic area.

Efforts to locate and rescue archeological ruins produced nothing and this phase of the programme was cancelled. The flora rescue programme was also cancelled when it was found that none of the species were in danger of extinction.

Local labour was used for the construction of the dam and most of the other activities described. According to the work schedule, up to 3500 workers, with differing levels of skills, were hired.

The ecological monitoring to be carried out by the CNA for water quality has continued. However, the effects on the coast have not been evaluated.

LESSONS LEARNED

The INK environmental impact statement review process is improving although, for this project, the permit to begin work and the identification of mitigating measures were not received at the same time. The follow-up of the project did not start with the project. Due to a lack of specific information, and local and regional quantitative indicators, the Environmental Impact Statement was more descriptive than quantitative and analytical from the diagnosis, the projections, the impact evaluation to the proposal of the mitigating measures.

The use of different classifications and standards, for example of soil, water quality, and species abundance and diversity, made comparison of the magnitude and importance of the resources and possible impacts difficult.

There is a marked need to reduce, among the communities to be relocated, speculation that may result in mismanagement of compensation. The communities should be invited to participate early in the environmental evaluation of the project to evaluate with better precision the costs of the impacts and mitigating measures that directly affect them. In this project, these aspects were considered later on and not defined until agreements were reached with the communities.

A clear idea must be obtained of the social aspects of each group affected and benefited, directly or indirectly.

The participation of state and federal institutions resulted in new programmes for use of the dam, including seeding with fishes and other alternatives for production, and the creation of programmes to stimulate the participation of women in the irrigation districts.

The communities involved in the process should be encouraged to participate in its organization to develop their own programmes and prevent manipulation by outside influences.

Precise information should be used to identify the combination of effects and evaluate the residual and cumulative impacts.

The estimated costs for the mitigating measures, such as deforestation, reforestation, relocation and compensation, are often much lower than the real costs. As much data as possible should be compiled to increase the precision of the estimate.

Post-project environmental monitoring should be considered as part of the project with a budget for short, medium and long-term studies.

Although there have been previous experiences with projects of this nature, they have not been compiled to create specific terms of reference for the scope of the environmental assessments nor entered into data bases to serve as a learning experience.

LIST OF RELEVANT PUBLISHED PAPERS OR OTHER SOURCE MATERIAL

CNA 1992, Environmental Impact Statements, The Huites Hydroagricultural Project, Sonora-Sinaloa, Mexico (sp) INE-SEMARNAP. 3 Volumes

CNA-INE 1989, Basis for cooperation in environmental impact assessment (sp) Mexico. Unpublished document.

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