Environmental Sustainability of Water Management in Mexico

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P R E F A C E

Sustainable development for water resources management is an important but very broad and complex issue. The conditions and requirements for its achievement could vary from country to country: it depends on factors such as geographical conditions, socio-economic issues, regional practices, institutional arrangements, legal frameworks and cultural background. In the case of Mexico, the sustainable development for water resources planning and management cannot be ensured without a comprehensive analysis of both the legislative and legislative frameworks. The regional development of the country, which to a significant extent can be triggered by efficient water resources management, would undoubtedly be dependent on the modification of the weaknesses and contradictions in the existing policies, laws and regulations, and their implementation.

It should be noted that Mexico is well ahead of many developed and developing countries in many ways, especially in terms of the number of water projects constructed, successful transfer of irrigation districts and development of informal markets of groundwater. Even though it has made significant progress in terms of formulating environmental policies, it still faces many economic and social problems of developing countries, as well as those related to a newly industrialised country. Environmental degradation is one of these main concerns. The deterioration of the natural resources of the country, water resources being one of them due to improper management, is not improving the life-styles of the vast majority of the population in any significant way. Accordingly, extensive modifications in the planning and management processes, including consideration of environmental and social factors and stakeholders participation, are urgently needed for the water sector.

Various international institutions have carried out reviews of environmental management of water resources in Mexico. For example, in 1998, OECD published an Environmental Performance Review of the country. Even though the overall panorama it presents is not very far from the truth, the analyses suffer from almost near-total reliance on official figures and statistics. Accordingly, the report contains numerous inaccurate “facts”, and many of its conclusions are clearly misleading at best, and erroneous at worst. The various reports the World Bank has produced in recent years on the sustainable development of the water sector have identified inadequate consideration of environmental and social issues in the formulation of national water strategies and action plans to be a main constraint to integrated water resources development.

Mexico has for several years been one of the main borrowers of the World Bank. The Bank has instituted a wide range of environmental and social reforms mainly in response to international pressure from donor governments. This changes are part of an evolving broader international approach to sustainable development. In the case of Mexico, the loans of the Bank changed from structural adjustment, economic liberalization and infrastructure development in the 1980s, to anti-poverty and environmental projects in the 1990s.

The present report on the *Environmental Sustainability of Water Management in Mexico* is the result of an in-depth analysis of the water resources management practices in Mexico. It focuses on the consideration of environmental and social factors within the existing legislative and institutional frameworks, policies and strategies, and how these are being actually implemented. The study encompasses an extensive review of the Environmental Impact Statements that have been prepared by the private sector consultants for the water authority of the country, the National Water Commission of Mexico. The study primarily analyses the environmental and social considerations that are currently being taken into account during the planning and construction phases of the water projects in Mexico. The strengths and weaknesses of all these analyses are also discussed in detail.

To the best of my knowledge, no such comprehensive analysis of the environmental assessments of water projects has ever been carried out for any developing country. This detailed analysis should enable the water authorities to identify the main problems in the processes, legislation and practices, which ensure that the entire environmental assessment and management process for water projects in Mexico is non-functional at present. Wherever possible, alternatives have also been proposed, which should significantly improve the existing environmental management process in Mexico.

As we enter the 21st century, national policies in all areas should be finalised only after extensive consultations and discussions within the civil society. Sustainability of water projects should not be an exception.

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I. INTRODUCTION

Mexico is a country with an approximate area of two million square kilometres and a population of over 95 million (World Bank, 1999). The development pattern is inversely related to its water availability. Less than one-third of the country´s water is found within the 75% of the territory in which most of the large cities, industrial facilities and irrigated lands are located.

Mexico is the seventh country in the world in terms of the number of water projects constructed for irrigation purposes. There are 130 large dams, more than 1,200 medium-size dams, 1,090 diversion dams, 77 thousand deep wells, 68 thousand km of canals, 47 thousand km of drains, and 54 thousand km of roads. One of the main achievements of the water sector is increases in water supply distribution and sanitation services of a higher percentage growth rates compared to increases in population. In addition, through the National Programme on Clean Water, it has been possible to control the number of cases of cholera in the country during the last 10 years, in both rural and urban areas. Granting of water use concessions and wastewater discharge permits is regulated, as are the users rights and obligations. A public registry of water rights is being established to ensure legal certainty of water rights, and to promote water markets. In the rural sector, by mid-1996, the Mexican government, through the National Water Commission of Mexico (Comisión Nacional del Agua, CNA) had transferred more than 86% of the 3.3 million ha of publicly irrigated land in the country to joint management.

In spite of these efforts, overpumping of aquifers, expensive river basin transfers to meet increasing water demands of the urban areas, and conflicts among competing users have increased over the past fifteen years, with consequent serious economic, political, environmental and social impacts. The demand for water resources in Mexico has been on a continuous upward trend during the recent decades because of the twin pressures of population growth and increasing per capita demand. The current population in Mexico is estimated to increase by more than 2-fold by the time the country reaches a hypothetically stationary population by the middle of the 21st century (Castelán, 2000). Average population density in Mexico is 49.3 persons/km^2. Almost half of the population lives in Central Mexico, and about one-quarter of the population lives in rural areas.

Equally, as more and more people reach higher standards of living, their per capita water demand is expected to increase as well. Hence, the most important water challenge facing the country in the 21st century would be how to provide the right quantity and quality of water for all different types of water uses for an ever increasing population in a sustainable and cost-effective manner. The quantity of freshwater in Mexico that can be used at any given time is limited due to economic and technological reasons. It is now evident that nearly all the easily exploitable sources of water in the water deficit regions of the country have already been developed, or are in the process of development. This means the costs of development of each new additional sources of water is likely to be significantly higher in real terms in the future, compared to what have been observed in the past. A recent review of the domestic water supply projects carried out by the World Bank, which included a project for the Mexico City, indicated that the cost of development of each cubic metre of water for the next generation of projects is likely to be 1.75 times, and in many cases even three times higher than that of the present generation (World Bank, 1998). Thus, adequate quantities of clean water will only be available in the country in the future at a much higher unit costs than estimated at present.

Since water projects are highly capital intensive, and environmental issues have become increasingly critical requirements for obtaining loans from the development banks, Mexico must give priority considerations to these factors in order to continue receiving the necessary loans for future water projects. It is no longer adequate to ensure a project is technically feasible and that the total benefits exceed total costs so that necessary loans can be obtained from the major financial institutions. Unquestionably, environment has now become an

integral component of the international political agenda, and accordingly environmental feasibility of a project is now as important as the other two techno-economical factors (CNA, 1996a).

On a national level, total water abstraction has reached about 186,000 million m^3 per year, which accounts for 43% of the country´s renewable water resources. The total consumption represents only 15% of the total renewable water. The national water balance however, does not reflect the pressing problems affecting a large proportion of the country´s aquifers and river basins. Regional water balances in over half of the country show considerable deficits, indicating high degree of groundwater mining, as well as the increasing problem of water pollution. Although excessive concentration of population and economic activities in few selected urban areas are important factors which are contributing to these unbalances, it is unquestionable that many problems are due to management inefficiencies (INEGI, 1997).

According to the IV Report of the President of Mexico to the Country, 1st December 1998 (www. gobernación.gob.mx), by 1998, 86.5% of the population in the country had access to clean drinking water and 73% to sanitation facilities. These figures represent an increase of services to 2 and 1.6 million people more compared to 1997.

Table 1. Drinking water availability and sanitation facilities, 1997-1998*.

	1997 p/	1998 e/	Var. %
Drinking water			
National	80.9	82.9	2.5
– Urban areas 1/	65.1	66.6	2.3
– Rural areas 2/	15.8	16.3	3.2
Sanitation facilities			
National	68.3	69.9	2.3
– Urban areas 1/	60.5	61.5	1.6
– Rural areas 2/	7.8	8.4	7.7

1/ Cities with more than 2,500 people.
2/ Cities with less than 2,500 people.
p/ Preliminary figures.
e/ Estimated figures.
* The figures are given in millions.
Source: SEMARNAP/CNA, 1996.

In 1989, the CNA was created by a Presidential Decree as the sole federal authority dealing with water management as an autonomous agency attached then to the Ministry of Agriculture and Water Resources. In 1994, CNA was relocated from the earlier Agriculture and Water Resources Ministry to the Ministry of Environment, Natural Resources and Fisheries (SEMARNAP). The CNA claims that the Mexican water policies and strategies are consistent with the principles of the Dublin Statements, and those established in the Earth Summit held in Rio de Janeiro in 1992. However, even though these meetings created a momentum, the truth is that they are not properly reflected in the management and planning of water resources development not only in Mexico, but in many countries in Latin America.

From an environmental viewpoint, the main national concern is the highly contaminated river basins. Of 314 national basins, only 218 have been studied at some depth. These 218 basins represent 77% of the territory and account for 93% of the population. More than 70% of the industry and 98% of the irrigated lands are located within these areas. The 1994 study of the CNA on water quality in these 218 basins, indicated that most of them are at present contaminated with organic, industrial, and/or agrochemical wastes (CNA, 1994). Groundwater quality is very variable within the country. In many areas, it is contaminated by arsenic or arsenic salts and the leachates from solid wastes and wastewater. Chromium and boron are also

problems in certain groundwater zones, as are the residues from pesticide and fertiliser users. The major groundwater problem is the over-exploitation of the aquifers (Garcés-Restrepo, et. al, 1997).

Water contamination has very severe public health impacts in Mexico. The health effects associated with gastro-intestinal diseases only are estimated to cost US $3,600 million, and it is currently the most serious environmental health problem of the country (Saade, 1997). The gastro-enteric diseases, which result from the consumption of polluted water, represent the second major cause for child mortality (278 per 100,000) in the country (UNAM, 1997; National Research Council et al., 1995). Cholera re-emerged in Mexico in 1991, and 3,000 cases were noted in 17 states. In subsequent years about 200 deaths have been reported annually due to cholera. In 1996, the number of cases dropped as a result of a large-scale programme of chlorination of drinking water.

The agricultural area of the country is estimated to be about 20 million ha, approximately 6.2 million ha of which are under irrigation. Irrigation is mostly gravity-based, with large schemes developed around storage reservoirs. About 3.3 million ha belong to 80 irrigation districts and 2.9 million ha to more than 20,000 medium- and small-size irrigation units. Agriculture accounts for 8.5% of the GDP and employs 28% of the economically active population. Irrigation accounts for 55% of the national agricultural production and 70% of the agricultural exports. The 30% of the cropland under irrigation supports 15% of the country´s farmers The main irrigated crops are maize (24%), wheat (20%) and sorghum and soya (9%) (Garcés-Restrepo, et. al. 1997; Johnson, 1997).

The lack of investment in drainage infrastructure is contributing to rising water tables and salinity problems in approximately 10% of the irrigated lands. Point and non-point sources of wastewater discharges from urban and industrial areas, and agricultural activities are putting heavy stress on aquatic ecosystems. There are 137 coastal lagoons in Mexico with a high ecological sensitivity, but the rivers flowing into them contain high levels of pollution. The presence of faecal coliforms makes many lagoons unsuitable for contact recreation. Aquatic weeds currently cover about 680 km^2 in 268 lakes and reservoirs, 10,000 km of canals and 14,000 km of drains.

The inefficient use of water in the agricultural sector represents over 80% of the total national consumption. The inefficiency and wastage in both agricultural and domestic sectors are having adverse impacts on the country´s groundwater. The levels of contamination are due to discharges of municipal, industrial and agricultural contamination, and are increasing steadily. The losses in the municipal water distribution systems in the country are generally higher than 40%, and the amount of wastewater properly treated is still very low (about 7%).

The demand for water has exceeded the surface and groundwater that can be sustainably abstracted in numerous areas. This has produced hydro-ecological imbalances due to the overexploitation of aquifers and reuse of untreated or partially treated water, and pollution-related problems (Escamilla & Kurtycz, 1995). Beyond the technical and legal solutions required to solve the conflicts that arise between the various users (Naranjo & Biswas, 1997), the users themselves must contribute to the development of alternative solutions. To optimise this self-help mechanisms, the work must advance with systematic evaluations in order to provide feedback on what has been achieved and/or what is feasible. Sustainable development needs more than an environmental policy: a concerted effort by all the concerned parties is necessary within the context of overall policies.

In recent years, many Mexican institutions have adopted environmental policies. However, their implementation leaves much to be desired. The institutions need to clearly recognise that development and environment are part of an integrated process, which is affected by the extent and type of past economic and demographic growths, and at the same time closely linked to future world economic development and population growth (Urquidi, 1996). It is essential that the environment be given high priority at the highest levels of the governments so that appropriate authorities can successfully coordinate their programmes and

actions, both within the public sector as well as between the public and the private sectors. Isolated actions with no clear policy framework are not likely to result in any tangible results in the medium to long terms. However, government actions by themselves will not be enough: society in general, and NGOs and the media in particular need to be involved as well (Biswas, 1997a).

There is an urgent need for a more integral approach for managing the small- and medium-size enterprises in terms of their environmental impacts. It has been a most difficult task to design and successfully implement environmental protection measures for medium- to small-scale industries all over the developing world. Mexico is likely to be no exception. Accordingly, both private and governmental sectors should develop and implement joint programmes for these purposes.

Environmental policies should consider the challenges imposed by economic globalisation, the need for development, and employment generation, as well as the need and demand for sustainable development (INE, 1994). Such policies should be linked to the changes in lifestyles, and simultaneously to the societal preferences and needs for the sustainability and economic growth. On the basis of information available at present, those developing countries that have strict environmental policies and laws have generally failed to implement them. Economic and trade issues need to be specifically considered. In most cases, actions related to environmental protection strategies require both substantial large investments and changes in the lifestyles of the people. Assuming both these factors can be handled simultaneously, they will contribute to improvements in both environmental quality and higher living standards.

Regional economic distribution within the country should be a long-term objective, as well as the impacts of the environmental policies which should consider the carrying capacity of the ecosystems. Therefore, medium- and long-term planning programmes should be regularly reviewed, updated and strengthened. Even though appropriate legislation is a fundamental requirement, it will not generate sufficient conditions for the protection and restoration of the environment.

Sustainable development demands a clear understanding of the interactions between economic, social and natural systems so that efficient and timely decisions can be taken which would affect both the environment and social welfare on a long term. Consideration of only efficient technologies, production and consumption processes will not contribute to the long-term process of sustainable development. Information, education, research and socio-cultural factors are equally important elements since they often contribute to the emergence of new attitudes and participatory behaviour from the society as a whole.

II. ISSUES FOR ENVIRONMENTAL SUSTAINABILITY FOR THE WATER SECTOR

According to the 1994-1995 and 1995-1996 Annual Reports of SEMARNAP (SEMARNAP, 1995, 1996), Mexico has witnessed an intense process of economic development during the past decades, but this has not been matched the needed realisation that economic development cannot be sustained over the long-term without appropriate environmental safeguards. Not surprisingly, the country now has a very deficient environmental control process. Increases in population, fragmented and inappropriate national policies, and industrial development patterns and other associated factors have promoted an irreversible urbanisation process which, due to historical and institutional reasons, has contributed to the development of homologous centres of population and economic activities. These urban centres are now directly contributing to serious environmental problems. These environmental problems can be resolved only if the policy makers become aware of the critical importance of considering environmental factors in sustaining the water development process of the country, and then formulate and implement appropriate policy decisions. Such a necessary and enlightened approach for the most part is missing at present. Furthermore, it would require determined collective efforts by the Government, private sector and the civil society as a whole, which is also mostly absent at present.

According to the report of the National Institute of Ecology, (INE, no date), on April 28, 1992, the Federal Government signed a loan agreement with the World Bank to design and implement an environmental programme for Mexico, which would be executed by the Ministry of Social Development. The total cost of the project was US $88 millions, of which 50% represented a loan from the World Bank. The objectives of this programme were: i) to improve the capacity to implement actions on environmental protection and protection of natural resources (short-term); and ii) to promote capacity building of the institutions and the development of policies which could meet the same national objectives more efficiently (long-term).

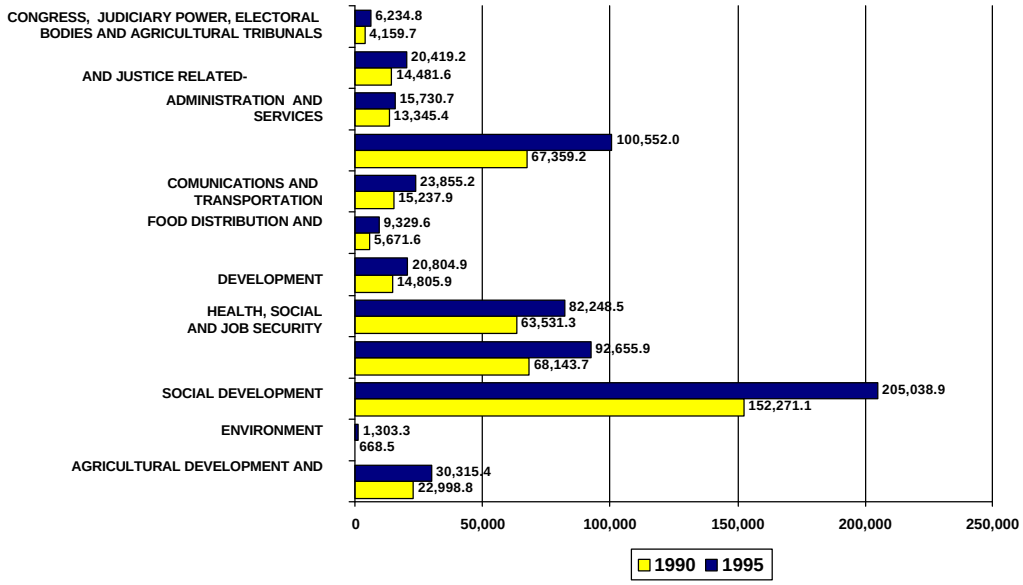
On the same date, the Federal Government signed another agreement with the Global Environmental Facility (GEF) for a grant, which would also be executed by the Ministry of Social Development. This grant was expected to assist Mexico in implementing environmental emergency plans to develop and to implement management plans for 10 protected areas in the country, as well as to develop strategies for eco-tourism.

In 1993, Mexico devoted 1.7% of total government R&D spending to pollution abatement and control. In 1996, the Federal Government spent nearly $ 17 million on environment-related scientific and technological activities. In fact, Mexico´s overall research and development expenditure is very small in both absolute terms ($17 per capita) and relative terms (0.25 % of GDP in 1993). Most of this spending is by the Federal Government (73%). Overall expenditure by the private sector amounted to little more than 10% of that of the public sector, equivalent to 0.03% of the industry´s share of GDP. Private R&D expenditures in basic science has decreased while spending on technology has risen in line with growing interest in cleaner production and finding ways to boost productivity. Private enterprises support 23% of the R&D expenditure aimed at modernising industry, particularly in petrochemicals, chemicals, steel and communications. Private sector collaborated with universities or research organisations only on very specific projects (OECD, 1998).

The figure 1 shows the investment of the public sector in 1990 and 1995 in Mexico. While social development invested more than 200,000 million pesos in 1995, environmental-related activities were benefited

only with 1.3 million pesos. The sources do not specify which social development or environmental programmes have been supported economically with public funds. However, no sustainable social development can be achieved if the environment where the populations live is not preserved.

Figure 1. Investment of the Public Sector (1990 and 1995)*



Source: INEGI. (1998). ***Anuario Estadístico de los Estados Unidos Mexicanos 1997***. Instituto Nacional de Estadística, Geografía e Informática. México, D.F. pp. 519 - 520.

* The data are given in million pesos.

rogrammes in Mexico have been developed over the years in the past mostly in a totally *-hoc* -exploited aquifers; water quality improvement programmes; wastewater surveillance activities; aquatic weed control; and the establishment of coordination agreements between users, and state and Federal authorities for regional problems. However, for all practical purposes, these are grammes that have neither been planned with proper technical, economic, social and environmental considerations, nor have serious attempts been made to implement adequately the

ve plans, or even because of them, it has to be admitted that the overall result thus far has been one of giving primarily lip service to the environmental management of the water sector. in appropriate institutions have basically been insignificant. With very few exceptions, the senior management of CNA has not considered -term sustainability of the water projects. has failed thus far to develop any comprehensive environmental policy or strategy for the water sector. In fact, the main constraints for the proper implementation of the Water Resources rogrammes on water conservation in Mexico, is the absence of an overall strategy for sustainable water resources management in Mexico, as well

environmental sustainability, water quality management, environmental impact assessment, and other

Traditionally, increasing water demands in Mexico have been met mainly through the construction of new infrastructures. No definitive considerations have been given to concerns such as water scarcity and the increasing costs of supplying it. Issues like consumption patterns and efficiency of existing water use practices have not been taken into consideration both in planning and management of water resources. Demand management through appropriate water pricing has been basically ignored.

INSTITUTIONAL DEVELOPMENT

Mexico has a long history of water management that goes back thousands of years. However, in modern times, the institutional development of the country started with the first River Basin Commissions, which were established at the end of the 1940´s and the beginning of the 1950´s, with the objective of starting regional development programmes sustained by water-related projects. Later, in the early 1960´s, large-scale rehabilitation projects were supported in order to increase productivity in the existing irrigation districts. The plans for large river basin transfer were developed to expand irrigated land in the north-west of the country, as well as to ensure a source for future water supply to Mexico City´s Metropolitan Area (Herrera, 1997).

The National Water Master Plan (NWMP) was developed in 1975 based on alternative socio-economic scenarios for the planning horizon 1975/2000. Three alternative scenarios were developed. They included political aspects, investment rates, product/capital ratio, Gross National Product, population, employment, income distribution and agricultural exports. The main objectives of the NWMP were to achieve the most appropriate distribution of the population and to lower the levels of air and water pollution, and ensure proper management of solid waste. It was thought that self-sufficiency in basic food grains would be achieved, and employment would be generated in the agricultural sector and a certain percentage of the population would have access to water supply and sewerage (Herrera, 1997).

In order to develop a NWMP, the country was divided into regions and sub-regions. Thirteen regions were defined according to the hydrological configuration of the country, and 102 sub-regions according to geopolitical jurisdictions. Each sub-region included a number of municipalities of the same state, so that regional programmes could be planned at the sub-regional level.

Regarding water quality control, the objective of the NWMP (1975) was to keep the levels of industrial pollution as in 1970, and priority river basins and critical polluting industries were identified. The NWMP was completed in 1975, and in 1976 the National Water Plan Commission was established to implement the plan and update it on a regular basis. However, the institutional arrangements during the 1976-1985 represented serious limitations for implementing the strategies outlined in the NWMP. In 1976, the Ministries of Water Resources and Agriculture were combined into the Ministry of Agriculture and Water Resources, and the Government decided to focus mainly on the growing problems of the agricultural sector. Consequently, the NWMP programmes could not be implemented.

In 1981, major investments were made in the water sector, and many projects were constructed. However, after 1981, the global financial crisis had a major impact on Mexico, forcing the government to review its investment programme for the country and reallocate the financial resources available that year. So far as water resources development were concerned, the government focused on short-term planning and there were serious economic problems for the construction of more than 400 projects. The Deputy Ministry of Hydraulic Infrastructure negotiated new credits with the World Bank and the Inter-American Development Bank (IDB). The credits were to support rolling investment programmes instead of the normal practice of credits that are negotiated for specific projects, with a yearly allocation of financial resources.

In 1985, the implementation of water policies became more difficult, since water-related issues were moved to ministries other than the Ministry of Agriculture and Water Resources. Thus, trying to implement the recommendations of the NWMP, the National Water Plan Commission was transformed into the Mexican Institute of Water Technology (IMTA) (Herrera, 1997). However, by the end of the 1980´s, water use efficiency and water quality in the country had not improved, and scarcity in 2/3 of the country had been identified. The conflicts between users and uses had increased: 30% of the population had no access to water supply in 1989, and 50% to municipal sewage service.

Accordingly, new water policies were developed focusing on the following issues (Herrera, 1997):

- integrated water planning and management (both in terms of water quantity and quality);
- introduction of market mechanisms, pricing and other economic instruments to encourage more efficient use of water;
- reinforcement of governmental regulations through a single water authority;
- adequate institutional coordination at all levels of the government;
- decentralisation of the responsibilities;
- promote more participation of users and society as a whole.

In 1989, the National Water Commission of Mexico (CNA) was created by a Presidential Decree as the sole federal authority dealing with water management as an autonomous agency attached then to the Ministry of Agriculture and Water Resources. In 1994, CNA was relocated from the earlier Agriculture and Water Resources Ministry to SEMARNAP.

Currently, theoretically SEMARNAP coordinates the programmes and policies of four semi-independent entities besides from CNA: the National Institute of Ecology (INE), the Office of the Federal Attorney for Environmental Protection (PROFEPA), the National Institute of Fisheries, and the IMTA, which is the institution which conceptually provides technical assistance and support to CNA. However, for practical purposes CNA has acted as a totally independent institution.

The CNA has the authority for and management of national waters. Their inherent public assets shall be the responsibility of the Federal Power, either directly or through the CNA (Anon. 1997). The Law of National Waters stipulates the administrative structure of CNA to be as follows: Technical Council, General Directorate, six Sub-directorates (Administration, Water Administration, Operation, Planing, Construction, and Technical Issues), Rural Programmes and Social Participation, Social Communication, and Regional and State Offices.

The membership of the Technical Council of CNA consists of the Ministers of Finance and Public Credit, Comptrollership, Social Development, Energy, Mines and Parastatal Industries, Agriculture and Water Resources, Fisheries and Health. Since this Law was enacted, institutional arrangements for water has changed. CNA is now part of SEMARNAP. Accordingly, this ministry is now a member of the council. The Director General of CNA is responsible for the follow-up and implementation of the decisions agreed to by the Technical Council, and who reports to the Council.

The Technical Council (Law of National Waters, Article 11) is empowered to carry out the following activities:

- review and approve policies and measures permitting programming and coordinated action between federal agencies involved in water affairs;
- consider matters submitted to it on administration of water and the Commission's revenues,
- assets and resources; review the programs and budget of the Commission, oversee its implementation and review the report submitted by the Director General;

- propose the terms under which the borrowed funds required by the Commission are to be negotiated and conclude
- approve the establishment of basin councils.

Conceptually, the Technical Council, with its membership on the various sectors, should be able to promote the integrated management of the water resources of Mexico. The Technical Council should be abl to discuss and review the main concerns and priorities related to water from different perspectives, which should result in the most balanced and efficient decisions for the country in terms of water management.

Under the Law, the Director General of C
reports both to the Technical Council and to the President. Since the Law was enacted, the institutional arrangements for the water sector have changed. Since CNA now is a part of SEMARNAP, conceptually Director-
amended to reflect this reality. Thus, both the Secretary of SEMARNAP and the Director General of CNA are both appointed by the President and repor
purposes, acts as an independent institution, and SEMARNAP has very little, if any, control on its policies, programmes and activities, even though theoretically CNA is a part of SEMARNAP. Thus
having one Ministry of Environment, Water Resources and Fisheries, so that their activities could be coordinated, has not worked in practice.

Clearly, the Technical Council has not managed to be an assertive and coordinating body as the Law

Currently, there are acute problems with water quantity and quality-
overexploitation of water surface and groundwater bodies, lack of appropriate legislation for municipal and

environmental and social issues. If there were more checks and balances, it is likely that the magnitudes and

arrangements of CNA should be seriously and objectively reviewed and modified accordingly, if integrated and efficient water managem

institutional change was made to forge better linkages between the appropriate environment and sustainability issues. It is
to the Rio Summit, rather than because of perceived national requirements. Similar changes occurred around the same time in certain other Latin American countries, like Br

DECENTRALISATION OF INSTITUTIONS

It is very likely that the programme on decentralisation, as promoted by CNA, would not work

accountability at the municipal level. The planning continues to be ad hoc and short-
governments change every three years, which seriously disturbs continuities of policies and programmes. In most cases, the municipal funds are inadequate to cover even
average, the municipalities in Mexico account for less than 3% of total public investment. Most public investments come from the central public sector. Nearly 84% of all public investment made in 1994 by the
e levels of government (federal, state and municipal) came from the Federal Government and another 13% came from the states. Local governments do not have adequate control of their resources. Grants are
-committed to federal projects through “matc
the local governments have to put up some of their own funds in order to obtain federal funds for the

projects. Thus, control of the funds is frequently tied to prior commitments with the Federal Government (Saade, 1997).

So far as local environmental laws are concerned, each state in the country has its own, but most state institutions are weak as a result of low priority accorded to environmental concerns, lack of experience in environmental management and limited environmental budget. In 1983, municipal governments were entrusted with the responsibility of providing drinking water supply and sanitation. However, at present the Federal Government still plays a fundamental role in financing water projects. Even though this was supposed to be the first step to a decentralisation process, much yet remains to be done. The success of decentralisation would depend on the ability of the municipalities and states to set priorities for infrastructure, and manage resources according to the local needs.

In general, municipalities in Mexico lack technical capacity and experienced human resources. Historically, the federal and the state governments have been responsible for infrastructure financing. Thus, most municipal officers lack experience carrying out rigorous economic and fiscal analyses of the proposed public projects. The adequate provision of water and sanitation services and planning and investments in all municipal infrastructures require financial autonomy and technical expertise on the part of the municipalities, which are basically missing at present. Without regular and adequate income sources, the municipalities are highly unlikely to meet these expectations.

For decentralisation to be effective, it is essential that more funds be transferred to the states and municipalities; the municipalities should acquire and control their own sources of revenues; and new financing mechanisms need to be developed to provide adequate incentives to the private sector to encourage their participation. The involvement of the private sector would lead to the development of new financing alternatives that could involve new stakeholders for the construction and operation of new infrastructure projects. The Mexican government has granted a few concessions to private entities in medium-size cities and a contract to operate water and sanitation services in Mexico City. However, it is too early to evaluate the results of this effort. Participation of the private sector could lead to new sources of finance, technology, as well as improved management through more qualified human resources.

In recent years, independent water utilities have been formed as an effort to manage urban water services on a commercial basis. By early 1996, 360 utilities had been formed, of which 207 were financially autonomous and the remaining 153 still needed state or municipal support (OECD, 1998).

In the rural sector, the Mexican government (through the CNA) started the transfer of irrigation districts[1] to the water users. By mid-1996, more than 86% of the 3.3 million ha of publicly irrigated land in the country had been transferred to joint management. Users associations represent farmers in irrigation

[1] **Law of National Waters, Article 58.** Rural producers may freely form bodies corporate for the purpose of setting up systems to provide farm irrigation services to various users, for which purpose they may set up irrigation units under the terms of this Section. In this event, the concession of national water shall be granted to the bodies corporate formed by such users, who shall receive freely conveyable certificates, in keeping with the regulations to this Law. Certificates shall not be compulsory in irrigation districts.

Law of National Waters, Article 64. Irrigation districts shall include the areas within their perimeter, water infrastructure, surface water and groundwater for water supplies, storage reservoirs and the installations required for their operation. If the Federal Government has participated in the financing, construction, operation or management of the works necessary for a district to operate, the Commission, within a strict deadline, shall proceed to hand over their management and operation to the users, under the terms of this Law and its regulations.

districts and units[2]. Johnson (1997) has comprehensive analysed the transfer of management of irrigation districts in Mexico. He noted that water users associations have operated and maintained the modules, as well as collected the tariffs. More than $170 million were collected in 1994 and 1995 which were used to support the operation and maintenance activities of the modules, and have also supported the majority of the O&M activities by personnel from CNA.

In order to sustain the management of the transferred districts, the users need to establish an investment fund to cover emergencies and future development (Johnson, 1997). So far, the Law on National Waters does not recognise water right to individual users or does not grant a volumetric right. Thus, all modules receive the same amount of water, irrespective of their size or requirements. The law defining concessions also is unclear as to what should be the priorities when shortages occur.

There are very few evaluations of the impacts of the transfer of management of irrigation districts in Mexico. Kloenzen et al. (1997) carried out a two-year field research study to assess the impacts of the transfer of irrigation districts in the Alto Rio Lerma Irrigation District (more than 100,000 ha). The results show that the transfer has resulted in positive impacts on maintenance of the districts, as well as in the cost of recovery for O&M activities. The findings also indicate that there has been very little impact on groundwater use and on surface water allocation and distribution.

LEGAL FRAMEWORK

The policy framework for water resources management in Mexico is integrated by several laws. The main one is the Mexican Constitution (1917), which stipulates certain basic conditions under which the nation´s water resources could be used and managed. It defines that water resources are a public property, and stipulates that they are under the control of the Federal Government. The Law on National Waters and the Federal Law on Water Excise Taxes set the regulatory, economic and social instruments for water management. The Law for Ecological Balance and Environmental Protection defines the environmental regulations, and the General Health Act establishes the standards for drinking water.

Law of National Waters

So far as water resources is concerned, the National Congress approved a new Law of National Waters (Ley de Aguas Nacionales) in December 1992, additional regulations in January 1994 (Anon, 1997), and modifications to some of the articles in December 1997 (SEMARNAP, 1997a). The Law of National Waters establishes broad objectives for the development and implementation of the plans and the policies for water resources management. The responsibility for implementing the law was assigned to the CNA.

The Law of National Waters recognises the importance of efficient water resources management and authorises CNA to carry out this function with the objectives of achieving sustainable development and the efficient use of the nation´s water resources (World Bank, 1994). The Law of National Waters and the Federal Tax Law define the regulatory, economic and social instruments necessary for water management. The Law of National Waters gives special attention to water quality, both to protect human health and to preserve and/or enhance aquatic systems. The strategy is based on:

- systematic monitoring and evaluation of water quality;
- establishment of a set of water quality standards;
- establishment of a discharge permit and effluent charge system ; and

[2] The irrigation in Mexico is organised in private ownership (represent 1 million ha), group ownership and management or units (represent about 1.7 million ha), managed both by the users; and irrigation districts (3.2 million ha) jointly managed by the users and the government (Kloenzen et al., 1997).

- construction of wastewater treatment plants and sewerage facilities.

According to the law, water users, both industrial and municipal, must comply with specific discharge conditions established by the CNA. They must pay for discharge rights for using national water bodies as carriers of their wastes, and they must inform the CNA at regular intervals detailed information on their wastewater discharges in terms of both qualities and quantities. The Federal Law on Water Excise Taxes establishes that water has an economic value (based on its availability) and the polluter-pays principle. The law is updated annually and stipulates water use and pollution fees for different categories of use based on its availability.

The Law of National Waters was amended in December 1997 with the objective of defining the structure of the basin councils, as well as to enforce the participation of the appropriate authorities and the users in the development, implementation, updating and evaluation of the basin planning processes. The amendments also consider concessions and water rights. According to this Law, the Government transferred the control of the irrigation districts to the farmers, who became responsible for the operation, maintenance and administration of the systems. The Law also allowed private investment in irrigation and drainage infrastructure.

At present, the Basin Councils are expected to manage water resources from integral and regional perspectives, and should involve water authorities, states and municipalities, as well as the users. There are at present 314 hydrological basins, 37 hydrological regions and 13 administrative basins.

Even though river Basin Councils have been established in the country, there is still no management of water at the basin level. In all basins, there are serious problems in terms of pollution as well as water rights for both surface and groundwater.

Regarding agricultural lands, the Mexican Constitution (Art. 27) defines that the land (*ejido*[3], previously protected by law as common property) may be bought and sold, introducing major changes in the allocation and marketing of water rights. Domestic and industrial needs have been given priority over agriculture, resulting in heavy pressure for irrigated-land agriculture. The water rights are vested in the government, and it is the CNA which negotiates and monitors water rights. At present, the only identified beneficial use is for domestic purposes. Irrigation rights for water resources (surface and groundwater) are for specific periods of time, from 5 to 50 years, and can be revoked under certain specific conditions.

One very important aspect related to water resources management and planning is decentralisation. The new Water Law promotes the creation of water users associations to improve water management in the irrigation districts. The transfer of irrigation districts has involved a complex process of negotiations with thousands of users. Actually, the experience drawn from the first two years of the process was very helpful in drafting the Law enacted in 1992. With the support of the users, during the last 3 years, more than 2.4 million hectares, or 75% of the irrigated area has been transferred to 316 new user´s associations in 54 districts, involving over 319,000 farmers (Herrera, 1997).

The CNA is planning to update the NWMP. Decentralisation should be focused in such a way that stakeholders have an influence in policy formulation, investment choices and management decisions affecting their communities. By law, the River Basin Councils have to sanction the river basin plans and once integrated within the NWMP, they become mandatory for the federal government, and inductive for local and state government and users. Bottlenecks and necessary actions and resources needed to eliminate them have to be identified and evaluated; unrealistic or unfeasible situations will feedback into regional planning (Herrera, 1997).

[3] Ejido, in Mexico, village lands communally held in the traditional system of land tenure that combines communal ownership with individual use. They are holdings of 100 to 800 hectares depending on the type of crop and land use.

The Law on National Waters makes mandatory for the Federal Government to develop the Water Programme. The Law of National Waters, as well as the Water Programme 1995-2000, identify several issues of fundamental importance for the sustainable management and development of water resources in Mexico. The main ones are: river basins as the unit for water resources management and planning; development of reliable information systems; and the need for capacity building from the institutional, legal and human resources viewpoints.

General Law for Ecological Balance and Environmental Protection

The General Law for Ecological Balance and Environmental Protection (LGEEPA) and its regulation was first issued in 1988. Its regulation had to be amended first in 1996[4] due to the rapidly changing conditions as well as the inadequacies and shortcomings of the earlier legislation. The main modifications included: definition of the roles of the governments at the Federal, State and Municipality levels regarding prevention and control of water contamination, supporting the decentralisation processes; definition of instruments of environmental policy (land use planning, economic instruments, environmental regulation of human settlements, environmental impact assessment, auditing); biodiversity (natural protected areas, restoration areas, and use and protection of flora and fauna); environmental contamination (air pollution and hazardous wastes); public participation and environmental education and information (SEMARNAP, 1997b).

The 1996 amendments of the LGEEPA have improved Mexico´s liability regime. Now any party that contaminates or degrades the environment or adversely affects natural resources or biodiversity shall be liable for and must repair the damage caused (strict liability) without prejudice to any criminal or administrative sanctions that may apply. The 1996 LGEEPA amendments expanded the number of activities for which EIA is required. These now include: pipelines, forestry plantations, change of and use in forest areas; arid zones and tropical woodland; industrial parks that involve hazardous activities; coastal real estate development; construction and other activities in wetlands, lakes, rivers and estuaries; and fishing, aquaculture, farming or ranching activities that could impede the preservation of one or more species or harm ecosystems (OECD, 1998).

The time to elaborate Environmental Impact Assessment was reduced to about 60 days, instead of 90 days or more allowed earlier. Over 1,000 EIAs are filed each year, but the number of decisions is considerably smaller. In some cases, EIAs of individual projects have been used in connection with land use plans at regional level to evaluate projects´overall effects and the adequacy of mitigation measures as shown in Table 2 (OECD, 1998).

Several instruments have been incorporated in this law with the objective of preventing actions that would be legally punishable. The instruments are as follows:

a) Ecological land use planning. Land use planning represents the process to evaluate and programme land use and management of natural resources, to protect and restore the ecological balance, and to protect the environment. With the new modifications of the law, land use planning would be implemented at the national, regional, local and sea levels. However, its implementation has been very poor so far due to the ambiguity of its legal status, objectives and outputs. A regulatory planning framework is also lacking.

b) Economic instruments. The economic instruments are defined as the regulatory and administrative mechanisms with fiscal, financial or market characteristics through which the users assume both the benefits and environmental costs of their economic activities. The Federal and the State

[4] The Regulations of LGEEPA were modified again in 2000.

Governments would develop economic instruments that would be beneficial to those who protect the environment because of the economic incentives, and would punish economically those whose actions damage the environment. Regarding water resources, one example is its sound use and prevention of contamination.

c) Environmental regulations of human settlements. Planning and management of cities should include environmental criteria. The Article 23, VII of the LGEEPA, mentions that the use of water for urban purposes should include the maintenance costs, and should consider the volume that it is used and water quality deterioration.

d) Environmental Impact Assessment (EIA). Even though this regulation has been in place for more than 20 years, its implementation has been very poor. Some of the main reasons for the lack of application of the EIA have been heavy centralised decision making processes of the Federal Government, ambiguity in the type of project or activity which requires EIS, lack of clear administrative procedures, lack of mechanisms for social participation, absence of the appreciation by the management of the importance and relevance of environmental factors to ensure long-term sustainability of water projects, etc. Thus, the amendments to the LGEEPA in this respect have the following objectives:

- At present, SEMARNAP can demand an EIS for each project that could result in ecological disruptions or threaten the public health and the ecosystems, even if they are not mentioned specifically in the legislation.
- Stresses the importance of obtaining the legal permit from the appropriate authority before the construction of any project, or any activity which would affect severely the environment and natural resources.
- Defines type of projects and activities which may not have significant impacts and thus may do not require submission of an Environmental Impact Statement (EIS) at all, and those which need to submit only a preventive report.
- Simplifies the administrative requirements for the EIS of projects and activities which are responsibility of the local authorities.
- It links the EIA procedures to those of land use planning and human settlements. When local authorities develop plans for urban development and land use planning, all the projects and activities should be included so that the Federal Government can evaluate them from an environmental viewpoint as a whole, and not individually.
- Increase public participation during the preparation of EIA. Before the amendments of the law, social participation meant that the general public could read the EIS submitted on the projects and activities. With the latest modifications, the public can discuss projects and activities which could severely damage the environment, or threaten the public health or the ecosystems.
- Specifies the responsibilities of the professional staff who participate in the preparation of EIS.

e) Mexican Official Norms on Environmental Issues. In order to achieve the sustainable development of the natural resources management in the country as well as any economic activity, SEMARNAP would issue Mexican official norms on environmental issues. Looking for the benefit of the country, the norms would consider not just technical issues, but also economic and social ones. External and internal investments would be promoted, as well as financial incentives, and the development of new markets and productive activities would be stressed.

f) Self-regulation and environmental auditing. The Law promotes voluntary compliance of environmental regulations. It notes that producers and industries or industrial groups can develop voluntarily environmental self-regulation for improving their processes and protecting the environment. The Ministry would monitor industries more closely. It would establish environmental audits at the national and regional levels, and would establish a system of financial incentives to enforce their requirements. The Ministry has

considered the certification of environmental referees, as well as the support of small and medium size industries through the regional centres.

g) Environmental Research and Education. For the first time in any Mexican legislation, both research and education on environmental issues have been considered. The LGEEPA stresses the importance of incorporating environmental education in basic education, and to promote linkages between the government, universities and research centres in order to develop long-term environment-related programmes. The law also recognises the importance of developing human resources in this area because of national interest.

Table 2. General Law of Ecological Balance and Environmental Protection (LGEEPA)

Title	Chapter
General dispositions	• Preliminary standards • Distribution of responsibilities and coordination • Environmental policy • Policy instruments
Biodiversity	• Natural protected areas • General standards • Types and characteristics of natural protected areas • Decrees for the establishment, management and monitoring of natural protected areas • National system of natural protected areas • Restoration zones • Wild flora and fauna
Sustainable use of natural resources	• Sustainable use of natural resources • Preservation and sustainable use of soil and related resources • Exploration and exploitation of non-renewable resources and effects on ecological balance
Environmental protection	• General standards • Control and prevention of air pollution • Control and prevention of water pollution and aquatic ecosystems • Control and prevention of soil pollution • High-risk activities/risk management • Hazardous waste and material • Nuclear energy • Noise, vibrations, thermal and photic energy, odours and visual pollution
Public participation and access to information.	• Public participation • Right to access to environmental information • General standards
Control, safety measures and sanctions	• Inspection and monitoring • Safety measures • Administrative sanctions • Complaint mechanisms • Federal offence procedures • Citizen complaints

Source: OECD, 1998.

The Federal Law on Excise Taxes

The Federal Tax Law on Excise Taxes is a general law that is updated annually. It contains provisions related to the activities of the Federal Ministries, including SEMARNAP. It establishes rates as annual water abstraction and pollution fees.

The National Water Law and the Federal Law on Excise Taxes define the regulatory, economic and participatory aspects of water use management. Granting of water use concessions and wastewater discharge permits is regulated, as are the users´rights and obligations. A public registry of water rights is being established to ensure legal certainty of water rights, and to promote water markets. A license or concession is necessary for everyone, public or private, to use water, and a subsequent permit is required for discharging wastewaters into the rivers, or on the land. Those who benefit from water use, or those discharging into the water, have to pay for the management and development of the resource, and for the restoration and improvement of water quality, in proportion to their water consumption or to the amount and characteristics of the wastewaters discharged (Garduño & Villavicencio, 1996).

Resource fees for taxing water were put in place in 1982. Under the Federal Law on Water Excise Taxes, the National Congress establishes the level of these fees on an annual basis. They range from $ 0.003 to $0.796/$m^3$, depending on the use of the water, and the local availability. Settlements with less than 2,500 people depend completely on federal or state funding; cities up to 50,000 people also get Federal and state funding but are expected to mobilise part of the necessary capital cost themselves through loans or private credits. Cities with more than 50,000 people finance the capital costs through loans and/or by granting concessions to private firms. A small part of the cost of rehabilitating irrigation infrastructure is being financed by the World Bank and the IDB loans (OECD, 1998).

Water used for agriculture and for drinking in small rural communities is not subject to such fees. Pollution fees for discharges were established in 1991 and are payable per kg of contaminant in excess of the effluent limits established by the Federal Law on Water Excise Taxes (BOD, total suspended solids, total nitrogen and phosphorus, faecal coliforms, pH and the sum of heavy metals plus cyanides). Small rural communities are exempt from pollution fees as well as polluters who have submitted to CNA wastewater treatment proposals. The revenue generated from resource abstraction and pollution fees is collected by the Treasury and becomes a part of the general revenue. In irrigation districts, agricultural water charges now cover fully operating and maintenance costs of the distribution systems (OECD, 1998). Most of the more than 300,000 users who hold concessions to abstract water and/or permits to discharge effluents do not comply with the law, or comply only partially. Through a combination of exemptions, amnesties and sanctions, users are being encouraged to comply with the regulations. The greatest problem is with the agricultural sector and for groundwater abstraction, in the service sector.

CURRENT PLANS

Water Programme 1995-2000

The official Mexican water resources policy, as presented in the Water Programme 1995-2000, (SEMARNAP/CNA, 1996), is oriented towards ensuring the availability of water to satisfy the needs of the population and to promote the development of economic activities in a manner that is environmentally compatible and sustainable for each region of the country. Its main objectives are to provide clean water to an additional 10 million people, improve the quality of the water, construct more wastewater treatment plants and provide with sanitation services to another 15 million people, through the Programme on Drinking Water and Sanitation (CNA, 1997c). Investments would be needed to modernise small- and medium-scale

industries, including adoption of cleaner technologies. Regarding the irrigation sector, the target is to irrigate 1040 km^2 more of land and rehabilitate 8,000 km^2 of existing irrigation systems (OECD, 1998).

The main problems related to water supply vary from providing services to a megacity like Mexico City, one of the world´s largest cities, to ensuring access to safe water for more than 100,000 communities with less than 500 persons.

The Water Programme focuses mainly on the following issues:

- projects in rural areas, with less than 2,500 people;
- projects in urban areas, with less than 2,500 people;
- projects in urban areas, with more than 2,500 people;
- macroprojects in main cities;
- projects in the northern border;
- treatment of municipal wastewaters in specific basins; and
- public health.

Some of the quantitative targets identified the National Water Programme (OECD, 1998) are the following:

- increase the number of people in rural areas having access to drinking water from 13.8 to 18.8 million and sanitation facilities from 5.5 to 15.1 million;
- increase number of people in urban areas having access to drinking water from 62.8 to 68.8 million and to sewerage networks from 56 to 60 million;
- maintain adequate disinfection for at least 95% of the water supplied by drinking water systems, and increase their total installed capacities from 2.21 to 2.37 billion cubic metres per year; and
- increase the treatment of urban wastewater from 0.536 to 2.586 billion cubic metres/year by rehabilitating existing systems and constructing new ones, with special focus on 15 priority basins.

Absence of appropriate levels of water pricing and poor collection system for water tariffs have ensured that water supply revenues make only a token contribution to the enormous financial requirements for the water supply and sewerage sectors, which have become increasingly dependent on the federal budget for their development. The investment cost to achieve the objectives of the Water Programme 1995-2000, including the increase in system efficiency, has been conservatively estimated at $7 billion (43.6% for water supply projects; 36% for sewerage networks and 20.4% for sewage treatment). This annual investment represents more than double the current levels of expenditure (OECD, 1998; Saade, 1997).

In spite of the decentralisation processes, the states and local governments still depend heavily on the federal budget and subsidies. Thus, in order to achieve most of the objectives of the Water Programme, the Federal Government would have to develop new financing mechanisms, probably with increasing emphasis on the attracting investment.

In 1995, financing of municipal water infrastructure investment came from the Federal Government (24%), state and local governments (30%), loans (27%) and water utilities (19%) (OECD, 1998). The investment from CNA in that year was about $220 millions for water supply (42%), sewerage (52%), municipal waste water treatment (5%), and consolidation of water utilities (1%) (Table 3). Part of the annual budget of CNA is linked to the revenue it earns from resource and pollution fees. The potential to increase the revenues is tremendous, since a high percentage of fees due is not collected and agricultural users are exempt (OECD, 1998).

Table 3. Investment for water supply, sewerage and sewage treatment

Year	Total investment (million pesos)	Federal Government	States and Local Governments	Loans	Private and water operator
1991	2,563	39	28	33	[a]
1992	2,460	52	25	23	[a]
1993	3,155	50	29	18	3
1994	2,330	61	18	15	6
1995	2,244	24	30	27	19

a)Included under "loans"
Source: OECD, 1998

Water Resources Management Project

The Water Resources Management Project (PROMMA) is a follow-up to the actions initiated in 1991. It is supported by the World Bank, and covers field areas of irrigation and drainage, on-farm and minor irrigation networks improvement, and water supply and sanitation project. The overall objective is to achieve an "integrated, economically efficient and environmentally sustainable water use through better management" (World Bank, 1996).

The project is expected to assist the Government of Mexico to improve the policies on water resources and management capabilities in different areas. PROMMA is being executed by CNA. The total cost of PROMMA is estimated at $342 million, 54.5% of which would be provided by the World Bank as a loan, and the rest would be provided by the country. Some of the main objectives of this project are: i) training and technical assistance; ii) modernisation of meteorological, hydrological and climatological networks; iii) streamlining and strengthening of water use administration; iv) planning and information systems; and v) modernisation of the operation and security of dams and reservoirs management.

The PROMMA, at least conceptually, could have a major positive effect on the environment. It is expected not to finance any new development project, or any new hydraulic infrastructure facilities. It is expected to ensure that sufficient environmental attention and expertise are brought to bear on the regional water resources planning and management issues. The project is expected to contribute to significant environmental benefits, and provide the government with adequate tools for the detection of water contamination and pollution, establishment and enforcement of effluent discharge standards (and thereby significantly improving water quality); identification and characterisation of areas having unsustainable use of surface and groundwater; development of stabilisation plans for aquatic and riparian ecosystems; improvement of water resources planning at the river basin level with the participation of environmental specialists and river basin councils to ensure consideration of environmental issues; and improvement in allocation of scarce water resources as well as promotion of water use efficiency.

The World Bank Policy Paper on Water Resources Management (1993), the PROMMA, the Mexican National Water Plan 1995-2000, and the Law of National Waters of Mexico, identify several issues of fundamental importance for the sustainable management and development of water resources. The main ones are: river basins as the unit for water resources management and planning; the need for having reliable data and information systems; and the necessity for having capacity building from the institutional, legal and human resources viewpoints.

The PROMMA agreement was signed in 1996. It stressed the fact that water resources management needs to be strengthened at the central and regional levels. It pointed out that even though Mexico had considerable expertise in the construction and operation of water projects, the water sector still needed a

strong, cohesive interdisciplinary group, having a broader vision on planning and management. The project document confirmed the general findings of the earlier study on the "Training Needs Assessment for Development of CNA Professional Staff" (CNA, 1992a), which indicated that CNA lacked expertise, equipment and technology in the field of monitoring programmes, essential for managing and controlling water quantity and quality, regional water resources planning, reservoir operation, aquifer management, and dam safety.

The importance of human resources development is identified both in the Water Sector Policy Paper of the World Bank (1993), and the PROMMA, as a priority requirement to achieve an overall strategy on the management of water resources. The PROMMA confirms that the development of an institutional framework, as well as the human resources, would improve the management and planning of water resources, during and after the project implementation. Some of the areas wherein human resources development have been identified as fundamental are development of policies and guidelines for better management of water resources at the national and the regional levels, improvement of institutional frameworks, and development of instruments for better coordination between the regions and the users.

The CNA is going through a process of decentralisation, which is expected to take place at the same time as the project is being implemented. Accordingly, a considerable part of the project is expected to be implemented by the regional offices, which lack technical and operational capacities. Because the regional offices would require strong support from the central offices in terms of capacity building and training, some of the risks identified which could constrain the successful implementation of the PROMMA were "decentralisation, technical skills and capacity building." To mitigate this risk, PROMMA recommended a major emphasis on "institutional development, technological support and training." A total of $37.6 million have been allocated to finance goods, services, training, and consultants to support water resources planning and management activities at all levels in CNA, and to improve the technological resources and skills of the professional staff. The monitoring of the implementation of the project was expected to focus in the first year on the progress in training programmes and adequacy of project coordination.

Even though the objective of the PROMMA was to improve the overall management of water resources in Mexico, there have been several fundamental problems for its successful implementation during its early years. The funds under the various World Bank projects in Mexico generally have not released by the Mexican government in a timely fashion to the implementing agency, which made it difficult for CNA to plan and carry out the different activities efficiently. In addition, CNA has proved to be a somewhat weak institution, without adequate internal coordination or presence of any long-term vision. Policies, priorities, and institutional structures are often ad-hoc, and change regularly. Policies and priorities are often decided without any clear rationale by the senior management, and also without any consultation with appropriate stakeholders and/or qualified and experienced CNA staff members. Activities undertaken are often isolated without clear understanding of their interrelationships, or identification of follow-up actions. Just to give an example, one of the objectives of the PROMMA was to rationalise the water quality monitoring network in the country. So far, and after several consultancies of external experts (Biswas, et al., 1997), not even a conceptual framework for cost-effective and efficient water quality monitoring network in Mexico has been prepared, let alone agreed to by the management.

The other two risks identified by the World Bank for the implementation of the PROMMA are the project management and coordination within CNA, and the inadequate budgetary allocations. In addition to management constrains, such issues are preventing the appropriate and timely implementation of the project. At the present stage, it has to be admitted that PROMMA is likely to be a failure. It is highly likely to achieve most of its objectives. The Government of Mexico, including CNA, would have to become aware of the importance of the commitments they have made not only with the World Bank, but also with the water sector, and finally with the tax payers and the citizens, who have to contribute with to the repayment of the 186.5 million, which is being borrowed from the Bank. The repayment will be over 15 years at the Bank´s standard interest rate.

Institutional Training Programmes for the Water Sector

The programmes on protection, conservation and improvement of the natural resources, include not just the development and implementation of appropriate technical, environmental, legal and institutional frameworks, but also the development of qualified human resources who are capable of formulating and implementing rational policies. As an initial step, training and education on environmental issues have to be recognised as a fundamental requirement for analysing and solving the very complex problems associated with the sustainable development and management of the country´s water resources.

In the international arena, the importance of environmental education have been repeatedly stressed in major meetings such as the United Nations Conference on the Human Environment (Stockholm, 1972) (UNEP, 1981); Intergovernmental Meeting on Environmental Education (Tbilisi, Republic of Georgia, 1977) (SEDESOL/INE, 1994); 10th Anniversary of the Stockholm Conference (Nairobi, Kenia, 1982) (SEDESOL/INE, 1994); International Strategy for Action in the Field of Education and Environment for the years 1990-1999 (Moscow, Russia, 1990) (SEDESOL/INE, 1994); United Nations Conference on Environment and Development (Rio de Janeiro, Brazil, 1992) (UN, 1993); and the Global Forum on Citizens (Rio de Janeiro,1992) (SEDESOL/INE, 1994).

Education, information and culture represent instruments or tools through which environmental problems could be appreciated, understood, and addressed to both by the government and the society as a whole. Without the awareness and appreciation of the importance of the environmental factors, sustainable development of water resources cannot be achieved.

The Programme on Environment 1995-2000 (INE, 1996) defines specifically fundamental objectives to improve environmental management in the country. Unfortunately, however, it does not consider quantitative targets in terms of environmental outcomes. The Programme includes the instruments for environmental policies that have been developed in Mexico:

- development, financing, and administration of protected areas;
- regulation of fauna and flora;
- land use planning;
- environmental impact assessment;
- risk assessment;
- economic instruments;
- information;
- education, training and research; and
- agreements and social participation.

These tools, which must be developed jointly with the active participation of the public, are essential for the successful implementation of any programme on environmental protection. According to INE (1996), environmental policies in Mexico consider environmental education as a mechanism to develop awareness and knowledge within the institutions and the society, related to the status of the natural resources of the country, as well as its proper management and planning. In realistic terms, however, much of the activities referred to earlier have been basically theoretical and paper exercises: their impacts on water institutions and universities are invisible for all practical purposes.

The general consensus at present is that environmental education should incorporate social issues, as well as development alternatives for the population living in poverty (Guillén, 1996; INE, 1996). The social problematic is directly linked to the deterioration of the environment, since the quality of life of the society

and the environment are closely linked to each other. In fact, public health issues are directly based on the relations between the population and the environment within which they live (Velázquez, 1997).

For the successful formulation and implementation of the programmes on water resources planning and management, appropriate human resources development should be a priority consideration. Knowledgeable and experienced staff at all levels, having broader perspective and understanding of the importance of integral management of natural resources, is urgently needed. Environmental and social issues are two critical areas where staff members should be educated and trained in order to achieve sustainable water resources management. One of the groups who should be targeted for such capacity building is the managers of the institutions within the water sector, who should be educated and trained on the environmental and social consequences of their decisions on not only water planning and management, but also on associated natural resources and human health. CNA, like most other water institutions in developing countries is dominated by engineers. While considerable lip service is now given to environmental and social issues and public participation, the managers for the most part do not believe in them.

Some of the institutional training programmes that have been undertaken by CNA/IMTA and which have proven to be of very little use, would be briefly discussed next, except the Water Resources Management Project, which has been analysed before.

a) Training Needs Assessment for Development of CNA Professional Staff

When CNA was established in 1989, it inherited a staff of 35,000 people, a large percentage of whom lacked the necessary knowledge and skills and only 2,700 were in the middle management positions. (CNA, 1992a). The CNA policy on training and education was to attract trained people and develop their expertise through an ambitious programme of post-graduate training in different fields of water resources management. This programme started in 1990 with the support of the Mexican Institute of Water Technology (IMTA). By June 1992, more than 100 persons had graduated.

The National Water Plan Commission evolved into IMTA in 1986. Initially it was expected to be one of the institutions responsible for the solution of complex water problems for CNA, and for the training and development of technicians and professionals from the water sector, mainly from CNA. In other words, IMTA was expected to be a practical think tank, and also to provide facilities to properly train a cadre of new breed of water professionals. It has, for the most part, been unsuccessful thus far in fulfilling its two objectives.

In 1992, the CNA started a diagnosis to identify the areas of expertise and training needed for professional staff within the institution so that it could perform its tasks properly and efficiently. An attempt was made to develop a framework for an action plan to build expertise in CNA according to the changing conditions resulting from the new policies on management and planning of the water resources in Mexico (CNA, 1992a). It was divided into two main areas: management development and technical development, and was focused mainly on the needs of senior and middle managers at the national, regional and state levels.

The secondary objectives of this capacity building assessment needs were the following:

- upgrade overall management skills;
- define the role of CNA officers and develop CNA policy concepts;
- meet critical shortfalls in certain specific areas; and
- establish a suitable CNA/IMTA programme, consisting of short technical courses to meet CNA operational needs

The assessment was carried out with the support of IMTA as well as from consultants from the Thames Water International and Overseas Development Administration (ODA), U.K. A methodology and survey questionnaires were developed, and 56 managers from CNA and IMTA were interviewed (CNA, 1992a).

According to the assessment carried out, the main constrains within CNA was the lack of knowledge and expertise in the field of general management. Other main issues identified were the following:

- The definition of the role of CNA personnel was lacking. There were important disparities between the technical skills of the personnel and the activities they were carrying out. The problem was not lack of educated staff, since a considerable number of the personnel working in the different offices already had higher degrees, which were to some extent related to their areas of work. The difficulties were noted instead because of inconsistencies in the information or the lack of information itself.

- The different areas were not functionally efficient because of the lack of personnel at specialist levels.

- The appropriate staff members were not being released to attend the relevant training courses.

The assessment concluded that training was needed on management in all the areas of CNA. Technical training should focus on defining the role and functions of CNA officers, and relationships with other users through workshops. Broader concepts of river basin management should be strengthened. Areas like environmental impact analysis and management, and project evaluation should be enforced. A strong need to develop expertise in water quality monitoring was also identified.

Based on this assessment, CNA had planned to build adequate expertise to undertake the new activities resulting from the decentralisation as well as from the new water planning procedures. The project was expected to start in April 1993, and continue for at least three years. CNA would implement the training projects, with the support of IMTA and ODA. The contribution from ODA was expected to be $875,000.

Unfortunately, however, the IMTA assessment of the training needs for CNA professional staff was not properly carried out. It considered only certain sections of CNA. For example, major divisions of CNA like irrigation and infrastructure, and water administration were totally ignored. In the case of infrastructure it was because IMTA had already carried out an assessment earlier. However, IMTA-ODA assessment found that the quality of the material used for the training courses organised by IMTA, as a result of their earlier assessment, was very poor. Water Administration had its own management training programme, run by external experts (CNA, 1992a).

For several years, CNA has been going through a process of decentralisation. Under this programme, the regions and the states, as well as the users and the water utilities have been given more and more responsibilities, although they are still under the overall coordination and even control, of CNA. It was precisely to meet these demands resulting from the decentralisation, that CNA embarked in 1992 in the development of major training programmes focused mainly on the needs of the states and the regions, for which the assessment process was initiated. In spite of the focus of the study, very curiously, the assessment was carried out primarily in Mexico City: only two regional and one state offices were interviewed. The report included the evaluation of only one water utility in one of the states.

If the main objective of CNA for this assessment was to develop a framework for an action plan to build appropriate expertise so that decentralisation can work, the team should have visited most of the regions and states to get a clear picture of the situation prevailing outside the Mexico City, and to assess their specific requirements. Even though a general lack of personnel, mainly qualified, was identified in all the

places, the assessment was unlikely to have been reliable since existing capacities and future requirements in the states and the regions, including location-specific local problems and constraints were not reviewed.

For whatever reason, CNA never implemented the results and recommendations of this assessment. After engaging in this effort with IMTA and ODA, and after investing in foreign consultants, CNA basically ignored the exercise. New efforts were started afterwards on assessing capacity building requirements, but always from "square one," without considering the studies carried out earlier. Not surprisingly, none of these studies resulted in any sustained action for building the necessary expertise within the institution.

b) Assessment on the Process for Capacity Building for the Sub-directorate of Water Administration, CNA

In March 1995, the Directorate of Water Administration of CNA, with the World Bank support, carried out an assessment of the capacity building requirements for the directorate, with the support of an external expert (Biswas, 1996).

The report comprehensively analysed the processes related to the administration of water, as well as the requirements needed for the programme on capacity building (institutional arrangements, and human resources development). Since the water administration processes are interrelated, and depend directly on the performances and actions of the other directorates of CNA, the lack of coordination among these directorates were identified as a major constraint for the efficient formulation and proper implementation of the administrative processes. Other main issue identified was the lack of expertise of the personnel in terms of carrying out duties.

The recommendations included an urgent need to streamline the administrative processes, and the need to train the professional and managerial staff at the different levels, in the central, regional and state offices. Since a programme on capacity building for this Directorate on Water Administration would represent just a partial solution, an overall programme on capacity building for CNA as a whole was recommended. However, two changes in the Sub-Director General of this area in one year have meant no perceptible progress has been made during the past two years, not only in the area of capacity building but in other areas as well.

In 1996, the Directorate of Planning, CNA, started the process of developing an overall assessment of the needs of capacity building for CNA, with the support of IMTA. As of now, it has not been possible to obtain a copy of this analysis. Irrespective of what may have been the quality of the study (all IMTA studies reviewed for this analyses clearly indicate their poor qualities), or whatever may have been recommended by this report, it does not appear to have had any impact.

c) Exercise on Capacity Building for the Water Sector in Mexico

Integrated water resources management has now been accepted globally as a requirement for countries to achieve the sustainability of water development. One important means to manage effectively the water resources is to build the capacities of the concerned institutions, managerial systems and human resources (Alaerts, et.al., 1991). National capacity building programmes include the updating and implementing of policies, the institutional strengthening, and the development of human resources, at local and national levels, with emphasis on local communities.

The Programme on Capacity Building for Sustainable Water Sector Development, of the United Nations Development Programme (UNDP), represents another effort for the development of appropriate policies and legal framework, institutional strengthening and community participation, and human resources development for the water sector, especially in developing countries.

In 1993, UNDP started a long-term process in the development of national programmes for the planning and implementation of national water resources through capacity building. The countries initially selected were Peru, Bolivia, Costa Rica and Mexico in Latin America; Sudan, Mali and Ghana in Africa; and China (Guizhou Province), in Asia (UNDP, 1996).

In Mexico, the programme on capacity building was started in 1995 under the supervision of a foreign UNDP-expert (Biswas, 1995b) and was coordinated by IMTA, with the support of a multi-disciplinary team of staff members and consultants. The main objective of this programme was to identify the priority areas of capacity building through a national consultative process, and then to outline how and by whom the needed capacities could be developed.

Stakeholders from all the water sectors and users were expected to be consulted, and initially there was an agreement on the process that would be used for this study. The analysis was expected not to represent IMTA´s needs or preferences, but a national consensus on the priority needs of the country in terms of capacity building in a few selected priority areas. The process was expected to be mainly consultative, and the consultation was expected to be national. IMTA carried out discussions with mostly middle level staff members of CNA, SEMARNAP, and UNAM. These discussions resulted in the preliminary selection of 75 areas in which capacity building would be needed. IMTA´s own bias was clear since 72% of the areas identified were related to research and technology, and 28%, with human resources development (IMTA/PNUD, 1995; Arreguín, et.al, 1996). Policy and institutional issues were basically ignored.

Further to these discussions, IMTA organised a brain-storming session with experts from different disciplines and institutions. Five study areas were identified:

- integral management and planning of water resources;
- impact assessment and water quality;
- hydrometeorology;
- irrigation; and
- rural and urban water supply and sanitation.

In each one of these areas, the following issues were expected to be analysed: information, health issues, social aspects, institutional arrangements, budget, strategies, tariffs and cost recovery, and technical aspects.

Terms of reference (TOR) for discussion papers for each one of the 5 areas were developed, which were subsequently prepared by the consultants chosen by IMTA. The discussion papers were distributed to representatives of several public and private institutions, research centres, universities, users associations, and NGO´s, both local and national. National meetings were organised in different parts of the country, with participants to whom the discussion papers were sent earlier. A total of 239 experts took part in these five workshops.

The sub-areas selected as priority by the working groups were as follows (Arreguín et al., 1996):

- integral planning and management development: methods and models for the allocation of water; and training programmes;
- environmental impact assessment and water quality: legislation for river basin management; and administration of the legislation for impact assessment;
- hydrometeorology: flood characterisation and control; and development of manuals related to floods;
- irrigation: operation, distribution and use of water; and salinity and drainage; and

- rural and urban water supply and sanitation: integral supply and sanitation for small communities (including awareness issues and education), and organisational development of public utilities, including modifications in the legal framework.

While the process for this study was carefully developed, its implementation left much to be desired. Because of internal IMTA politics, the project did not have a single project director, as was agreed to with UNDP earlier. Many of the IMTA Coordinators either did not understand the objectives of this exercise, or decided to bend them to suit their own personal requirements. Another major constraint of this exercise was the TORs prepared by IMTA for the development of the discussion papers. There was no communication between the Coordinators, as well as between the Coordinators and the consultants for the five background papers. Thus, the focuses of each one of the five TORs were different and not surprisingly the products were also different. The consultants were not properly briefed, nor did they basically know the types of outputs that were expected from them. The discussion papers were also not developed through extensive consultations as agreed to earlier, but basically reflected, almost exclusively, the personal views of the consultants and the senior IMTA staff members.

The report was not expected to represent IMTA´s interest and views, but outline the national consensus of water professional who were supposed to have been consulted and also those that were present at the meetings. However, in some of the areas, the IMTA staff had already decided, a priori, what was needed and how these were to be accomplished, and discussions were focused on that direction from the very beginning. On the other hand, for some unknown reasons, IMTA erroneously expected unilaterally to receive from UNDP one million U.S. dollars for implementing each project, even though. UNDP had clearly stated from the very beginning of the process that they would provide only the seed money for the programme, and once the assessment was completed, the various institutions agreed to by the national consensus to implement the capacity building exercise would jointly prepare a consolidated capacity building programme. With this programme, UNDP would assist the various institutions to raise the necessary funds from national and international sources.

Not surprisingly, with the TORs that were different from each other, with no communication between the IMTA coordinators and the selected consultants, and with an already pre-determined hidden-agenda in certain areas, the study did not produce usable results. No direct follow-up actions even resulted from this project.

WATER QUALITY MONITORING

Sustainable development of a basin or a region, in its broader sense, would not be feasible until and unless it is based on the sustainable use of natural resources, especially its water resources. In zones with a greater degree of development and where water is scarce, sustainable exploitation of water resources will depend on the degree to which water is used efficiently and water pollution is controlled.

Mexican water resources policy, as presented in the Water Programme 1995-2000, is oriented towards ensuring the availability of water to satisfy the needs of the population and promote the development of economic activities in a manner that is environmentally compatible and sustainable in each region of the country. While conceptually this policy is sound, its implementation leaves much to be desired.

The Law of National Waters gives special attention to water quality, both in terms of protecting human health and preserving aquatic systems. The strategy is based on a systematic monitoring and evaluation of water quality; establishment of a set of water quality standards; establishment of a discharge permit and charge system and building wastewater treatment facilities.

Mexico is classified into 37 hydrological regions and 314 river basins. The CNA has evaluated the water qualities in 218 river basins in the country, which represent 77% of the territory, 93% of the population, 72% of the industrial sector and 98% of the irrigated areas. It was concluded that most of the basins are at present contaminated with organic, industrial, and/or agrochemical wastes (CNA, 1994). In the case of groundwater, the main problem is over-exploitation of the aquifers, which are often affected in many areas by heavy metals, fats, agricultural chemicals, etc.

The Mexican legislation considers seven different uses of water according with to quality:

- human consumption (after disinfection);
- drinking water supply source (before potabilization);
- recreation;
- agricultural irrigation;
- livestock; and
- protection of aquatic life in fresh water and aquatic life in the ocean.

The parameters and values that define various uses are noted in the respective Mexican regulations and criteria.

The basins have been classified as first, second and third order basins according to their degrees of disturbance. The first order basins are considered to be priorities in terms of control activities. There are 20 first order basins, which generate 89% of the total pollution load (evaluated as BOD). Only four basins, Pánuco, Lerma, San Juan and Balsas, account for 50% of the industrial and municipal wastewater discharges, including those from the main cities. Other first order basins include the Blanco, Papaloapan, Culiacán and Coatzacoalcos rivers, because of the magnitude and characteristics of their industrial pollution; as well as the basins of those rivers that discharge into the Cortes Sea because of high agrochemical residues leached from the irrigated areas.

There are 34 second order basins and 162 third order basins. All these basins are to be managed according to the specific problems each one encounters.

The quality of the water in the country is indicated by the index of water quality (ICA). The ICA denominates the level of contamination at the time of sampling, and is expressed as a percentage of clean water. Thus, highly polluted water would have an ICA close or equal to zero %, and clean water, would have an ICA near to 100%.

The physical, chemical and bacteriological parameters considered to determine the ICA are pH, colour, turbidity, oil and fats, suspended solids, dissolved solids, dissolved oxygen, biochemical oxygen demand, electrical conductivity, alkalinity, NO3, NH3, PO4, Cl, total hardness, total coliforms, faecal coliforms, and substances active to methylene blue. The criteria to decide whether the water is appropriate for a certain use is as follows (CNA, 1996b).

- *Drinking water*

90-100	Excellent, purification is not needed for its consumption
80-90	Good, with minor purification
79-80	Slightly polluted
50-70	Polluted, purification necessary
40-50	Very contaminated
0-40	Excessively polluted, it should not be consumed under any circumstance

- *Agriculture*

90-100	Excellent
70-90	Good
50-70	Slightly polluted
30-50	Polluted, treatment needed for most crops
20-30	Very polluted, to be used for certain selected crops, like forages
0-20	Excessively polluted, cannot be used under any conditions

- *Fisheries and Aquatic Life*

70-100	Excellent
60-70	Good, very sensitive fishes can survive
50-60	Slightly polluted
40-50	Polluted, aquatic life limited to very resistant species
30-40	Highly polluted
0-30	Excessively polluted, not suitable for aquatic life

- *Industrial*

90-100	Excellent
70-90	Good, minor purification necessary for certain products
50-70	Slightly polluted
30-50	Polluted, treatment needed for most uses
20-30	Highly polluted, restricted use only
0-20	Excessively polluted, not suitable for any industry

- *Recreation*

70-100	Excellent
50-70	Good, but not for sports like diving
40-50	Slightly polluted, not suitable for contact sports like swimming
30-40	Polluted, avoid any contact
20-30	Highly polluted
0-20	Excessively polluted, not suitable for recreation

Water Quality Monitoring Programme

The Water Quality Monitoring Programme that is basically in existence at present was developed to cover the needs of the 1960s. The current network of 564 surface water stations is an inherited network that has grown over a period of more than 20 years without any systematic consideration. Sampling frequency is variable, from monthly to quarterly depending on budget and location, and there are prolonged data gaps when funding is a constraint. Most CNA laboratories are old and many are dysfunctional because of lack of modern instrumentation and chronic under-funding. There is no national reference laboratory for the setting of standards. Generally, the level of expertise in environmental chemistry and toxicology is inadequate for modern water quality management needs (Ongley & Barrios, 1997), and quality control and quality assurance leave much to be desired.

In terms of water quality, the strategy for its improvement is through the legal framework. Priority is given to first order basins in terms of development of monitoring system, systematic evaluation of the water bodies; development and introduction of discharge permit system (records, surveillance and control); promotion of pre-treatments before discharging industrial to municipal wastewaters sewage network; and redesigning of the payment system related to the discharge of wastewaters. In terms of infrastructure, sewage system are to be expanded, and municipal and industrial wastewater treatment plants are to be constructed and rehabilitated. Institutional capacities are to be strengthened through training, as well as the development of the information system related to water quality, and research and technological development. The concept of reuse is to be promoted and quality considerations are to be incorporated within a new culture of water.

According to the analysis by Biswas et al. (1997b), the water quality monitoring programme in Mexico, should consider different goals simultaneously depending on the different users. The goals could be as follows:

- assessments of water quality trends in the country, as well as regional and local trends at desired locations;
- assessments to ensure that the international obligations of the country under the various agreements and treaties notified by the country can be met successfully;
- regulatory monitoring to ensure that the standards established and legal requirements are being met satisfactorily on a regular basis; and
- decentralisation of the highly centralised monitoring activities, and promotion of participation of the private sector and academic institutions.

The specific micro goals identified by Biswas, et.al. (1997b) include the following:

- estimation of waste assimilative capacities of the rivers;
- assessment of the appropriateness and implementation of water quality regulatory strategies;
- surveillance to detect adherence to or violation of water quality standards;
- detection of sudden changes in water quality due to accidental and/or deliberate discharge of pollutants;
- forecast of hydro-ecological emergencies due to low flows;
- estimation of reduction in pollutants loading so as to meet legal water quality standards; and
- forecasts of water quality conditions due to expected changes in waste discharges, e.g., construction of a new industry.

Groundwater and surface water should be monitored in different and specific ways. In addition, the approaches to standard trend monitoring and regulatory or compliance monitoring could vary from one case to other.

Participatory Opportunities for the Private Sector

Even the strongest water authority is likely to become weak eventually, unless it is not supported by the public. The organised participation of water users and interested parties is a must for an integrated water resources management. It is necessary to streamline and coordinate research and development activities carried out by the private sector, universities and research institutions in Mexico. International cooperation should be considered to achieve the greatest social, economic and environmental benefits.

The water planning and management programme area includes studies related to the classification of receiving bodies in terms of water quality, redesign of the monitoring networks, design of water quality laboratories, pre-treatment of industrial discharges, and reuse of the water. Also, projects related to the municipal and industrial wastewater treatment plants, laboratories, and reuse of the water. Another actions

would include communication methodologies for water project development; social-impact studies of water-related problems; real-time hydro-meteorological forecast techniques; geographical information systems; satellite imagery for water resources assessment; and wastewater reuse methodologies, to mention some examples.

The operation and maintenance necessary to ensure reliable results from new equipment will require development and successful implementation of new maintenance and repair procedures in observation, communications and computing networks, effectively allowing the equipment to serve as a network foundation for a number of users and purposes. New schemes and methods for contracting out work to private sector will be necessary to gradually incorporate additional equipment to maintain the network's technological and national coverage levels.

However, prior to developing new technology, a comprehensive analysis of the problem is necessary to determine whether it is necessary simply to improve information sources and reliability so as to feed the technology with precise data, thereby obtaining adequate results, or whether it is a problem which requires adaptation or development of new technology. Equally important s the fact that the private sector can play an important role in water quality monitoring, analyses of samples in laboratories, and in other areas of water quality management. If they seize this opening, the private sector can ensure that the process benefits both developing country societies and environments.

Access to information, including data, regarding water planning and management in Mexico is now almost negligible for any individual who does not work in CNA. Even within CNA, information is not available to individuals unless they work in the same division where that information is produced, or data are collected. Water quality is not an exception. By law, all information generated by the government should be made available to interested public and private sector institutions, universities, research centres, NGOs and citizens. However, CNA has completely ignored this legal requirement thus far. Accordingly, neither the Government as a whole nor the general public have a clear idea of what are the problems with water quality or how these problems could be resolved. Universities and research institutions are unable to carry out any in-depth investigation because of absence of data.

Efficient water management in Mexico is still a long-term goal. The development of an efficient and reliable water quality monitoring programme would undoubtedly constitute a major advance in terms of water quality management at national and regional levels.

WASTEWATER MANAGEMENT

Currently, there are a series of legal requirements which regulate the discharges of wastewaters to water bodies. However, these regulations were developed over a period of time by different groups, without appropriate consideration of existing laws and regulations. Accordingly, the existing legal regime is inconsistent: regulations are often in conflict with each other, responsibilities for ensuring their compliance is highly diffused in institutional terms, and overall objectives to be achieved are often not cleared. In order to evaluate the quality of the water in the country, it is necessary to develop a comprehensive regulatory framework for wastewater discharges at the national level.

Diagnosis of Water Pollution

Both water quality and legal expertise in CNA in this area leaves much to be desired. Accordingly, the country needs a consistent sets of water quality regulatory framework which can be implemented. An attempt to develop such a framework has not been begun. In fact, all the signs indicate that CNA is not even

aware that such a new framework is urgently needed. The main source of water pollution is agriculture, which contributes with more than 75% of the pollution load. It´s control and regulation goes beyond any environmental legislation, since they represent non-point sources of pollution which experiences from all countries indicate are very difficult to control. The solution to such diffused sources of contamination is more on the control of the amount of pesticides or fertilisers applied in terms of their efficiency. Thus, the regulation on wastewater discharges focuses mainly in the point sources from industries and municipalities, which aggregate at about 170 m^3/sec at the national level. According to current estimates, there are about 35,657 sources of wastewater in the country: 517 are higher or equal to 5,000 m^3/day; 1,182 are between 800 and 5000 m^3/day; 2,395 are between 100 and 800 m^3/day; 3,545 between 25 and 100 m^3/day; and 28,018 are equal to or less than 25 m^3/day (CNA, 1996b).

The areas with higher population in the country have the main industrial activities, and also account for a higher percentage of drinking water and sewage facilities. The areas with more than 50,000 population are responsible for 79% of the wastewater generated at the national level. About 50% of the municipal discharges are from 146 urban areas with more than 50,000 people; 10% from localities with more than 2,500 and less than 25,000; and 20% from localities with less than 2,500 people. The discharge from domestic activities average 1.28 millions tons of BOD, out of which only about 0.03% are treated. This clearly indicates the inefficiency of the legislation that has been put in place from 1970, and also the capacities of institutions that are expected to implement them.

The GDP of Mexico increased by more than 8% until 1979, and this promoted the development of the industrial sector mainly in 3 cities: Mexico City, Guadalajara and Monterrey. The national growth decreased after 1979. However, overall, the industrial sector has prevailed, and has even increased. As a direct result of non-controlled industrial, municipal and agricultural activities, Panuco, Lerma, Balsas, Coatzacoalcos, Blanco, Papaloapan, Valle de Mexico, Conchos, Coahuayana, Culiacán, Fuerte, Yaqui, Mayo and Bajo Rio Bravo river basins are now highly polluted. Reduction of water pollution can only be successfully achieved with the participation of the different economic sectors of the country, and support of the society (INE/SEMARNAP, 1996).

According to the information available from the National Water Quality Monitoring Network, all the main bodies of water in the country are polluted (CNA, 1994). Currently, about 68,000 ha. of surface area in 268 bodies of water, 10,000 km of canals and 14,000 km of drainage channels are infested with aquatic weeds. Such infestation of aquatic weeds provides an ideal habitat for the vectors of water-borne diseases, which affects public health. Fisheries and navigation are adversely affected, and water losses increase due to higher levels of evapo-transpiration. Flow velocities in canals decline due to the obstruction caused by aquatic weeds. This increases sedimentation in the canals. Overall, water management steadily becomes more and more inefficient.

The groundwater has an heterogeneous quality in the country. In many cases it is contaminated with metals, pesticides, agricultural run-off, etc. However, main problem with respect to groundwater has been over-exploitation, which has resulted in the salt water intrusion in certain coastal aquifers, and land subsidence in Mexico City.

Main Sources of Pollution

a) Municipal sources. In 1997, 15.1 millions of Mexicans did not have access to sewage facilities (79% in the rural areas), resulting in acute pollution problems. At present, the total amount of water extracted for domestic use is about 8.5 km^3 (270 m^3/s). Even though there is infrastructure to treat 1.4 km^3 (43 m^3/s), only 0.53 km^3 (17 m^3/s) are treated efficiently. There are 7.3 km^3 (23 m^3/s) of wastewaters and just 5.5 km^3 (174 m^3/s) go to the drainage. Consequently, about 6.8 km^3 (214 m^3/s) are discharged to the environment with no treatment at all (SEMARNAP/CNA, 1996).

b) Agricultural Sector. In 1995, 61.2 km^3 of water was used for agricultural purposes nearly $2/3^{rd}$ of which come from surface waters and $1/3^{rd}$ from groundwater. It was estimated that only about 40 km^3 was used in irrigation and the rest was lost in the canals and due to evaporation. Average, there is a return flow of about 12 to 15 km^3/year with pesticides and fertilisers which pollute the water and promote the growth of aquatic weeds (SEMARNAP/CNA, 1996).

c) Industrial. In 1995, the total volume of industrial water used was 2.5 km^3 (78.7 m^3/s), by the 1387 industries considered as the most important in the country for the volumes of water they use and discharge. Nearly 75% of the water utilised by industrial activities came from groundwater, and 25% from surface water. In addition, the thermal power stations used an additional 5.0 km^3/year of brackish water for cooling purposes (SEMARNAP/CNA, 1995).

According to the Water Quality Monitoring Network, the industrial sector faces severe constraints to use the surface waters, since 58% of the water is polluted, and 21% is highly polluted. In 1994, the volume of industrial discharges was about 2.05 km^3 (64.5 m^3), contributing to 1.6 million tons of BOD/year, which corresponded to pollution generated by 68 million people. The amount that was treated was about 8% (0.17 km^3 or 5.3 m^3/s), and an average of 0.12 millions tons of BOD was removed. The amount of untreated wastewater was estimated at 1.88 km^3 (59.2 m^3/s), containing some 1.28 million tons of BOD.

In general, the industry extracts excessive amounts of water for its processes and produces a high amount of pollutants like acids, fats, oils, heavy metals and total suspended solids. The industries that use more water and pollute more are the producers of sugar, petrochemicals, petroleum, pulp and papers, food and metals. Some of these industries are located in areas having low water availability, causing over-exploitation of aquifers, and high-pollution of the environment.

It is estimated that the demand of water at national level by the year 2,000 will be 2.6 km^3 (82 m^3/s), and the amount of wastewater discharged would be 2.1 km^3 (66 m^3/s).

Legal Framework

The first law which mentioned the environmental issues was the Federal Law to Prevent and Control Environmental Contamination. It was passed in 1971, and its regulation in 1973. It included air, water and soil-related issues. It focused was to control pollutants and their causes, irrespective of their origin. Its implementation was the responsibility of the then Ministry of Health, since the environmental problems were viewed only in terms of public health. One inconsistency about this Federal Law was that it was issued before the reform of the Article 73/XVI of the Mexican Constitution, which establishes that pollution issues are under the then Council of General Health.

The above Law focused on preventing contamination of those water bodies, which still had their natural characteristics intact. However, the intention was to preserve these bodies in their natural conditions, but use their assimilation capacities rationally so that the water quality for their intended use was not altered. It considered also the control of pollution of water bodies, which were already contaminated. The idea was that, with the help of the different sectors, the quality of the water could be improved. With this objective, criteria were developed to classify the water according to its quality and intended use. An action plan was developed with the objective of regulating the discharges and promoting the construction of wastewater treatment plans. The plan established that the parameter to evaluate the discharges would be the "specific conditions for discharges of wastewaters (CPDs)", which considered industry-specific effluents and emission limits. The CPDs would be fixed by the authorities based on studies of the qualities of the water bodies through which the waters of the country would be classified depending on their uses and their assimilation capacities. The deadline to comply with the CPDs was stipulated to be not less than one year and no more

than three years. CPDs could be modified after 5 years, if the changing demographic or ecological conditions so warranted, or before they represented a risk to the public health.

The Federal Law on Water was issued in 1972. It established the water utilities as institutions to reinforce the regulation and distribution of water. In 1982, the Federal Law on Environmental Protection was passed, which includes protection to fauna, flora, soil and marine ecosystems. This Law was later modified in 1984. It required for the first time preventive measures for the protection of the environment including evaluation of the environmental impacts of public and private projects, as a basic instrument of planning. This law could not be implemented since no regulation was ever issued, and according to the Article 3 of the 1984 Law, as long as no regulations were issued, the regulations of the earlier Law continued to be valid.

The restrictions imposed on the discharges of the industries were decided once the CPDs had been defined. This required very detailed and complex studies to define the assimilative capacity of the water bodies and the calculation of this capacity among the different industries. These studies were not only very time consuming but were also very expensive. Thus, even if the CPDs are considered to be the most efficient way of determining how bodies of water could be used according to their assimilative capacity, it was essential to consider another alternative which could be implemented on the technical and economical basis Garduño & Villavicencio, 1996).

Regulatory Instruments

The LGEEPA, along with the Law of National Waters and the Federal Law on Excise Taxes, provide the regulatory, economic and participatory framework for the granting of discharge permits. These are regulated by the polluter pay principle, in which the tariffs depend upon the pollution loads and the assimilative capacities of the receiving bodies. According to the legislation, CNA is responsible for the water quality management of the country through its classification of water bodies. CNA should define what should be the quality of the discharges from the industries and the municipalities; which discharge parameters should be monitored; what are the assimilative capacities of the receiving bodies and what are the quantities of pollutants that can be discharged. Specific goals need to be established for each water body of the country.

It was the LGEEPA (1988) which gave the then Ministry of Urban Development and Ecology the responsibility to issue technical norms to prevent and control water pollution, the responsibility for which at present lies with INE/SEMARNAP. From August 1988 to October 1991, 33 Ecological Norms were issued on wastewaters (29 are for industries, 1 for hospitals, 1 for municipal sewage discharging to water bodies and 2 for irrigation).

These norms defined the maximum limits of the most characteristic constituent parameters for wastewater discharged by different industries and municipalities, so that they were restricted in terms of total pollutants produced. These limits could be achieved through secondary treatments (biological). On 10 July 1992, the Technical Norms on Ecology were reviewed and converted into Mexican Official Norms (NOMs). The NOMs replaced 90% of the CPDs.

By 18 October 1993, there were 33 NOMs, and by 5 January 1995, there were 11 more. These NOMs include regulations for thermal power, sugar industry, petrol, petrochemicals, fertilisers, plastics, food, beer, milk, glass, rubber, iron and steal, textiles, pulp and paper, soft drinks, coffee, metals, hotels, hospitals, municipal drainage, irrigation, etc.

The Law on National Waters and its regulation define the quality of wastewaters before these could be discharged into the water bodies. The CNA is responsible for taking necessary actions to achieve the quality needed. It is also to develop policies, define and survey the implementation of CPDs; quality of

drinking water; and sanctions. To define the characteristics of the discharges according to the assimilative and dilution capacities of the water bodies, the law and regulation include the "Statement to classify the bodies of water and stream in the country." The law also stipulates that it is necessary to have a permit in order to discharge wastewaters. This is with the objective to verify the implementation of the regulations.

CNA is responsible for preventing pollution and improving the quality of the water according to both the NOMs and CPDs. The permits would be issued to the users after the consideration of classification of the water bodies, NOMs and CPDs. The Federal Law on Excise Taxes would establish the level of payments for the rights to use water. In 1995, the CNA made the proposal to INE to modify the regulations concerning wastewater, substituting the 44 NOMs for 3 NOMs:

- NOM-001-ECOL-1996, defines the maximum limits for pollutants in the discharges of wastewaters to water bodies;
- NOM-002-ECOL-1996, defines the maximum limits for pollutants in discharges of wastewaters to the sewage; and
- NOM-003-ECOL-1996, defines the maximum limits for pollutants in treated wastewaters that would be reused for the public services.

The NOM-001-ECOL-1996, would be implemented in 3 parts:

- Part 1. January 1st, 2000, for population equal to or more than 50,000 and non-municipal discharges when the pollutant levels are higher than 3 tonnes/day of BOD or total suspended solids.
- Part 2. January 1, 2005, for population of 20,001 to 50,000, and non-municipal discharges with pollutant levels higher than 1.2 to 3 tonnes/day of BOD or TSS.
- Part 3. January 1, 2010, for populations of 2,500 to 20,000, and non-municipal discharges with pollutant levels less than 1.2 tonnes/day of BOD or TSS.

The regulations define the following uses:

- A: Rivers, used for irrigation, fisheries, navigation;
- B: Rivers, urban use, natural and men-made lakes, irrigation use, recreation and wetlands;
- C: Rivers, protection of aquatic life, natural and artificial lakes, urban use.

The proposal for the NOM-002-ECOL-1996 was published 9 January 1997 in the Official Federal Journal. The final version is ready to be published. The proposal for the NOM-003-ECOL-1996 has been signed and authorised for publication in the Official Federal Journal.

The Federal Law on Rights complements The Federal Law on Excise Taxes. According to the National Water Law, it is the Federal Rights Law which should define the levels of fees for industries if their discharges do not comply with the regulation. This law is to be reviewed annually. The objective is not to make a profit out of the funds received from industries that do not comply with the requirements but to promote changes in wastewater management.

It is the responsibility of the industries to sample and analyse the quality of their effluent discharges. The surveillance on wastewater discharges is the responsibility of CNA (for federal bodies of water), and sewage is jurisdiction of the states and municipalities. It is important to note that no funds have so far been allocated for the implementation and surveillance of the regulations on wastewaters. The financial crisis of the country has forced the Federal budget to support work for education, health and poverty alleviation. Environment and water quality management have not been considered a priority so far.

Implementation of the Different Instruments

Numerous problems have been noted for regulating the effluent discharges. Monitoring activities are comparatively new, and lack of continuity in authorities and legislations have been a continuing problem. The main problems are not that all the receiving water bodies have not yet been classified, but rather that the cost of the physico-chemical analyses that should be carried out by the users is very high; considerable problem exist with solid wastes disposal; reasonable water quality laboratories and expertise outside Mexico City simply do not exist; and the rural communities are disperse.

New single standards (Mexican Official Norms, NOMs) have been approved for all industrial and municipal disposals. These have replaced 90% of the 44 standards issued earlier for specific industrial and municipal discharges (CPDs). The objective of the new legislation is to simplify the processes by emphasising economic incentives. For example, effluent charges could be reduced by 6 to 44% for those facilities which have treatment plants, and discharges which could not only comply with the legislation, but also better than stipulated. Those industrial concerns which develop programmes to improve the quality of their discharges and comply in a timely manner, are exempt from any payment. Those users whose discharges exceed by 5 times any of the parameters need to develop a wastewater treatment programme within a certain time (OECD, 1998). A major problem, however, is that the different legislations consider different parameters, and/or different concentrations, which make both compliance and enforcement difficult.

A comprehensive analysis of the legal framework for discharges indicates major inconsistencies between the existing legislations. For example, the criteria for evaluation of discharges are different under the three laws. The LGEEPA considers ecological criteria and classification of receiving bodies and streams; the Law on National Waters considers just the classification of the receiving bodies and streams; and the Federal Law on Excise Taxes, has established unilaterally, a list of receiving bodies and streams, with no technical considerations but theoretically based on technological criteria. While the LGEEPA and the Law on National Waters recognise the NOMs and CPDs as regulatory instruments, the Federal Law on Excise Taxes recognises only the CPDs as the solely instrument to control the discharges. It does not even consider the existence of the NOMs. In addition, many of the laws define the conditions under which each regulation could be followed, nor under what conditions. No Law has priority on the others in terms of implementation.

It is not clear to the users which parameters should be considered: CPDs or NOMs. For the implementation of the different regulatory instruments, it is essential that a hierarchy be established among the different laws. It should also be ensured that the various legislations do not contradict each other.

As mentioned earlier, the amendments to the LGEEPA included the definition of the roles of the government at the federal, state and municipal levels for the prevention and control of water contamination. According to these amendments, the Federal Government is responsible for controlling the discharges to national water bodies; states are in charge of the discharges to water sources from the states, as well as to those national water bodies for which they are responsible; and the municipalities are responsible for the discharges to the sewage systems, with the support of the states whenever necessary.

The realities, however, are very different. In the states and the municipalities, the institutions that are responsible for distributing water are different from the ones that are in charge of preventing and controlling contamination from wastewaters. It is thus necessary to carry out institutional reforms so that only one authority is responsible for these activities. The water utilities do not have adequate financing for their present operating costs, let alone the funds necessary to cover future investments needed for supplying drinking water to a continuously expanding population. The water utilities have to be supported until they can be financially independent so that they can carry out new activities. So far, the cost for the construction and operation of treatment plans has to be covered from the Federal budget and from subsidies for both the

states and the municipalities. In addition, the general public does not appear to accept the fact that they have to pay for the services, including water.

Even though the discharges permits are regulated by the polluter pay principle, most of the polluters do not pay at present. The small-scale industry, for example, had an average income of around $1,000 in 1997, and thus their economic conditions do not allow them to undertake any effective pollution control measures (España, 1997). Many major industries often find "political" alternatives to avoid paying non-compliance fines, and some others simply prefer to pay without modifying their major production processes to improve effluent qualities, or constructing new treatment plants. Another major problem is the politicians themselves. In order to attract votes, they some times misguidedly push for very low, or even no charges for supplying drinking water and for maintenance and operation of sewage systems.

The criteria to establish sanctions and fines also varies in the different legislations:

- The LGEEPA establishes sanctions from 20 to 20,000 days of the average minimum wage of a worker; to close partially or totally, temporarily or permanently, the sources of pollution; administrative arrest for up to 36 hours and the decommissioning of the sources of pollution. When there is the risk of acute deterioration to the natural resources, ecosystems or public health, the government can shut down certain activities which do not comply with the legislation.
- The Law on National Waters establishes sanctions from 500 to 10,000 days of salary; to close partially or totally, temporarily or permanently, the processes which generate the discharge; suspension of activities and even the discharges; and to revoke the permit to discharge, which means stopping the discharges. When the discharges can result in acute problems for public health, or for the ecosystems, the activities or the discharges could be stopped.
- The Federal Tax Law only mentions the payment for the rights for the effluent discharges.

It is evident that comprehensive and objective analyses of the existing legal, economic and institutional frameworks are essential for the prevention and control of water pollution. If the effluent discharge fees, as stipulated under the existing legislations, are promptly and efficiently collected, and other allowable legal sanctions are implemented, they would provide a powerful incentive to reduce the discharges.

At present, the payments for the rights to discharge in water bodies is used by CNA to construct water projects. Modifications have been proposed so that these fees could be used to promote wastewater management activities like changes in the processes of industries, or construction of new treatment systems.

An integral analysis of the legal, institutional and economic framework is urgently needed. It is absolutely essential to make appropriate amendments to the different legislations so that they are mutually consistent and implementable. More emphasis needs to be placed on water quality management, and the availability of good quality drinking water should be a priority. It is necessary to improve water quality monitoring. For domestic wastewater treatments, cost effective alternatives, such as, lagoons and submarine outfalls, need to be considered, especially as their costs are often only a small fraction of that of conventional wastewater treatment plants, and they are also much easier to manage.

III. ENVIRONMENTAL IMPACT ASSESSMENT OF WATER PROJECTS IN MEXICO

During the last 70 years, 1270 reservoirs have been constructed in Mexico, having a total storage capacity of 150 km^3 to regulate seasonal and annual variations. More than 700 km of aqueducts deliver over 36 m^3 per second of bulk water, which benefit more than 70 million people (González-Villarreal & Garduño, 1995). However, by 1995 (CNA, 1997a) more than 15 million people still did not have access to clean drinking water, and another 30 million to sanitation facilities. In addition, four million ha of land have yet to be irrigated, and 70% of the hydroelectric potential of the country has still to be developed.

The quantity of freshwater in Mexico that can be used by people at any given time is limited due to economic, technological, social and environmental reasons. Nearly all the easily exploitable sources of water in the water deficit regions of the country have already been developed, or are in the process of development. This means the costs of development of new additional sources of water are likely to be significantly higher in real terms in the future than what have been observed in the past. A recent review of the domestic water supply projects carried out by The World Bank, which included a project for the Mexico City, indicated that the cost of development of each cubic metre of water for the next generation of projects is more than 1.75 times, and in many cases even three times higher than that of the present generation (World Bank, 1998). Thus, clean water will only be available in the country in the future at a much higher unit costs than estimated at present.

In order to assure that the environment and natural resources would be protected during the construction and operation of the present and the future water projects, environmental impact assessment (EIA) legislation and procedures represent a critical need for the country.

The EIA for major development projects was made mandatory in Mexico in 1988. Prior to this date, the creation of environmental units within the Federal Government Administration, set the basis for the legal adoption of EIA. One of these, the "Intersectoral Commission for Environmental Sanitation" (Comisión Intersectorial de Sanidad Ambiental) designed the EIA procedural framework that was adopted in the Law of Public Works (Ley de Obras Publicas) in 1980 (CNA, 1996a).

It was after the promulgation of the Law of Public Works in 1980, and the Federal Law of Environmental Protection (Ley de Protección Ambiental) in 1982, that the then Ministry of Social Development (Secretaría de Desarrollo Social, SEDESOL) developed the guidelines for the preparation of Environmental Impact Statements (EIS). The General Law of Ecological Balance and Environmental Protection (Ley General de Equilibrio Ecologico y Protección Ambiental, LGEEPA) was promulgated in 1988, and amended in December 1996. By 1992, about 70 EIS related to water projects had been prepared (CNA, 1996a).

The implementation of the LGEEPA and its regulation have traditionally been poor. Heavy centralisation, absence of environmental expertise, lack of realisation of the management of the importance and relevance of environmental and social issues, lack of clear administrative processes, ambiguity in the type of project or activity which requires EIS, absence of modalities for social participation, etc., have all contributed to its poor implementation. Thus, main modifications to the LGEEPA (Section V) were related

to the EIA problematic in Mexico, including its surveillance and implementation. The LGEEPA defines, for example, the type of projects or actions that need to be authorised in environmental areas by SEMARNAP. It includes water projects, projects and activities in wetlands, lagoons, rivers, lakes and estuaries, as well as in littorals and federal zones; and following activities: fisheries, aquaculture or agricultural activities which threaten public health or affect the preservation of the ecological balance and require environmental protection. The law also requires that EIS should evaluate both the positive and negative impacts of the projects, and not just emphasise on the negative ones , as it was the case earlier.

According to the LGEEPA, SEMARNAP can demand an EIS where activities could result in ecological unbalance or threaten the public health and the ecosystems, even if they are not specifically required by in the legislation. The law stresses the importance of obtaining a legal permit from the appropriate authority before the construction of any project, or any activity which could affect severely the environment and natural resources. It links the EIA procedures to those of land use planning and human settlements. When the local authorities develop plans for urban development and land use planning, all the projects and activities should be included so that the Federal Government can evaluate them from the environmental viewpoint as a whole, and not individually.

Most importantly, the LGEEPA promotes public participation during conduction of EIAs. Before the amendments to this law, social participation meant that the general public could read the EIS submitted on the projects and activities, if they so wish. With the new modifications, there is an opportunity for the public to discuss the various projects and activities which could severely damage the environment, or threaten public health or ecosystems. According to the law, any person, social group, NGO, or association can denounce to the Office of the Federal Attorney for Environmental Protection (Procuraduria Federal de Protección al Ambiente, Profepa) those activities or omissions which could result in ecological deterioration or threaten the environment or the natural resources, or which do not comply with the law. Those persons or institutions who turned out to be responsible for the damage, can be taken to court.

EIS GUIDELINES

In Mexico, initial decision to review water projects are undertaken by an internal CNA body (Department of Environmental Management and Evaluation) which deals exclusively with EIA. After receiving the EIS from the consultants, and before submitting them to SEDESOL, the EIS are reviewed, mainly in terms of having followed the terms of reference CNA had defined earlier. The LGEEPA allocates SEDESOL the responsibility to evaluate EIS. It mentions that prior to the construction of a water project, CNA has to submit to SEDESOL, a preventive report if the project will neither have adverse impacts on the environment nor violation of established limits and thresholds. Within 30 days, SEDESOL is expected to review the preventive report and, if it considers that the information submitted is not sufficient, it will require EIS at different level to be carried out. If SEDESOL does not give any answer within the time frame established by the law, it means that no EIS is necessary.

The EIS should include (at least) a description of the potential impacts on the ecosystems due to the projects or activities. It should include the characteristics of the ecosystems affected, as well as the preventive and mitigation measures necessary to avoid and/or reduce to the maximum extent the negative impacts of the planned projects on the environment. The details of the information required for EIS at different levels and the preventive report are included in the LGEEPA regulation. EIS could be a three levels, general, medium and specific, depending on the project characteristics, its location and overall potential environmental impacts: general, medium and specific. For all projects, a general EIS must be submitted. If the impacts are not significant, a project may be cleared at this stage. For projects which could have significant impacts, more detailed studies (medium level) may have to be prepared. Finally, if a project is considered to have serious impacts, further elaborate studies (specific level) may have to be submitted before it can be cleared for implementation. The evaluation of all EIS would include the following issues: ecological land use planning;

regulations for protected areas; ecological criteria for protection of flora and fauna, and sound use of natural resources and environmental protection; and ecological regulation for human settlements, as well as all ecological regulations, and ecological norms mentioned in the LGEEPA.

According to the legislation, the projects which were 10-75% constructed, but were not completed by 1988 when the LGEEPA was promulgated, needed to submit an environmental diagnosis to the concerned Ministry; and those projects which were 10% constructed by 1988, needed to submit an EIS. However, there was no need to submit any type of environmental analyses when more than 75% of any project was constructed, when it would not result in any change of land use, and when the land to be affected would be between 101 and 1,000 ha.

The structure of the diagnosis is very similar to the one of the EIS. The main difference between an environmental diagnosis and an EIS is that EIS is mainly predictive in terms of impacts, whereas the diagnosis should be predictive, but should also identify any impact that was not identified when the project was planned. The diagnosis should include a detailed description of both negative and positive impacts of the project, as well as an analysis of the implementation and usefulness of the mitigation measures which were proposed when the project was planned compared to when the diagnosis was carried out. In the diagnosis, it should be possible to identify the negative and positive impacts of the projects themselves in the area of the project and in the surrounding areas, and thus mitigation measures should be very concrete and specific.

Following is a description of water projects which do not require preparation of any type of environmental report, as well as those which require Preventive Reports (Table 3), and those which require EIS and type of statement needed.

Table 3. EIS requirements for specific water projects

Do not require EIS	Preventive report
• Dams having a storage capacity of less than 500,000 m^3. • Agricultural units smaller than 100 ha. • Isolated wells. • Levees • Extractions of water for less than 10% of annual volume. • Projects smaller than 100 ha. • Rehabilitation, conservation and maintenance projects. • Projects needed in emergency situations.	• Dams with a reservoir area not bigger than 1,000 ha. • Irrigation projects between 101 and 1,000 ha. • Extraction of volumes of water less than 10-15% of the annual runoff. • Utilisation of water within the same basin. • Introduction of technology in rain-fed agricultural areas which do not need drainage.

Source: LGEEPA Regulation, 1988.

Projects which require a Preventive Report

The LGEEPA would require a Preventive Report, instead of an EIS, in the following situations:

- When there are NOMs which regulate the emissions, discharges or any other environmental impact resulting from the project or activities.
- When the projects or activities are part of any urban development plan or land use planning already evaluated by SEMARNAP.
- When the facilities are within industrial areas previously authorised for certain activities.

Projects which require the EIS

- Open land areas for agricultural activities or to grow livestock; or modifications needed to change from rain-fed agricultural areas to irrigated areas, and which require a surface bigger than 1,000 ha.
- Dams with a reservoir area bigger than 1,000 ha.
- Extraction of more than 50% of the annual run-off from a natural body of water.
- Intra-basin transfer of water.
- Introduction of technology to rain-fed agricultural areas, which require drainage.
- Projects which pollute or prevent the recharge of aquifers used for drinking water.
- Projects which destroy historically- or culturally-important areas.
- Projects which impact negatively on the life style of ethnic groups living in the area.

a) EIS, General Level

- Open land areas to agricultural activities, between 1,001 to 50,000 ha.
- Dams with a reservoir area between 1,000 and 10,000 ha.
- Projects to transfer of water, shorter than 50 km.
- Drinking water projects for urban areas, including collection, distribution and purification of water.
- Drainage works less than 50 km long, located outside the area of the main project.
- Projects which imply change in water use.
- Projects which result in over-exploitation of aquifers.
- Projects in Protected Areas.

b) EIS, Medium Level

- Irrigated areas, between 50,001 to 100,000 ha.
- Dams with a reservoir area between 10,000 to 15,000 ha.
- Projects to transfer water, between 50-100 km.
- Drainage works 50-100 km long, located outside the area of the main project.
- Projects for distribution of drinking water to urban areas which include collection, transfer, potabilization, and distribution systems.

c) EIS, specific level

- Irrigated areas bigger than 100,000 ha.
- Dams with a reservoir bigger than 15,000 ha.
- Projects to transfer water, more than 100 km.
- Drainage works longer than 100 km long, out of the area of the main project.
- Projects for distribution of drinking water to urban areas which include collection, transfer, potabilization, distribution systems and wastewater treatment.

The regulation of the LGEEPA defines the information that should be included in the different levels of EIS. The preventive reports as well as EISs are prepared by private consultants under Terms of Reference prepared by CNA. At present, the legislation states that SEMARNAP should evaluate general level the EIS within 30 working days, and the medium and specific levels within 60 and 90 working days respectively. The law also specifies that if SEMARNAP, for the purpose of evaluating any EIS, needs the opinion of another institution, the evaluation periods could be longer:

45 (30+15) working days for an EIS in the general form;
90 (60+30) working days for an EIS in the intermediate form;
120 (90+30) working days for an EIS in the specific form.

Once the EIS has been evaluated, the SEMARNAP can either approve the request for the construction of the project as it is in the EIS, ask for modifications with the objective to ameliorate the negative impacts of the project, or deny the authorisation. According to the LGEEPA, the decision of the SEMARNAP would be based only on the environmental factors that could be affected by the specific projects.

Review of the EIS of Water Projects in Mexico

The EIS is an important product of the EIA process because it is this document which supplies information on the environmental impacts of the different public works to the decision-makers. It is therefore, essential that the information contained in the document be reliable and appropriate. EIS is a vital procedural stage, which if carried out effectively, can contribute to improve the quality of the EIA, particularly when it is complemented by a structured process for post-project EIA auditing.

As part of this research, the Environmental Impact Statements of water projects in Mexico which are under the responsibility of the CNA were analysed. There are Environmental Impact Statements (EIS), Environmental Diagnosis, ecological land use planning studies, etc. The list of the documents analysed can be found in Annex I (CNA no date, f-j; CNA, 1989; CNA, 1990, b-k; CNA/BANOBRAS, 1990; CNA, 1991, a-z; CNA, 1992, b-j; CNA, 1993, a-d; CNA, 1997, b, c).

The analyses of the Environmental Diagnosis of the Cutzamala System, Phases I, II y III (CNA, 1997b) and the Environmental Impact Statement of the Macrocircuito-Cutzamala Project (CNA, 1997c) are presented in detailed in the Annex II (Water Supply and Distribution in The Metropolitan Area of Mexico City: A Case Study).

In general, the EIS of water projects in Mexico are descriptive rather than analytical and predictive. The analyses are of questionable value, for decision-makers as well as for follow-up studies and monitoring. Mitigation measures proposed are based on generalised principles and not supported by specific analyses or findings. The statements do not include any monitoring programme to test predictions and facilitate the impact management. They also lack any detailed social or environmental analyses. Participation and involvement of the public is mostly absent.

The unsatisfactory quality of the EIS of water projects in the country represent a serious limitation for developing any post-project evaluation or impacts management. The mitigation measures are so vague and general that it would be impossible to do any follow-up. The statements do not contribute to the mitigation of adverse impacts or enhance project benefits. The institutional arrangements necessary for implementing the proposed measures are not defined, and the costs of implementing any recommendation are not properly budgeted for in the cost tables. Mitigation measures are often characterised by their scarcity and uncertainty, predictive techniques are used whose margin of errors are not known, and evaluation methods which assess and present information are concerned primarily with the approval procedure, with little or no attention to environmental management during the post-approval stages.

The amended LGEEPA established the evaluation procedures for environmental impacts of different projects and activities as an instrument to ameliorate their negative impacts on the environment. The EIS should be a document which should be produced before a project or activities are carried out to evaluate the negative impacts and propose alternatives, from sites to general approaches for their management. However, there is no requirement in the legislation that stipulates that once the EIS is prepared, evaluated and approved, it should actually be implemented. The EIS as it is currently practised, does not actually represent a useful tool for environmental management, it is simply a document that is necessary to clear a project. Once the approval process is complete, that EIS is filed and never reviewed, or used thereafter. There is no regular follow-up of the mitigation measures that were recommended in the EIS, or post-evaluation of the

projects or actions to verify that no other significant negative impacts have been produced and how they are to be ameliorated. Since there is no post EIA phase, it is not possible to determine the actual environmental, social or economic impacts due to the project, that could represent a lesson for future projects. It seems that every EIS is an individual activity, which has no relevance to similar projects either before or after. Any knowledge that results from the study remains with the staff who carried it out. There is thus no knowledge enhancement of CNA, and inspite of the legal requirements, the general public is basically ignored. For all practical purposes, even if they so wish, the public has no access to any EIS.

The institutional arrangements for clearance of EIS are fundamentally flawed. This is because the person responsible for clearing the EIS in INE (SEMARNAP) is an employee of CNA. The person is seconded to INE, but his carrier structure remains at CNA. Accordingly, the officer concerned is unlikely to oppose any project which CNA proposes since such a stand is highly likely to ensure his prompt dismissal. Under such institutional arrangements, it is highly unlikely that INE will take a stand on any project that CNA champions.

The LGEEPA established that post-project evaluations are mandatory, and that a legal system has been put in place to legally proceed against the developers of the projects or actions which do not comply with the legislation. However, the legislation does not have any instrument to force the developers either to utilise effectively the EIS they have produced with high costs, to follow it up, or to make post-project evaluations to actually assess both positive and negative impacts of the project, improve its implementation, and make this a experience for the future. The situation is unsatisfactory since the developed in these cases is an official government institution like the CNA.

The main problems found in the reports analysed would be discussed next.

a) Process to develop environmental studies.

In Mexico, the EIS/environmental diagnosis are regularly consistently cleared by the appropriate authorities, irrespective of the environmental and social impacts of the projects, or the quality of the statements. Since the reviewers are either convinced a priori that all projects are good and they have minor social and environmental impacts which can be ignored, or feel threatened institutionally that by taking a stand in rejecting very deficient EIS their own employment would be at stake, they routinely approve all reports. The standard argument is that the construction of individual projects would improve the economic situation of the region (and thus of the country) and also the life-style of the population, consequent of which the emigration rate would be reduced. The overall process has thus become a paper exercise which satisfies the legal requirements but not the spirit and the objectives of the law. No serious attempt is made to determine what could be the overall impacts of the projects, what other alternatives could be explored, or what could be appropriate mitigation measures.

There are many water projects in the country in which the infrastructure is deteriorated even before the project is totally constructed because of lack of maintenance (CNA 1990j; CNA 1991 f, k, m, p, x, y). The history of water development in Mexico indicates that proper planning has consistently been a main weakness of the government. The only real consideration thus far has been economics and engineering factors in the water sector were a priority is over. It has been demonstrated that social and environmental issues can result in the failure or success of the best engineering projects. Construction of water projects is not enough: integral management is very much needed if a successful and stable water sector is expected, and if improvement of the environment, health, life-style of the population, etc., are a serious concern. The country lacks a culture of decision-making in the long-term.

Neither the environmental diagnosis, nor the EIS include an integral analysis which include the potential social and environmental benefits and negative impacts of the projects. In general, the comments of the reviewers focus only on the “improvement in life-style of the farmers due to the operation of the

projects," which are automatically expected to happen for all water projects. The rural areas have historically been marginalized from the decision-making processes which are concentrated at the centre of the country. Not surprisingly, extreme poverty has continued to plague millions of people. Until and unless these issues are identified as and perceived big problems, they would not be solved, and the overall situation is unlikely to improve.

In addition, no environmental diagnosis analyses properly what could be the general benefits, if any, of the projects already constructed and in operation for the local and regional population. In the best cases, the reviewers just note that there has been "increase of agricultural production and improvement of the socio-economic level of the population." However, no facts and figures are mentioned to justify such conclusions, nor specific examples are given which could scientifically prove the areas has economically progressed due to the construction and operation of the projects. The environmental diagnosis and EIS invariably note that the reasons for the government to open an area to irrigation following the construction of dams and canals, is to increase the agricultural production, to improve the life-style of the local population and to decrease the emigration of the rural people to the United States. However, the reports never discuss how the irrigation projects are fulfilling the original expectations. Mexico has opened millions of hectares to irrigation, but this has not improved permanently the life-style of the local people or their economic status, much less it has stopped emigration to USA. Thus, if these justifications are the main reasons why Mexico constructs so many projects, the policies themselves need to be strongly questioned and modified, since obviously the rural areas of Mexico have not improved very much as a result of the construction of the water projects.

There are EIS which are basically copies of each other, like the ones on Los Reyes and Jesús María projects (CNA 1991n; 1991o). Both EIS were prepared by the same company and they are located in the same state of the country. The approach, analyses and mitigation measures are identical. It is surprising it never occurred to the reviewers as to how two different projects could result in identical mitigation measures, recommendations and conclusions. One suspects that the consultants simply made two copies of their report and submitted them under different titles. This is a striking example of the lack of interest and technical expertise of a consulting group and the reviewers. Not only the reports failed to make an appropriate diagnosis in order to maximise the benefits and minimise the negative impacts of the two projects, also the reviewers failed miserably to ask the elementary question as to how two EIS could be identical. This is a clear example of a process that is deeply flawed.

There are common problems identified in all reports, and one of them is the deterioration of water quality. In all the cases, the quality of the water of the rivers is already poor mainly due to discharges of wastewaters containing oils, bacterial contamination, etc. Thus, based on their field visits, reviewers could make a good case on the status of the surface water pollution in the region and the necessity of having a functional water quality monitoring network. An environmental diagnosis could be useful if it included an overall diagnosis of the water and agricultural policies in Mexico, based on their field experiences. These analyses could then be taken to the decision-makers who could realise how their macro-level decisions made at the Centre are affecting normal populations in the regions. For example, in the case of the project developed in Tanquién, San Luis Potosí (CNA, 1991p), bad management of the project from the government side, and misinterpretations of the agricultural and water policies from both the users and the government sides, as well as vested interests, have risen to such an extent, that contrary to what was expected at the beginning of the construction of the project, farmers have not been benefited in anyway, and on the contrary, they have abandoned their lands, with the detriment to the local economy and social welfare. In this specific case, the consulting groups could had discussed in depth how the rural sector has suffered due to the inefficiency of the institutions and the lack of coordination between the different local groups.

A main constraint for the sustainable water management in Mexico is that neither the environmental diagnosis, nor the EIS or the studies, represent any usable and reliable source of analysis and information for the decision-makers of any institutions at any level. This "lose-lose" situation is due to a combination of unfortunate circumstances: lack of interest from the private consulting groups for preparing objective and

critical reports which could be used by decision-makers to improve the environmental conditions in the country; reluctance of and disinterest in enforcing the law and demanding good-quality reports, which could actually be used to make the projects sustainable and more beneficial to the population and simultaneously ensure less environmental deterioration; and the lack of interest from the civil society as a whole in getting involved in decisions that affect them directly. Actually, not only the reports should be critically analysed, but also the whole process of their preparation. This analysis should indicate clearly what are the shortcomings of the process, and then outline what steps could be taken to overcome them in order to ensure the sustainability of water projects in Mexico. The emphasis should be to produce a streamlined and implementable process.

b) Quantity and quality of the information

Most of the reports are very badly written, including numerous grammatical and spelling errors. The pagination of the statements is often not consistent. Some of them do not have page numbers, some start pagination in each chapter, and in some the pagination is stopped in the middle of the text. The reports are very superficial, and contain no detailed analysis of any issue. Many reports do not have an executive summary or even an introduction. Theoretically, this means that the decision-makers have to read the entire document, which in many cases contain more than 100 pages, in some cases over. It is clear that at present no decision-maker would bother to read the reports, or takes their conclusions and recommendations seriously. Regarding the objectives of the projects and the reports, in many cases they are very general, vague and not concise. In some of the reports, the objectives of the project are "to improve the life-style of the population and achieve national food self-sufficiency." This is such a general and major objective that it could never be achieved with only one water development project.

All the reports include chapters on physical, biological and socio-economic conditions, but never an integral analysis of these three issues so that an overall perspective on the impacts due to the construction of the project can be obtained. In all the cases, studies, EIS and environmental diagnosis, the potential impacts are defined based on matrix methodologies, mainly the Leopold matrix which was devised some 30 years ago. The chapters on environmental impacts are invariably descriptive. Not even a single report reviewed included any analysis or discussion of the predicted impacts. Many diagnosis are very poor in terms of quality. However, it is not surprising that they do not contain any analysis, since they do not even have the relevant data on the project. In many reports, the "analyses" of the impacts are limited to statements such as "the impacts are of different magnitudes, both positive and negative."

In some cases like the one on the diagnosis on the La Fragua project (CNA, 1991 m), the quality of the report is so bad that it is basically useless for any purpose. One thus wonders who is primarily responsible for this sad and serious situation: the consultants for preparing them, or the institutions for reviewing the diagnosis and not demanding modifications to improve its quality so that these could be usable.

If the construction and operation of the water projects have in general the same positive and negative impacts, the Mexican institutions should have already identified the main problems as well as the benefits of the projects during the construction, operation and maintenance phases, to improve the overall implementation of the projects. For example, all the diagnosis and EIS mention that water quality and soil monitoring is needed, but no long-term monitoring programme on water quality has thus far been formulated let alone being implemented. Improper use of agrochemicals has been recognised as a main problem for more than 20 years, but again no programmes have been developed in consultation with the farmers, and the private sectors. No agreements have been reached between the public and private agricultural sectors to initiate training programmes at national and regional levels to evaluate the real and imaginary needs of the farmers, and educate them on the appropriate use of different agrochemicals so that problems are kept to a minimum.

A study on agrochemicals and their impacts in the environment was carried out in 1991 by CNA (CNA, 1991e). The background information includes an interesting description of the rural areas in Mexico. The overall objectives of the study were to identify the main negative impacts resulting from the use, application and disposal of agrochemicals in rural agricultural areas; develop solid criteria to reduce these impacts, propose alternatives for a better surveillance and follow-up actions; and develop a manual addressed to the several public institutions. The study was based on field work carried at in several areas, to determine both municipal and industrial discharges, as well as the quality of the receiving bodies of water. The report included interviews with farmers, visits to several irrigation districts, identification of negative and positive impacts based on the factual use of agrochemicals, overall assessments on health and agrochemicals related-issues, visits to universities and research centres to identify research programmes on the use of agrochemicals, interviews with sellers of agrochemicals, etc. The recommendations of the study for the best management of agrochemicals were as follows: i) management programmes on the use and management of agrochemicals, including security measures, ii) training of workers, farmers and technical staff on the agrochemicals and pesticides, and doses in which they have to be used, iii) training of workers, farmers and technical staff on the proper storage, iv) disposal of containers and pesticide residues, and v) strategies to protect water, land and crops. A study like this to identify the main problems and the alternatives available to manage agrochemicals is very much needed. It would be useful to find out if the manual was ever written and distributed, if the recommendations were implemented, and if so, what were the results.

In the EIS of the Canoas project (CNA, 1991ñ), the report notes that the environment is already deteriorated due to a project constructed earlier, but miraculously, "in future, there would be almost no negative impacts in the environment, and the economic and social benefits would make a difference in the area, improving the socio-economic conditions, and decreasing the emigration rate." The recommendations include appropriate use of fertilisers, pests control, salinity control, integral management of the region, etc. The report does not explain the rationale of the assertion that the new project would not harm the environment, even though the earlier one did. It appears that the main objective of an EIS is to state there would be no adverse environmental impacts, irrespective of the high probability of their occurrence. The project would be cleared on the basis of the report. It is a damning indictment of the present process that neither the institutions nor the consultants engaged are really interested in protecting the environment, nor they consider their respective task seriously. Furthermore, the document is a diagnosis of a project that had been partially constructed. Accordingly, it should have been possible to assess reliably the environmental, social and economic impacts of the project that have already occurred and analyse the implications as to how adverse or beneficial the project is likely to be in realistic terms. However, unfortunately, there was no serious attempt to carry out an in-depth analysis of the positive or negative impacts of the project, also its short- and long-term implications.

In the case of the Tanquién project (CNA, 1991p), the partial construction of the infrastructure had affected permanently the environment and had displaced the native flora and fauna, and the land was subjected to erosion. Contrary to most of the diagnosis and assessment, in this case, the consultants actually conducted some interviews with the users of the irrigation district. Most of the farmers were aware of the importance of the construction of the project, and were willing to cooperate in the construction, maintenance and operation of the canals. However, there were severe conflicts between them. If this was the case, and the opinion of the community was sharply divided regarding the operation of the project, it is highly likely that the project would not achieve its objectives, and thus its construction should have been questioned. The diagnosis should have included an objective analysis on this important issue, so that appropriate decisions could have been taken.

The diagnosis and statements have been prepared by a group of consultants. In the case of the Las Burras project (CNA, 1991r), the introduction is a copy of the introduction in other reports prepared by the same group. However, this report is one of the very few diagnosis or EIS which proposes alternatives for the

construction of dams. The decision taken was based on the existing infrastructure and on the investment costs. The report does not mention whether there would be any difference on the environmental aspects between the different alternatives.

One of the main problems in Mexico is the poor maintenance of infrastructures, which contribute to the deterioration of canals, drainage systems and roads. Among other shortcomings are increasing infestation of aquatic weeds, deterioration of public health because of over-use of agrochemicals, employment generation is often a temporary condition, and the population working in the projects, normally live in poor and unhealthy conditions The consultants invariably affirm that the local and regional economy would improve in the near future with the construction and operation of the projects. However, in all the reports reviewed, there is no justification as to how and why this improvement could be a reality since the past performances indicate otherwise. Infrastructures always deteriorate because of poor maintenance, and this is unlikely to lift people out of extreme poverty. It would have been much preferable if the consultants had analysed the reasons for the earlier failures to avoid the same situation to be repeated.

Several reports mention that "the project would not affect the environment significantly, provided financing is made available for the mitigation measures." Provision of funds has never been the strength of the Mexican system, which ensures that if the EIS are not reliable, the environment would deteriorate, and accordingly, and as result, the area is unlikely to improve which after all is the main objective of the project. Advanced planning, management, administration and training are fundamental issues for the sustainability of the projects, but unfortunately, they are not considered as real requirements in the country.

c) Approach towards social and environmental issues

Mexico has environmental legislation and institutions, which indicates that the country is concerned about the environmental and the social issues in the country. The amended LGEEPA stresses the importance of the conservation of the environment and natural resources during the construction and operation of all projects. The reality, however, is totally different. No environmental study, diagnosis or statement of water projects currently makes any serious analysis of the environmental and the social issues associated with them. Nor do the authorities legally responsible for the environmental preservation of the country take their tasks seriously.

All EIS/diagnosis should include a chapter on social issues related to the community where the project or activities would be carried out. This chapter should include information on social issues like education, public health, etc. The objective should be to present a base-line information of the pre-project social conditions that reviews the living conditions and quality of life of the population, from which it should be possible to determine the extent of the benefits due to a project after its implementation. At present, such a chapter provides some random descriptions of the age of the population, education, etc., without any coherent or logical framework. No integral analysis is ever made which would enable the readers to appreciate the current situation of the communities, what their needs are, and how these can be met on. It is very difficult, if not impossible, for any decision-maker to make any decision on this type of information and analysis provided.

The chapters on "environment" and "social issues" do not provide any clear picture of the current situation and the overall needs of the local population, or the relevance and importance of the project to improve the life-style of the people, or how the project, potential impacts, and mitigation measures, all fit together, and how they would affect the long-term sustainability of the projects. The environmental aspects also represent other problem. There are long and unnecessary descriptions of ecosystems, without any conceptual framework as to how such information are provided, or their relevance to the study. There are no analyses whatsoever of the whole scenario which includes the project itself, expected economic and social benefits, environmental impacts (both positive and negative), etc.

There are several statements (for example, Zocoteaca, Huajuapan de Leon, Río Verde**)** wherein it is said that since "the environment of the project area has deteriorated very badly already, the project cannot result in any further negative impacts." The studies basically conclude that "the situation is so bad that it can not get worse," and accordingly any future impacts can be ignored since they could not worsen the situation any further. Clearly such an hypothesis is fundamentally flawed and is absolutely wrong. Environment can always get worse. In any case, such justification of projects on negative grounds can never be accepted. The sad fact is that the internal reviewers of such analyses should have found them totally unacceptable. The fact that such analyses are being routinely accepted indicates the incompetence of the reviewers, lack of appreciation by the top management that environmental issues should be seriously considered and continuation of a deeply flawed process.

Poverty is a very complex issue and its alleviation has proved to be very difficult. In the rural areas, improvement of the quality of life of the local and regional population, does not depend only on water for irrigation. Integrated planning combined with better living standards, higher education and training, properly planned irrigation systems, etc., would result in the improvement of the project areas and even of the region, not the short vision and lack of planning that has characterised the irrigation sector in the country for many decades. The conclusions of many reports are that no serious environmental impacts are expected during the construction and operation of the project: there would only be benefits for the population living at present in extreme poverty.

According to all the reports, the impacts of the projects are overwhelmingly positive, irrespective of their overall social, economic and environmental impacts. The analyses take a very narrow approach, and focus primarily on the direct and indirect jobs that may be created during the construction phase of a project. They conclude that the economic situations of the workers would improve "significantly," even though, as every one knows, the construction jobs are temporary in nature.

Most of the environmental reports seem to copy each other. One could understand that the impacts and mitigation measures of a project would be similar, provided the projects are somewhat similar. However, none of the environmental reports include specific analyses according to the physical characteristics of the areas, and their economic, social and environmental conditions. It appears the analysts consider the entire Mexican Republic is the same in terms of hydrology, climate, soil, population, industrial development, agricultural production, etc. In general, the statements outline similar past impacts, expected impacts and mitigation measures. It would not be surprising to find out that the analysts never even talked with the local people, or visited the project area. All the environmental reports lack critical analyses of the local conditions and the macro-policies that have lead to the economic, social and environmental deterioration in the relevant project areas.

The report on the Garabatos project (CNA, 1991ll) is very superficial, and inconsistent. For example, in the chapter of methodology (chapter IV, p.3), the analysts note that the impacts on flora and fauna will be very severe. Three pages later, it says "it is important to remember that the land in the area of the project is used at present for rain-fed agriculture. So, the percentage of flora and fauna that will be disturbed can be considered as irrelevant." Thus, if the issue of change of land use and deterioration of flora and fauna were important factors to consider for clearance of any report, such analyses would be of no value to make the necessary decisions. Such inconsistent reports should have been promptly rejected, and new studies should have been initiated.

The specific case of the Environmental Diagnosis of the Project on Hydro-Agricultural Infrastructure "Río Verde, Oaxaca (CNA, 1991i) is one of the most representative reports regarding lack of interest in the conservation of the natural resources in the project area. The main aquatic ecosystem of the area is the Chacahua lagoon, which is part of a National Park with the same name. The lagoon has a surface area of 3,325 ha. The project area included also several archaeological sites that are still not registered in the

National Archaeological Atlas. The main negative impact of the project was severe deterioration of the Chacahua lagoon due to agricultural drainage. The deterioration of the lagoon affected the local population very seriously, whose main economic activities depended on the lagoon. Many people make their living from fishing, and many others are employed in tourism-related activities. The moment the environmental conditions of the lagoon deteriorated, their sources of incomes disappeared.

This Rio Verde report is very poorly written. It does not contain any analysis, even though there are entire chapters on physical, biological and socio-economic characteristics of the project area. Clearly the environmental analysts should be properly trained on integrated management of water resources. The analysts insist that the project would be beneficial since it would generate employment and would improve the quality of life of the local population. They did not realise the impacts due to poor management in agricultural areas, which is endemic in Mexico, and which eventually resulted in the severe contamination of the lagoon, and consequent the unemployment of the local population who used to live out of the lagoon, and the increase in the extreme poverty of the local population. Thus, the projects instead of improving the quality of life of the people, actually contributed to its deterioration.

Regarding economic activities in the rural areas, irrigation by itself is unlikely to improve the life-style of the local and regional inhabitants. Appropriate management, investment and training are major issues which should be considered as important requirements for establishing irrigated areas. However, these issues are never mentioned, let alone seriously considered, in any of the environmental reports. Strangely the governmental institutions appear to be unconcerned about such major issues.

There are several analyses (for example, Grullo project, CNA, 1991k) which notes that "there would be socio-economic benefits, but in order to assess them accurately, it is necessary to carry out additional studies." No reasons are mentioned as to why an overall evaluation was not carried out for the study, and why it was considered necessary to undertake an additional assessment. In spite of affirming that the socio-economic impacts should be assessed accurately, the analysts conclude that the negative impacts of the projects would be "minimal," and the benefits to the region in economic terms justified the investment costs and construction of the projects.

The diagnosis on La Pólvora project (CNA, 1991l) noted that the life-style and financial status of the farmers who irrigate with wastewater has improved noticeably. However, it is further noted that the main negative impacts of the project are due to the lack of sanitation in the area resulting from the irrigation activities with wastewater, and consequently, the deterioration of the quality of life of the population. However, the report does not refer to any source of reliable information on this issue for further enquires. This means that so far as the analysts are concerned, the improvement in the life-style of the population is related only to its economic conditions, and not to health or environmental conditions. Analyst need to be trained in integrated analysis if a better quality of diagnosis or statements is to be expected.

The report in Las Burras project (CNA, 1991r) contain major inconsistencies. In terms of future impacts, it notes very vaguely that the overall impacts would be positive. The analysts of the project had already identified that the construction of the project would not improve significantly the life-style of the population, nor would it increase agricultural production. However, in the sections on potential impacts, analyses and conclusions, it concluded that "improvement of life-style would be the main positive impact of the projects." In one chapter, it mentions that the life style of the population would improve with the construction of the projects (p. iv and 70). In contrast, on page 73, it notes that "the positive impacts of the project would result in employment of the local population during the construction phase of the project. However, since the magnitude of the projects is considered to be small, it would not improve significantly the financial status of the local population, nor the agricultural production would be higher to improve the economy of the region." As soon as it was clear to the analysts that the project would not have significant positive impacts on the region from economic, environmental and social viewpoints, during either the

construction phase, or the operational stages, the analysts should have seriously questioned the desirability of the project, and the benefits from the investments proposed.

The diagnosis of the El Xhoto project (CNA, 1991s) is equally poor. The company "Ingeniería del Medio Ambiente" prepares very similar reports, irrespective of the social, economic and environmental conditions prevailing in the different project areas. The consulting company does not consider the actual background of the project, or the expectations and cultural problems of the population. Environmental diagnosis of different projects have exactly similar introduction, past impacts, expected impacts (both positive and negative), mitigation measures and conclusions. The environmental diagnosis developed by this company cannot be of any use to the decision-makers or to the staff in charge of the construction of the projects. This probably indicates that no one in the appropriate ministries even read the reports. The legal requirement of developing an environmental report has been satisfied: the rest is irrelevant.

All the diagnosis conclude that the project would result in the economic improvement of the area, with no "visible" deterioration of the environment, which presumably makes the reports acceptable since the projects could then be cleared immediately. Programmes on communication, information exchange and environmental protection are often proposed, but without specifying the objectives, expected outputs or budget.

There are very few assessment reports where the analysts at least mention the importance of considering social issues within the design and implementation of the projects in order to assure their sustainability. This, however, does not include any serious analysis of the social issues. In the Jesús María project (CNA, 1991n) the farmers were aware of the benefits of the project. They were agreeable to the inundation of their lands, for which they wanted a fair compensation. This is just one of the many project reports which considered displacement of communities due to construction of dams. Not even a single report mentions what was the planned process to resettle the displaced population, if any, or the compensation, the problems, alternatives and solutions.

The overall neglect of social issues represents a very serious problem in terms of future sustainability of the projects. The environmental reports on dams do not consider resettlement as an important issue, or even note the social, environmental and economic consequences of resettlement. The reallocation and compensation issues are very briefly mentioned. Unless one reads the reports very carefully and thoroughly, it would be impossible to realise resettlement is an important issue. It is mentioned within a paragraph, and clearly not considered to be important. No mitigation measures are considered for resettlement. Accordingly, one can only conclude that for the analysts and the governmental institutions, resettlement of displaced population and adequate compensation is basically a non-issue. This is indeed very surprising, especially as resettlement has turned out to be the most serious environmental and social problem associated with dam construction.

On the basis of the in-depth review carried out, it is clear that neither the institutions, the consultants or the Mexican institutions believe in sustainable development. They really do not seriously consider environmental and social issues; only economic ones. Until and unless this approach changes in the near future, the environment would continue to deteriorate further, with the consequent detriment to the society

d) Health issues

Public health is one of the main concerns in environmental diagnosis and EIS. However, they are generally mentioned very briefly and superficially. It seems that the rural population suffers primarily with infectious diseases like gastro-enteritis, diarrhoea, respiratory diseases and influenza. No cholera outbreaks are mentioned, even though anecdotal information indicates their occurrence. There are also no suggestions on developing an appropriate epidemiological programme for the area.

Irrigation with wastewater unless managed very carefully, is a serious health issue in terms of deterioration of the environment and quality of life of the local population. The diagnosis reports, which deal with wastewater irrigation should analyse objectively health issues of the area in terms of epidemics, like cholera outbreaks and mortality and morbidity due to gastro-intestinal diseases. The practices associated with wastewater are known to be very deficient in most places in Mexico, and environmental assessments could clearly identify problems, risks and opportunities with practices. Unfortunately, wastewater irrigation and its associated impacts on health, social, environmental and economic factors are not considered to be relevant for the development of appropriate practices and policies in the country in the project areas, neither by the analysts, nor by the institutions that are responsible for clearing the environmental diagnoses and EISs.

e) Mitigation measures

The legislation stipulates that the mitigation measures should be presented in such a way that the negative impacts of the project and activities could be ameliorated. However, irrespective of the type of project that is being assessed, the mitigation measures recommended are always very general and similar. All the statements/diagnosis invariably recommend mitigation measures, which can be best described as a "laundry-list" of activities. Priority measures are not identified, and no indication is given as to the potential costs of implementing any measure. Generally, issues like reforestation and water quality receive some attention: others are either neglected or noted in passing.

Regarding mitigation measures recommended, it is possible that they can be somewhat similar for some type of water and agricultural projects. However, it is difficult to see how the mitigation measures of all type of water projects in the entire country can be similar. Surprisingly there are no project-specific recommendations. For example, a project that will be constructed in the northern part of the country, with specific hydroclimatic and soil conditions, and people with certain culture and social traditions, must have a different sets of impacts (in terms of types, magnitudes and extent) compared to a project in the southern part of the country, where the technical, social, environmental and economic conditions are very different. An in-depth review of all the reports indicate that both the analysts and the appropriate Mexican governmental institutions consider at least implicitly, that the entire country is homogeneous, and accordingly the remedial measures for all the projects are similar.

The mitigation measures should include identification of monitoring programmes for soil and water quality to avoid their contamination from return flow from the agricultural areas; programmes for the appropriate management of agrochemicals; regulation to restrict the use of agrochemicals; reforestation; awareness programmes addressed to the users on public health issues; and efficient irrigation management practices to prevent development of salinity and waterlogging. The projects are normally authorised by the government, based primarily on their positive impacts. However, not even a single environmental diagnosis or EIS review consider whether the expected or actual social benefits are worth the cost of the environmental damages they would cause since at present the mitigation measures proposed were never questioned, or fully implemented. Assuming the mitigation measures were the most appropriate for the project concerned, the fact that CNA and INE (SEMARNAP) clear and approve the EIS or the diagnosis, does not necessarily mean that the budget for mitigation measures would be approved, or that it would be adjusted with time in terms of financial requirements.

There is a water quality monitoring network in the country which is 40 years old. The mitigation measures generally recommend the need to monitor the water quality that may be affected. However, the analysts ignore the fact that there is already a network, or how useful the network could be for the projects under consideration, what are the weaknesses of the existing network, and how these could be overcome. There are some projects that even include what would be the estimated cost of monitoring to determine the water quality. However, not a single analysis considers how to develop an ad-hoc water quality monitoring

in a certain specific location and for a limited period could be linked to the existing monitoring activities, or even how this monitoring network could be enlarged and improved. The main comment appears to be that water quality may deteriorate and hence monitoring is necessary. No consideration is given as to what parameters should be monitored, at which locations, for what periods of time and by whom. The real cost of monitoring is never estimated. Without such definitive analyses, general recommendations like water quality should be monitored is of little value to the decision-makers.

MAIN CONSIDERATIONS

On the basis of the in-depth research conducted for this study, it is evident that the qualities of the EISs carried out in Mexico for various water projects leave much to be desired. The studies can probably be best described as mechanical and somewhat superficial. Equally, institutionally, proper review and clearance processes for these studies are almost non-existent for all practical purposes. Major limitations also stem from the total absence of any post-approval monitoring of project impacts and absence of any check as to whether the mitigation measures recommended were ever seriously considered for implementation. The current process also suffers from total absence of any monitoring and evaluation, either by CNA or by SEMARNAP. The processes could be substantially improved if more reliable impact predictions and cost of mitigation measures were included in the EIAs carried out. The development of a strict and transparent process for conducting careful internal reviews of the EISs of water projects could result in the improvement of their qualities, standardisation of the procedures, identification of major issues that are not adequately considered, inaccuracies in information, inconsistencies in analyses, or any shortcomings apparent during the entire assessment process. Currently, public have only limited access to EIS, which does not necessarily contribute to their effectiveness, or ensures the transparency of the process.

The comprehensiveness, objectivity and accuracy of EISs as they are carried out at present, are matters of concern since many of them do not even meet the minimum regulatory requirements, much less provide adequate information on which to base necessary decisions. Proponents of the projects and their consultants need to monitor the quality of their environmental assessments, and to review them critically before submitting them for approval to the appropriate authority. It is clear that the current practice assures near automatic approval of a project as long as an EIS has been carried out, irrespective of its adequacy or quality. In the long run, it is in the developers own interest as well as that of the country, to identify the deficiencies in the statements before they are submitted, rather than wait to have them exposed by others at later stages of the review process (Lee & Colley, 1990) or even after the projects are constructed. Pre-decision review of the water projects in the country are undertaken by an internal CNA body, Department of Environmental Management and Evaluation, which deals exclusively with the EIAs. After receiving the EISs from the consultants, and before submitting them to INE (SEMARNAP), the EISs are checked, mainly in terms of satisfying the terms of references of the contract, and not by their usefulness or relevance to the environmental management process. There is no systematic institutional process to assess the quality of any EIS, and adequate expertise, or even interest, to review them properly. Furthermore, CNA as a proponent of the projects, has a vested interest to get them cleared as soon as possible. Thus, the entire process has basically become a paper exercise, which attempts to satisfy only the minimum legal requirements. Under such conditions, not surprisingly, even a single water project has thus far ever been rejected on environmental and/or social grounds. Not surprisingly, the existing conditions are inappropriate and inadequate to ensure the sustainability of the projects.

During the past few years, there has been some pressure from certain international institutions, especially the World Bank and the IDB, to develop and implement an environmental auditing programme for the water projects which are being financed by them. This pressure has resulted in limited improvements, since without this, the situation in all probability would have been even worse. Such international institutions need to take a much tougher stand before the environmental review process could be improved, and the

overall quality of the EISs become acceptable. The failure to develop appropriate post-project monitoring and evaluation programmes may have serious repercussions in terms of obtaining financial support from the international financial institutions for future projects.

It is true that one of the main constraints for better implementation of EIS is availability of funds. However, equally bad are the problems resulting from lack of expertise and general absence of appreciation by top and middle managers of the water and environment institutions, that environment is an important factor to consider to ensure the long-term sustainability of the water projects. The budget to implement the mitigation measures is clearly grossly inadequate; there is lack of expertise and interest from the officers in charge of the construction of the projects to implement properly the mitigation measures recommended; and monitoring of soil and water quality are seldom done regularly or properly because of lack of trained staff and funds. There is also no active involvement of the institutions which are supposed to be associated with the implementation of the mitigation measures. This is not surprising since often times they are not even consulted to determine their interest in such issues. Public participation in the process is conspicuous by its absence.

The environmental impacts of water projects in Mexico are mostly evaluated from a sectoral point of view at present. An integrative and multidisciplinary approach to promote sustainable development is missing. In fulfilling the existing legal requirements, formal statements of environmental impacts of major to medium water development projects (construction of large dams, development and rehabilitation of irrigation districts, etc.) are prepared. Recent investment projects have explicitly allocated funds for mitigating negative environmental and social impacts. However, to what extent these funds would actually be used to implement mitigation measures is a question that has yet to be answered. Based on the existing situation and trends, significant improvements are somewhat unlikely in the near-term.

The environmental diagnoses, which are different from the Environmental Impacts Statements, are not a legal requirement for the construction of any project. However, they represent an important management tool to ensure the sustainability of the projects that were 80% constructed by the time they were carried out. Construction of these projects were started before the LGEEPA and the relevant regulations were enacted. There is also an important conceptual difference between the environmental diagnosis and the EIS. Since the project to be evaluated have already been mostly constructed, the diagnoses should include a detailed review of the impacts that can already be observed. The mitigation measures proposed should be based on an analysis of these impacts, and identification of the best alternative from technical, economic, social and environmental viewpoints, which could then be immediately implemented before the completion of the construction of the project. However, for all the water projects analysed for this study, the qualities of the EISs carried out were very disappointing because of superficial analyses of available data and incomplete identifications of potential future impacts. The diagnoses are even worse, since description of the positive and negative impacts of the project that have already occurred are ignored, and no proper and cost-effective mitigation measures are proposed, which could improve the effectiveness and overall sustainability of the project, and also ensure that the benefits expected actually accrue to the local and regional population on a long-term, continuing basis. The processes used at present to analyse and clear environmental diagnoses, and continuation of the construction of the partially completed projects, should be seriously questioned by the authorities. Current processes need to be modified significantly, if the sustainability of the projects is an important concern for the country and the institutions concerned.

Current review indicates that the EISs and the diagnoses present serious problems not only in terms of the qualities of the documents but also in terms of methodology used. The data presented in the reports are seldom adequately analysed, and in others, when one searches for the data which should have been analysed, one finds that data themselves are also missing. Reliable and usable environmental assessments are now simply not being made. The mitigation measures proposed often do not even correspond to the problems identified in the reports. In most cases, identical mitigation measures are proposed, irrespective of whether the water projects are for drinking, irrigation or rehabilitation, and also irrespective of differing climatic,

physical, economic and environmental conditions. Clearly, the poor standards of the EISs and the inadequate and faulty process that is being used to clear them can be, to a significant extent, attributed to the fact that both the authorities and the consultants know that the existing studies are paper exercises, whose primary and only objective is to clear the construction of the water project as soon as possible. No one seriously expects that the mitigation measures recommended would actually be seriously considered for implementation. It should simultaneously be noted that it is simply not feasible to implement the recommendations of such poor studies. Thus, it can be concluded that what the institutions currently need is an environmental assessment study: its quality is totally irrelevant. This has contributed to the development of a vicious circle, where the main casualties have been the environment and sustainable development.

The socio-economic aspects that are generally considered in the reports include the resettlement of the population and the employment of local and non-local population during the construction phase of the projects, and reduction in the emigration rate. Having identified these issues, the reports mostly ignore the resettlement processes for the people who have to be involuntarily moved because of the construction of the dams. Issues like where the people could be resettled, compensations they should receive, how and by whom the resettlement process should be carried out, and costs of resettlement are mostly never considered.

If the construction and operation of all the water projects have in general the identical positive and negative environmental and social impacts, one has to conclude by analysing the reports, that CNA should have already identified the main costs and benefits so as to improve the overall environmental and social impacts of the projects. For example, Inefficient use of the agrochemicals has been recognised as a main problem in Mexico for more than 20 years, but again no programme has ever been formulated in consultation with their potential users, agrochemical industry and the general public. No training programme has been formulated, let alone initiated, at national and regional levels to address the real needs of the farmers, and to educate them on the types and quantities of agrochemicals that should be used so that their environmental and health impacts could be minimised.

There are several generic problems in the statements and diagnosis reviewed, one of which is water quality deterioration. In general, water quality of the rivers is already poor, primarily due to indiscriminate discharges of domestic and industrial wastewaters containing organic wastes, oils, chemicals, metals, bacteria, etc. Even though nearly all reports concluded water quality monitoring is essential, not a single one has developed a framework for a functional monitoring programme in terms of which parameters should be monitored, reasons for their selection, location and frequency of sampling, who would use such monitoring results, for what purposes, etc. A simple recommendation that a water quality monitoring programme is necessary, is unlikely to be of much use to the authorities concerned.

An environmental diagnosis would be more useful provided it contained an overall review of the water and agricultural policies of Mexico, to which project issues and conditions could be linked. The decision-makers could then realise the effectiveness and relevance of their macro-level decisions, and how and to what extent they could affect population in the project areas. In most cases, it should have been possible to outline how the past attempts for sustainable development of the rural sector in Mexico through water development has mostly failed due to continuing institutional inefficiencies and absence of coordination between the different local groups, as well as between the local groups and the concerned regional and central institutions.

Conceptually at least, the projects are authorised by the government because of their overwhelming positive impacts on the people and the environment. However, not one environmental diagnosis or EIS reviewed considered whether the expected or actual benefits would exceed the environmental costs identified, irrespective of their reliabilities, especially as the mitigation measures proposed are never seriously considered as to their appropriateness, and thus are never implemented fully. Even assuming that the mitigation measures recommended were the best and the most appropriate for the project concerned, and CNA and INE have cleared and approved the EIS or the diagnosis, it does not necessarily mean that the

budget to implement the mitigation measures would be approved, or the financial resources required would be released in a timely manner.

Construction of irrigation projects automatically does not improve social or economic conditions by themselves. Proper planning, operation and maintenance, as well as technical, financial and social support are important considerations. However, these issues are basically ignored by all the environmental reports. As long as these factors are not recognised as real problems, which could contribute to the failure of the projects and thus significant loss of investments, extreme poverty and environmental degradation in the rural areas are likely to continue, and may even increase. Irrigation projects contribute to adverse impacts as well as positive benefits, but the extent and magnitudes of these effects vary from one project to another depending upon a variety of conditions. Accordingly, the diagnoses and EISs must objectively analyse the projects in terms of the totality of the impacts, and make project-specific recommendations which could be implemented. Furthermore, the reports should provide reasonable estimates of implementing the mitigation measures. It should recommend which institutions should be responsible for implementing the measures and the timeframe within which such measures should be implemented. At present, it may appear to a cynic that initially there was one diagnosis or EIS, and the other 60 reports are basically carbon copies of this initial report.

A main constraint for using the environmental diagnoses and EIS in Mexico is that the reports do not provide any serious information and analyses to decision-makers in any institution to manage the environmental impacts of the projects properly. This situation stems from several factors. Among these are an absence of expertise and lack of interest from the consulting groups in preparing critical and objective reports which could be used by the governmental institutions; lack of interest from the governmental institutions in enforcing the legal requirements by demanding good quality reports, which could actually be used to improve the project, and this ensures that the expected benefits accrue, environmental deterioration is reduced; and general apathy of the civil society to get involved in decisions that affect them directly.

There are many consulting groups that do not have adequate expertise, or even interest in developing good environmental reports which could be used for better implementation of the projects, and/or ensure their long-term sustainability. There is no appropriate legal or administrative system to review and control the overall performance of the private sector groups, which conduct these studies, and impose sanctions for poor performances or ensure conductors of bad studies do not receive any new contracts for environmental reports. One of the recent changes, the LGEEPA is supposed to ensure that the consulting groups on environmental issues are properly trained, and thus are technically capable of carrying out the studies. However, it is still very early to judge if this change in the law alone would be enough to ensure that the consultants carry out their tasks in a more professional manner.

There is no reason for the institutions to invest in either the environmental diagnosis or in the EIS if there is no intention to use them for environmental management. For example, INE has cleared numerous environmental diagnoses and EISs, but this does not mean that there is any agreement or commitment from the concerned institutions that they will consider the results of the assessments seriously, and/or make a concerted effort to implement the mitigation measures. Once the report has been prepared, the legal requirements are satisfied. The project is then automatically cleared, and the reports are promptly filed and forgotten. Unless the reports are properly prepared, and then they are used to improve the actual planning, implementation and management processes, there is not much point in funding paper exercises.

In Mexico, the general public, non-governmental organisations and the media have not taken much interest in the environmental impacts of water projects, as has been witnessed in other developing countries like India, Bangladesh, Nepal, Thailand or even China While public participation in environmental assessments is considered to be important and is required by government policy, it is basically ignored. In fact, it is very difficult for public, NGOs and media to have access to the environmental studies, even though legally they are public documents. General public apathy, provision of lip service to stakeholder participation

by the institutions concerned, and control of access to environmental information, have made sustainable development of water projects in Mexico a most difficult process.

Even though the regulation of the Law on Ecology (LGEEPA) has been amended and the process of environmental assessment has now been given priority, it still continues to have numerous fundamental deficiencies in terms of implementation. Even though the law provides a detailed outline of the processes to elaborate EIS, clearly it is inadequate to force the institutions to take the entire process seriously by ensuring the consultants engaged prepare good, objective and usable reports, their recommendations are promptly implemented. This would assure that both the meaning and the spirits of the law are upheld. Until and unless these fundamental problems are recognised and then resolved, it is highly unlikely that the projects would be sustainable on a long-term basis or produce the anticipated benefits.

A main failure in the LGEEPA is in terms of the official evaluation of the diagnosis, EIS or studies of the projects. The Art.35, III., c, states that "the Ministry (of Environment) would take into consideration in the Environmental Impact Statements, ONLY the environmental implications of the projects or activities." The law does not clarify who then is responsible for the social and economic implications of the projects or the activities. This is a very dangerous gap, since legally, the institutions concerned cannot be forced to act even when the projects could be shown to have serious negative social and economic impacts on the project areas and/or the populations.

On the basis of the above analysis, it is evident that not only all the environmental reports need to be critically analysed, but also the whole process to prepare and clear them should be objectively reviewed. Based on such a comprehensive review, the process should be radically revised so that all major shortcomings are rectified. Otherwise millions of dollars would continue to be invested every year in water projects, but these projects would neither be sustainable not beneficial for the communities concerned. Without a functional and efficient system of environmental management of the water projects, their long-term sustainability cannot be assured, and thus the expected economic and social benefits are unlikely to accrue. Until and unless the top management of CNA and SEMARNAP actually believe that the environmental considerations are important, and should be properly incorporated in the planning, implementation and management processes, there is unlikely to be any significant improvement in this important and critical area.

IV. CONCLUSIONS

The water management problems in Mexico have become very complex in recent years, and their complexities are likely to increase ever further in the coming decades. Continually increasing population, rapid urbanisation, lack of clean water, inadequate sanitation and wastewater treatment, inefficient management at all levels, near-total emphasis only on technical aspects of supply management, and radical changes in management every six years, have made efficient and sustainable water management a most difficult, if not an impossible, task. Economic, social, environmental and institutional aspects of management are continuing to receive inadequate attention. In addition, adequate numbers of properly trained and experienced personnel are simply not available at all levels to ensure efficient planning and management of water resources.

Nationally, Mexico has a mosaic of climates, natural resources, economic activities and traditions. The arid, economically developed areas in the North can not be managed in the same way as the areas in the South, where there is plenty of water but significantly less economic development. Water resources cannot be managed sustainably and equitably from a centralised viewpoint, as has been done for decades. Regions should be managed according to the availability of resources, which should be matched to the needs and expectations of their habitants. Successful regional management should include long-term planning, political consensus on what should be done based on appropriate consultations with the stakeholders, economic support, negotiations with and among the users, etc. Institutional development and capacity building should be structured according to the regional needs. If regional, state and local level plans are not clearly agreed to objectives, developed with specific actions and adequate resources, efficient water management would not be possible. This, in turn, could contribute to deterioration of the health of the population and the environment, and even social stability.

One example could be the main urban areas of the country, both within the country and along the border areas with the United Sates, which are likely to have severe problems in terms of water scarcities and contamination over the medium- to long-term. The cities in the northern part of the country are located in arid areas, having scarce and contaminated groundwaters, which is already restricting agricultural and industrial activities. Thus, in the medium-term, it may be necessary to transport water from other sources, which may well prove to be economically inefficient, and socially and environmentally undesirable.

Mexican water resources policy, as outlined in the *Water Programme 1995-2000*, is oriented towards ensuring the availability of water to satisfy the needs of the population and promote the development of economic activities in a manner that is environmentally compatible and sustainable in each region of the country. While conceptually this policy is sound, its implementation leaves much to be desired. In addition, the present decision-makers, even though they formulated the policy, do not appear to have given much thought as to what actions need to be taken to make the policy a reality.

Enactment of appropriate legal framework and development of adequate institutional structure in Mexico for environmentally-sound management of water are relatively new. A major problem arises due to the lack of congruency among the various water laws. Clearly existing laws need to be critically reviewed to ensure they are compatible with each other, and have a consistent philosophical base. The institutional arrangements for sustainable water management need to be modified, and more effective coordination among the concerned institutions is essential if the environmental policies and laws are to be implemented. Even within one institution, CNA, the various environmental activities are highly diffused. No serious attempt has been made thus far either to integrate and coordinate these activities, or to develop a comprehensive environmental policy or strategy for the water sector as a whole. For example, approaches used at present for water quality management are *ad-hoc*, linkages between surface and groundwater quality

management are minimal, and overall water quality monitoring in the country leave much to be desired. In addition, the institutional capacities for efficient environmental and water quality management are extremely limited. All these constraints, plus the fact that the current senior managers of the institutions related to the water sector are basically giving lip service to the environmental and social issues associated with water development, mean that it is highly unlikely the situation will change before the election of the next President in the year late 2000, when another set of managers be responsible for the water and environmental sectors.

Unquestionably, given political and institutional will, the country could significantly improve the effectiveness of both the institutional and the legal frameworks for environmental management of the water sector within a limited time frame. Vertical and horizontal coordination needs to be strengthened, and the division of the responsibilities between the institutions would have to be clarified. More use of economic instruments like demand management and cost recovery would have to be made in conjunction with the implementation of appropriate regulations. Monitoring efforts for environmental and water quality issues need to be streamlined and strengthened, and information systems must be improved. Stakeholder participation to improve water resources management, which is being basically ignored at present, should be actively pursued. Furthermore, as in many other developing countries, whatever information on water quality and environmental degradation are available, it is carefully and consistently withheld from public scrutiny. Environment assessments of water development projects, which legally belong to the public domain, are almost impossible to consult. The philosophy and practice of CNA, which consider most information as confidential, are not conductive for sustainable water management. Clearly, this attitude needs to change dramatically. People, whose life are affected by water development positively and negatively, must have free and timely access to information in any free and democratic society.

In terms of decentralisation, the formulation of the basin councils, at least conceptually, is a good alternative to manage the water resources form an integral viewpoint. Basin councils are expected to plan and act depending on the regional needs, promote the formulation of region-specific strategies and actions for the best use of resources to improve the life of the local people and the environment. Basin councils are also the organisms to consider the regional political, economic and social issues within the context of overall water management. However, the basin councils have not yet made any visible impact on water management practices in Mexico. Three basin councils have already been established, but no real representation from the different sectors has been achieved, nor have these councils managed to improve water management in any visible way.

The reality is that the strategies developed by the Federal Government regarding integrated management and planning of water resources at the national and regional levels have not been implemented from an environmental viewpoint in any significant way. Traditionally, increasing water demands in Mexico have been met primarily through the construction of new infrastructures. No definitive considerations have been given as to how to cope with water scarcities and the increasing costs of reliance on supply management only. Issues like demand management, water conservation and increasing efficiency of existing water management practices are still not receiving adequate consideration. Demand management through appropriate water pricing has been completely ignored for the agricultural sector which accounts for more than 80 percent of the use of the nation´s water. Demand management for industrial water use is now receiving some attention; much progress has yet to be made for the drinking water supply sector.

According to the future scenarios developed by CNA at the regional level (CNA, 1997e), there would be an increase in urban and industrial water uses due to increases in population and economic development of the different sectors. Accordingly, planning and management actions must consider the specific needs and problems of each region of the country, as well as water balances of surface water and groundwater, which normally reflect such problems. In the major urban centres of the country, the alternatives available for more efficient water management include demand management, better use of rainwater, natural recharge of the aquifers, treatment of wastewaster, and promotion of water reuse.

Regarding water and wastewater treatment plants, most of the existing ones in the country have either not been designed properly, and/or their operation and maintenance leave much to be desired. Construction of treatment plants *per se* is not the solution for ensuring good quality water, appropriate design and operation are essential prerequisites to achieve optimal results.

The regional analyses carried out by CNA conclude in general that economic activities in the future are very likely to face serious limitations in all the river basins due to constraints imposed by the availability of adequate quantity and quality of water. The urban, industrial and agricultural development in the country depends basically on the more efficient use of water resources. Actions like detection of leakages in the distribution networks and increase in the reuse of treated wastewaters would have to be encouraged. Otherwise, future water availability would depend mainly on the exploitation of new sources, which are mostly already committed for other uses, and which could result in conflicts among the various users. In addition, such strategies are likely to prove very expensive. Policy changes, and use of non-technological solutions, are likely to prove more cost-effective in most cases.

There are already many irrigation districts which currently do not have enough water to cover their demands, even when rainfall is good. The problem becomes even more acute during dry seasons, when water availability becomes a serious constraint. Thus, increasing agricultural activities based only on the availability of surface water is not the best alternative, even when the land is of good-quality for high value crops. Equally, for irrigated agriculture to be efficient and sustainable, it would have to consider many issues simultaneously, along which are water availability (both surface and groundwater), investment costs for proper design, construction, maintenance and operation of the projects, institutional capacities, and economic, social and environmental impacts.

In terms of costs, the people will have to realise as soon as possible that it would be necessary to pay for the real costs of water delivery and wastewater treatment services, directly and through taxes. The charges that are collected at present are not even enough to cover even the minimum costs for operation and maintenance of drinking water and sanitation services projects let alone the investment costs. A major problem at present is that adequate funds are simply not available to improve water supply and wastewater treatment practices in the country. Users of these services would have to make financial contributions for their construction and operation.

Regarding the use of treated wastewaters in the urban areas, it is essential to develop policies to encourage their reuse. Properly treated wastewaters can be reused for irrigation of green areas and most crops, as well as for many industrial activities. Good quality water could thus be conserved for domestic consumption and for necessary industry. One alternative to achieve this would be if the price cost of the potable water is higher than the price of treated wastewater. This would mean development of a strategy to gradually increase the tariffs for good quality water so that those industries which could use treated wastewater find it economical to make this change. Industries thus could be encouraged through pricing policies to use treated wastewaters for their processes. The absence of potable water in small and scattered rural areas, where indigenous population live, represent one of the main problems which has yet to be resolved at the national level. Additionally, it is the lack of clean water, which contributes to severe health and environmental problems all over the country.

At present, there appears to be several possibilities which could contribute to the improvement of the environmental management process of water resources in Mexico. The first would be an effort by the NGOs and the media to force the Federal Government to live up to its legal obligations in terms of environmental requirements. This has happened in certain developing countries, like India, and given some time, it may occur in Mexico. The second possibility could be through the Mexican political system, where the entire top management of all ministries and departments change every six years, with the election of a new President. Thus, in late 2000, there would be a new group of top managers in CNA. If they are environmentally conscious, as they should be, the entire process could be changed radically within a very short period.

Finally, society should accept more responsibilities in terms of water conservation and use. Issues like increases in water fees to public awareness campaigns should be seriously considered.

So far as environmental impact assessment of water projects are concerned, if managers take environmental issues seriously, they would reject virtually all the assessments that have been carried out thus far. Once this starts to happen, the consultants carrying out such studies would realise very quickly that the old days of producing any report, which would be automatically accepted without any serious question, are over. This would immediately start to improve the quality of studies, and ensure some follow-up actions in terms of implementation of mitigation measures. Until this happens, the reports prepared would continue to gather dust in the shelves, and the environmental would continue to receive lip service.

If environmental sustainability of water projects is to be seriously considered, many policy, institutional and legal changes would be necessary. The changes necessary, and the reasons for institutions to promote such changes, are discussed in this report. Unless these changes are instituted, environmentally-sound water management in the country will continue to remain mirage, and the main casualties of this neglect will be the Mexican people and the environment, since none of them will benefit appropriately from the water development projects.

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ANNEX I

ANALYSIS OF THE ENVIRONMENTAL DIAGNOSIS, ENVIRONMENTAL IMPACTS STATEMENTS AND OTHER STUDIES

Environmental Diagnosis

1. Environmental Diagnosis for enlarging the Irrigation district No. 89 "El Carmen" in the Ejido Progreso, Chihuahua. Prepared by Ing. Roberto Alvarado Angulo, Construcciones y Estudios, S.A. de C.V. Report submitted to General Subdirectorate of Water Administration. Area of Water Quality, CNA, under Contract AATS-90-115, no date, 95 p.

The objective of this project is to construct infrastructure to irrigate 2,200 ha which would benefit 110 local families. About 30 wells would be drilled to cover a annual demand of 23.86 million m^3. The project includes construction of 24 km of lined canals, 24 km of unlined canals, 39 km of roads, and electricity. The investment cost of the project was estimated at 25 thousand million pesos (prices in 1991), CNA would cover 66% of the cost, and the balance would be covered by the farmers, mainly through their labour.

The Executive Summary is very general and very poorly written. It does not mention the impacts of the previously constructed projects, the implications of constructing or not constructing the project, or the mitigation measures. It is noted a cost-benefit analysis was caried out which showed very high social benefits. However, this is not mentioned in the Executive Summary, or the conclusions.

No alternative sites were considered for the construction of the infrastructure because of "the importance of the project," which naturally does not make any sense. If the environmental impacts of the project are likely to be permanent and negative, alternative sites should have been considered. The review of the impacts during the construction and operation of the infrastructure is qualitative rather than quantitative. The past impacts were identified as negative and permanent. Even then, the report concludes that the overall project would improve the economy of the region and there would be no negative impacts for the environment. No analysis is available to justify or explain this anomaly.

Regarding the mitigation measures, the report outlines a programme and provides some approximate investment costs. The mitigation measures include modifications in the crops, reforestation, monitoring programmes for soil and water quality, solid waste management, management of agrochemicals; technical support for fertilisers and pesticides, etc. The preparation of the site, construction, and operational phases are programmed, but no mention is made as to what could be the alternatives in case there is a delay in the construction of the project for external reasons. The main problem in the construction and operation of many water and other projects has been the absence of proper planning. Short-term economic benefits represent a priority for the decisions-makers, and not much consideration is given to the long-term implications in terms of economic, environmental and social factors.

In the EIS and environmental diagnosis, the chapters dealing with impacts are very long most of the times. However, much of the emphasis is on the methodologies that would be used, and not on the impacts and their actual and potential implications. Many times not even reliable information is available, and thus

no reasonable analyses can be expected. The assessments are mostly descriptive rather than analytical and no follow-up actions are recommended. It should also be clarified if the constructors of the project make use of the EIS or the diagnosis, and if not, why, and what would be their proposals to make both the processes and the products more useful and implementable.

The report cannot be used as a guideline because of its poor quality. It lacks any serious analysis or discussion not only of the specific issues related to the project, but also on the policies that should be pursued. There is no discussion of the different alternatives and their benefits and investment costs, or social, and environmental implications. The environmental diagnosis and EIS can be a useful tool for proper environmental management of a project, provided it is done properly and considered seriously. However, on the basis of this report, it appears that both the proponents of the project and the consultant were willing to do no more than complying with the legislation which require an environmental assessment prior to the clearance of the project. Such an approach is basically useless for environmental protection.

2. Environmental Diagnosis of the Project on the Hydraulic Project "Bocana del Tecolote, Guerrero". Prepared by Construcción y Estudios, S.A. de C.V. Report submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under Contract AATS-91-115, no date, 61 p.

The objective of the project is to irrigate 1,857 ha in the state of Guerrero, by constructing and also rehabilitating earlier water projects. It is expected to benefit 360 families. The cropping pattern would include coconut, beans, chilli and sesame seed.

About 70% of the main canal of the project was already constructed (14 km of the main canal, 14.5 km of lateral canals, siphons and roads). The project would include lining of 3 km of the main canal, and construction of 11 km of the lateral canals and 3 km of sub-lateral canal.

The impacts were identified to have been mainly positive. The socio-economic conditions of the local population working on the construction of the project had improved. Life style of the people has increased and employment generation has reduced emigration. New employment opportunities have attracted people from the region to move to the area in search of temporary jobs, either direct or indirect. The report notes that many of these people were farmers, but now they have become construction workers. When the project would be operational, workers are expected to get permanent jobs.

Before the construction of the project, the environment had already deteriorated due to increase agricultural activities. When the diagnosis was carried out, the project had not resulted in further deterioration of the environment, or flora and fauna, except water quality which had degraded due to the agricultural return flows. The quality of life of the users is expected to improve significantly because of the increases in agricultural production.

Mitigation measures were mainly reforestation with native species, monitoring programme for water quality, and legal management of agrochemicals in the irrigated area.

The report concludes that the project is beneficial for the area. It emphasises that employment opportunities are a positive impact since it would improve the life-style of the people. However, the fact that farmers would become workers on permanent basis could have some implications for the area in terms of agricultural and cultural viewpoints. Availability of labour may be very positive for the construction companies, but the socio-economic consequences of male emigration from the rural sector need to be careful analysed.

3. Environmental Diagnosis of the Hydro-agricultural Project "Rio Pajaritos, Oaxaca." Prepared by Construcción y Estudios, S.A. de C.V. Report submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA. and BANOBRAS, under Contract No. SGAA-90-87, March 1990, 103 p.

The objective of the project is to construct infrastructure for irrigation, which includes a 25 m. high dam, distribution systems, warehouses, and rehabilitation and construction of roads. A surface of 3,707 ha would be benefited by the project.

The past impacts include deterioration of flora and extinction of fauna. However, no information is available on other environmental impacts, or direct and indirect socio-economic positive or negative impacts. There is also no identification, assessment, evaluation or description of the potential environmental impacts. The mitigation measures proposed were to "avoid oil spillage, proper roads construction; incineration of solid waste, etc.." There is, however, no analysis of the impacts and identification of possible mitigation measures, which would include the population. Surprisingly, the report contains no conclusion notes, as in all other similar reports that "the project would benefit the economic development of the region."

There is no Executive Summary, and the objective of the project is simply "to provide agricultural producers with irrigation." Accordingly, it is necessary to read the 103 page report in order to get an idea of the project, its overall objectives, impacts, and mitigation measures.

This report must be one of the poorest diagnosis of a water project. Not only it contains absolutely no analysis, but also there is no information on the project in more than 100 pages. All the reviewers of the project, which included the internal reviewers of CNA, BANOBRAS (the National Bank for Public Works) and INE, obviously had no interest whatsoever in finding out the potential environmental impacts of the project.

The recommendations note that awareness campaigns are needed to ensure the cooperation of the farmers during the construction, operation and maintenance of the water projects. The only interesting aspects of the report is a review of the constraints the rural areas face at present, like old-fashion technologies, lack of credits and commerce, and threaten to public health. Such issues should have been considered before the project was initiated to ensure its sustainability. Otherwise, in spite of the investment, the project would not deliver the expected benefits. Ad-hoc efforts are highly unlikely to contribute to long-term benefits.

4. Environmental Diagnosis of the Hydro-agricultural Project "Laguna de Zumpango". Prepared by Ingenieros Químicos de Proceso, S.A. de C.V. Report submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under Contract AATS-90-102, July 1990, 135 p.

The objectives of the project include the use of the Zumpango lagoon as a 100 million m^3 reservoir, and to irrigate 10,000 ha in the "Los Insurgentes" irrigation district. Increase in agricultural production and raising of cattle were expected.

The Zumpango lagoon receives an average flow of 8.6 m3/sec, and its quality varies dramatically, from normal to very poor during rainy season. The lagoon receives wastewater from domestic discharges.

In order to increase the storage capacity of the Zumpango lagoon, it was proposed to increase its surface area. The lagoon was dried, and 1,863 ha of land was distributed to the farmers between 1979 and 1981 for agricultural purposes. However, in 1984, the land was to be expropriated again to continue with the project. Such poor management and planning have resulted in serious legal and financial problems. This prevailed until the time of the diagnosis, with the consequent delay of the project.

The project needed more efficient planning. While CNA is responsible for the projects in the main municipality, the Government of the State of Mexico is in charge of water supply. The project even lacks a proper engineering approach. Neither CNA nor the state government have agreed on any of the technically decisions which should have been taken by this time. Even when the diagnosis was being carried out, basic

project concepts were being modified, like the use of pumping plants. There was also no consideration of disposal of solid wastes that would be produced, or how return flow from agricultural lands would be handled. Since the costs for pumping and maintenance are very high, the lack of agreement between the various authorities has resulted in no investment in the irrigation district, because otherwise funds would be wasted in carrying out activities which may not produce any short- or long-term benefits.

5. Environmental Diagnosis on the Project on the Hydro-agricultural Project "Ampliación Delicias". Prepared by Diseños Hidraulicos y Tecnologia Ambiental, S.A. de C.V. Report submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract SGAA-90-82. August 1990, 145 p.

The main objective of the project is to construct the necessary infrastructure to irrigate 5,264 ha of land, distribution canals and drainage infrastructure. However, before initiating any new construction, priority would be given to maintenance activities.

The report points out that nearly 9,000 ha of land have salinity problems. There are also problems due to high water table, soil degradation, floods because of bad management, lack of adequate drainage, poor maintenance of the drainage system, and over-irrigation. Water quality is not appropriate for irrigation due to the high coliforms and sodium contents.

The potential impacts focus mainly on technical issues, not on the social ones. The mitigation measures proposed include management of solid wastes; control of soil erosion; promotion of multiple cropping; management of water resources, pesticides control; regional assessment of health issues due to pesticides; flood control systems; monitoring programmes for soil and water.

The main conclusion is that the project should not be enlarged until and unless appropriate maintenance activities are first carried out first.

The report does not contain an Executive Summary, which means every one is forced to read this 145-pages document which is very badly written right from the first page. The section on Introduction does not mention either the objectives or the outputs of the report or that of the project. The problems associated with the study are not specified and no alternative is considered. The analysts point out that they did not have access to the feasibility studies on technical and economic issues, as well as geohydrological issues and hydraulic balance because they were being carried out simultaneously.

The social assessment includes indicators (like population, education, services, etc.) but there is no analysis of the development of the region based on the irrigation projects that have already been constructed. It notes that "the local population has benefited with the construction of the irrigation projects and their lifestyle has improved," but it does not provide any specific examples or date to justify the assertion. It identifies that one of the main positive impacts of the project would accrue from the marketing of the fruits produced by irrigated agriculture. This would contribute to employment generation, and thus higher income, improvement of quality of life, and less emigration. Further to these automatic benefits for the economy of the region, which appears to be normal for all CNA, it is also noted that the investment needed to construct the infrastructure would be very high, and accordingly, the farmers would have to cultivate only high-value crops. Thus, the construction of the projects would not automatically benefit the life of the local people, integrated planning is needed. What would happen to the economy of the region if the agricultural production is not as expected, or if the marketing is not appropriate? It is difficult to justify the construction of such an expensive and financially risky project under such demanding conditions. It would be important to analyse other similar experiences in the country so that some short- and long-term strategies could be developed.

The report points out that the programmes on social development in the country are focused on achieving food self-sufficiency, generating employment in rural areas and encouraging the farmers to remain in rural areas. Unfortunately, however, it does not seem that the social development programmes and the construction of water projects in Mexico are leading to food-self sufficiency, employment generation in the rural areas and reduction of emigration from rural areas to urban areas. On the contrary, lack of planning, or poor planning, is severely affecting the rural sector.

The construction of projects does not always seem to be linked to integral management. The analysts could had taken this opportunity to carry out a very well structured analysis of policy issues, based on their field experiences, and of the present constraints for implementing the national social development plans for the irrigation sector.

6. Environmental Diagnosis on the Hydroagricultural Project "La Begoña, Guanajuato." Prepared by Coplain Ingenieros Civiles, S.A. de C.V. Report submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract SGAA-90-83. August 1990, 59 p.

The objective of the project is to rehabilitate the La Begoña irrigation district which has been in operation since 1968. The positive impacts of the irrigation project so far have been higher agricultural production, flood-control, and improvement in the lifestyle of the local population. Among the negative impacts have been changes in land use; erosion; sedimentation, erosion, pollution due to agrochemicals; water quality deterioration; devastation of the native fauna and flora; and health problems. The report claims that the roads that were constructed because of the project, have resulted in improvement in services like education, health and food distribution; employment generation and higher income for the local population. The report also recommends that there should be a programme on integrated pest management, including research programmes on biological control, and review and updating of the agrochemical legislation.

The mitigation measures recommended include monitoring soil and water programmes, improvement in irrigation practices in the project area; reforestation, terracing, etc. Overexploitation of groundwater was also considered to be important. It was further recommended to close those wells which were not working properly, and maintain those that were. No assessment was made as to what would be the reactions of the users whose wells were to be closed, and what alternatives may be available to them for getting irrigation water.

Regarding irrigation water quality, the report suggested that 70% of the organic matter should be eliminated and there should be no more than 8 helminth eggs. Since the irrigation district is only of the users of the La Laja river, achieving these parameters may not depend only on them. This issues was ignored. So far, as the legislation to control the use of agrochemicals is concerned, it should be noted that the farmers have historically used all the agrochemicals they could afford to ensure maximum production. They are unlikely to change their practices until and unless they are convinced that it is in their interest to do so, irrespective of any legislation.

Local awareness campaigns on health issues and proper management of agrochemicals and pesticides were also proposed. There was also a list of recommended institutions for the implementation of the project. However, no mention was made if these institutions were consulted as to their interest to be involved in the project. There was no analysing as to the reasons for their poor institutional coordination.

The diagnosis is very general. It does not give any specific information on what would be the benefits or negative impacts of the project on the area. The conclusions were: "the actions that would be carried out for the rehabilitation of the irrigated area would result in the improvement of the quality of the water and the soil, which were very deteriorated at present because of the abuse in the use of agrochemicals and fertilisers due to irrigation practiced earlier." Clearly, the absence of any logic in such a recommendation escaped the analysis.

7. Environmental Diagnosis of the Hydro-agricultural Project "Cupatitzio-Tepalcatepec, Michoacán-Jalisco". Prepared by Grupo Profesional Planeacion y Proyectos, S.A. de C.V. Report submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract SGAA-90-84, August 1990, 79 p.

The objective of the project is to construct, rehabilitate and maintain irrigation infrastructure in the Irrigation district No. 097, General Lázaro Cárdenas. The project includes construction of the Constitución de Apatzingán Dam, and rehabilitation of the canal systems and the main and secondary drainage systems of the irrigation district. Once the dam is completed and the projects are rehabilitated, 113,000 ha would be irrigated which would benefit 16,500 users. Technical assistance to the farmers would also be provided.

The report does not contain an Executive Summary, and the Introduction does not provide any description of the project. There is no clear analysis as to how the construction and operation of the projects have benefited the area, or what have been the negative impacts on the environment and the population. The diagnosis lacks any in-depth analysis of the previous and present economic, social and environmental conditions, as well as what are the actual and potential benefits to the area from the time the project was started. Resettlement and compensation processes for the population are totally ignored, even though these are likely to be the most sensitive issues of the project.

8. Environmental Diagnosis on the Irrigation Project "Coahuayana, Colima-Michoacán," Prepared by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. SGAA-90-85. August 1990, 82 p.

The objective of the project is to develop an irrigation district, improve the lifestyle of the people and the economic status of the region, with main emphasis on employment generation. The project consists of a combination of dams (constructed and under construction), irrigation canals, and distribution network (under construction) to irrigate 25,682 ha. Maintenance is an important consideration, since the irrigation district is in a coastal zone. Surface water is scarce; the main source being groundwater. Since the project is near to the sea, the aquifers may be subjected to salt intrusion.

When the diagnosis was carried out, there were agricultural activities in 68% of the area, even though 89% of it was hardly irrigated. According to the analyses, the main environmental impacts on the area from the beginning of the construction of the project were the pollution of surface water due to municipal and industrial wastewater discharges; agricultural return flow; overuse of agrochemicals and fertilisers; lack of appropriate drainage; salinity, erosion; loss of vegetation cover, growth of aquatic weeds, migration of fauna, and possible extinction of certain species due to uncontrolled hunting. Socio-economic impacts have been direct and indirect employment generation, mainly during the construction phase. There was increase in immigration, as many farmers became construction workers. The main problem was resettlement of the affected population.

The mitigation measures proposed included monitoring of agricultural return flow and soil quality. The use of wastewater irrigation was also proposed, as well as construction of stabilisation ponds and treatment plants.

Data on population, levels of education and health, etc., were noted. However, it did not include any analysis of how the lifestyle of the population has changed in real terms since the project was started, and also what were the expectations over the near- to long-terms. The report mentions that the socio-economic development of the area would depend mainly on the agricultural development from the project

This diagnosis emphasises that there should be a balance between the negative impacts of the project and the benefits, providing the mitigation measures are implemented. It notes the importance of developing

programmes on environmental protection in terms of mainly water quality and wastewater treatment. Since water would be pumped from the wells, there is a risk of overexploiting the aquifers. It considers alternatives and costs necessary to start a soil and water quality monitoring programme, and includes programmes for the protection of fauna (2 species are in danger of extinction: turtle and crocodile). There is the need to develop several programmes like reforestation campaigns, research programmes to recover soils damaged by salinity, and overexploitation of groundwater aquifers; protection of endangered species; drainage construction; assessment on the use of agrochemicals and waters polluted by them, control of wastewater discharges from industries and households, and prevention and control of aquatic weeds. Agreements with other institutions are proposed, as well as follow up programmes.

Some of the recommendations are not feasible, i.e., that there should be no human settlements in the federal zone next to the reservoir because of the solid and liquid wastes they would generate. People are very likely to live next to the reservoir because this represents the best alternative for them in terms of water availability. It is however, desirable to make them aware of the benefits they would enjoy if solid wastes and wastewater are not properly managed. An awareness programme that should simultaneously include economic incentives and sanctions over the short- and long-terms should be proposed and implemented.

The report does not contain an Executive Summary. The importance of an Executive Summary is to provide succinct information to the decision-makers on the importance of the project, its positive and negative impacts, the benefits to the local and regional populations, and investment requirements costs. If the Executive Summary is not included, it is most likely that most decision makers would never read the report because of paucity of time.

Social aspects were not analysed. According to the diagnosis, the development of the region depended basically on the implementation of the project. Even though the project was started before 1988, and the diagnosis was carried out in 1991, there is no information on how the project has changed the life of the people from the beginning of its construction to the time of the evaluation, or how the activities stemming from the project have improved the socio-economic aspects of the region, if any. Several years after the project was initiated, there should be some evidence on its short- and long-term impacts, from which it should be possible to make predictions of the future impacts.

9. Environmental Diagnosis on the Project to Reuse Wastewater in "La Paz, Baja California." Prepared by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract SGAA-90-88, August 1990, 100 p.

The objective of the project is to use treated wastewater from the La Paz City to irrigate 755.69 ha land of the irrigation district No. 66. Wastewater generated by the city would be distributed for irrigation so as to avoid overexploitation of groundwater by the agricultural sector, and thus conserve groundwater for drinking purposes in the city. Distribution of wastewater to the irrigation district would reduce wastewater to the La Paz Bay Wastewater treatment plants would be promoted.

When the diagnosis was carried out, there were already some wastewater treatment facilities and water projects, which needed rehabilitation. Once the infrastructure was rehabilitated, the users association was expected to take over its administration and operation.

Even though several social indicators are mentioned in the assessment (population, emigration rate, ethnic groups, employment, income distribution, services, educational level, etc.), there was no integrative analysis of the environmental, economic and social aspects of the project, The report did not explain the reasons as to why the infrastructure was not maintained earlier, and what steps should be taken to ensure the project was fully operational and sustainable.

Regarding the potential impacts of the project, the report describes some negative impacts like groundwater and soil contamination due to salinity intrusion and use of wastewater for irrigation, bacteriological contamination of the wells due to rainwater; disturbance or even disappearance of fauna and disruption of soil cover. On the social issues, it notes that "just 110 ha have been irrigated with wastewater, and thus no negative impacts can be observed so far." However, elsewhere it is mentioned that "there have been serious health problems." No specific data on public health deterioration due to irrigation with wastewater were provided, but it was noted that "the analysts are sure that there are health problems related to salmonella, hepatitis, typhoid fever, etc." It further noted that the quality of life of the local population had improved due to the presence of water, but that sanitation conditions have deteriorated. No facts and figures were given to justify such statements.

The report is very general and very poorly written. There was no analysis of the parameters that were evaluated to reach the conclusions, or whether these analyses were quantitative or qualitative. The report appears to have been prepared without any scientific analysis whatsoever. The report not only included any analysis, but also it contained no reliable data. It is highly unlikely that the analysts even visited the project.

10. Environmental Diagnosis of the Hydro-Agricultural Project "El Yaqui, Sonora." Final Report. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. SGAA-90-90, August 1990, 72 p.

The objective of the project was to increase the agricultural production and the associated irrigation infrastructure from 52,825 ha to 104,780 ha. The project included improvement in infrastructure, maintenance of canals and drains, improvement in the project operation and distribution of water; mechanisation of the main distribution network, and reuse of water. Equipment would be bought for the maintenance and conservation of the distribution network. The investment cost was estimated at about than 77, 300 million pesos (1990 prices) over 5 years.

The evaluation of the past impacts was qualitative because of the absence of historical data. A list of past and future impacts was included. The report contained no analysis at all. The mitigation measures contained a list of actions which are mostly irrelevant. What is noteworthy however, is the suggestion that the mitigation measures of any project should be implemented by the proponents of the project, and should be included in the contracts. No report should be considered as completed until the mitigation measures have been implemented.

There was no comment on what was the current situation in Mexico in terms of implementation or non-implementation of mitigation measures proposed for water projects, or if the mitigation measures are reviewed and updated according to the evolving conditions of the project.

The report, like others, was very general. It did not have an Executive Summary, and the Introduction had only 3 paragraphs with no information at all on the project. However, it stressed the importance of planning and management issues. It contained good maps on the project area.

11. CNA. Environmental Diagnosis of the Hydro-agricultural Project "Baluarte Presidio, Sinaloa." Prepared by Proyectos, Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract SGAA-90-92, August 1990, 119 p.

The objective of the project was to increase the irrigated area in the southern part of the Sinaloa state to 56, 523 ha by constructing the necessary infrastructure to use efficiently the 2,700 m3 runoff of the Presidio and Baluarte rivers. The final goal was to increase the production of maize, bean, sorghum, and sesame seed. The project was expected to benefit 2,589 families, provide employment to an average of 7,200 farmers each month. The total investment cost of the project was estimated at more than 1 billion pesos (1990 prices). The project was expected to be completed within 5 years.

It is a sub-project to transfer water from the state of Sinaloa to the state of Nayarit under the project "Hydraulic Interconnected System of the Northwest," within the National Water Programme. Other associated projects include construction of several dams, a national programme for shrimp cultivation, development of other aquaculture activities, honey production and promotion of small-scale industry.

Many families would have to be resettled because of the construction of the Santa Maria Dam. However, the report contains no analysis of the resettlement process, problems, solutions and alternatives, or compensation aspects.

The past impacts were due to the construction and operation of the Siqueiros Dam. The quantity and quality of water downstream of the dam were affected by the construction of the dam and filling of the reservoir . The reservoir has facilitated aquifer recharge. Even though the project was not fully operational, the infrastructure has already deteriorated because the programmes on construction and operation were not properly carried out. Funding was not available in time, and there was no political will to support the full operation of the project. Thus, even before the project was operational, it had to be rehabilitated because of structural defects in the dam, like cracks, leakages, etc. Increasing erosion in the irrigation area was noted, even though no agricultural activities were initiated.

Fauna and flora were damaged, but none of them were rare or in danger of extinction. During the construction phase of the dam, there were more employment, which increased the local population due to in-migration. The main problem in the area is the lack of permanent employment, which the temporary employment opportunities will solve.

Among the expected positive impacts are the socio-economic benefits that would result from the agricultural activities. The negative impacts include changes in land use, modifications in land and aquatic flora and fauna, deterioration of water quality, and overuse of fertilisers, pesticides and agrochemicals. The positive impacts would be social once the project is fully operational, provided it was managed properly. The mitigation measures suggested were efficient use of water resources, soil conservation, pest control, programme on environmental protection, monitoring of water quality, and establishment of a research centre on agricultural return flow.

The diagnosis did not contain an Executive Summary, and the Introduction simply notes that "it is necessary to construct some infrastructures in the State of Sinaloa". The report has a very brief analysis of the potential benefits and negative impacts of the construction of the project, and equally few alternatives and recommendations. The main concerns identified relate to the natural resources of the area. The assimilative capacity of the tidal areas and lagoons is very limited because of low exchange of water between the lagoons and the sea. Thus, the agricultural return flow is likely to remain in the lagoon for a considerable time. In addition, the overexploitation of groundwater in coastal areas could result in salinity intrusion, which would be counterproductive from all points of view. Finally, high sedimentation and return flows would reduce the growth rates of the benthos in the lagoon, affecting severely the food chain and limiting fishing activities.

The analysis claimed that the project would be beneficial for the economy of the region, because of agricultural development. However, it ignores fishing and its importance to the economy of the region, and how the fishermen would be affected. In addition, the infrastructure had already started to deteriorate even before it was complete. If this continues unchecked, the project could contribute to major adverse economic, social and environmental effects. No consideration is given as to how these adverse trends could be reversed.

12. Environmental Diagnosis on the Hydro-agricultural Project "Ajacuba, Hidalgo". Prepared by by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract SGAA-90-103, August 1990, 87 p.

The objective of the project is to transport surplus wastewater from the ZMCM to the irrigation district No. 63. Traditionally, the wastewater from the ZMCM has been used by the irrigation district No. 03. However, because of the increase in wastewater volume and its high demand, the irrigation district No. 63 is exploring the possibility of also using it for irrigation. With the construction of this project, 1,047 ha would be irrigated through the Art. 127 Constitutional canal, and 9,000 ha through the Ajacuba canal. In addition, productivity in 1,185 ha. would improve which would benefit 2,900 rural families. Excess water coming from the ZMCM during the rainy season would also be transported to El Marquez dam further irrigating 6,500 ha. The agricultural production is expected to increase in the entire area.

The income of the irrigators who are currently using wastewater has improved significantly. The main negative impacts of the project would be health deterioration, even though no specific facts and figures have been presented to justify this concern.

Mitigation measures proposed include actions like salinity control and reforestation. Importance of improving irrigation practices is emphasised. In addition, industries, hospitals, etc., need to initiate wastewater treatment so as to minimise heavy metal toxic and bacterial contamination of irrigation water. Flood irrigation and sparkling of the crops should be avoided. Wastewater irrigation should be stopped 15 to 20 days before the harvest (depending on the crops), and the crops should not include vegetables that are eaten uncooked, those which are eaten with skin, and the ones which are used for forage.

Like in most other diagnoses and EISs, this diagnosis lacks any analysis of economic, environmental and social issues. Whatever arguments are presented are superficial. The report concludes that the main reason to support this project would be because of the social benefits that would result from wastewater irrigation. However, it contains no serious discussion of the short- and long-term positive and negative impacts of the project, especially in terms of health.

13. Environmental Diagnosis of the Puente Nacional, Veracruz, Hydro-agricultural Project (General Level). Prepared by Ingeniería de Control Ambiental y Saneamiento, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA under contract SGAA-90-104, August 1990, 72 p.

The objective of the Puente Nacional project, is to irrigate 4,712 ha from the La Antigua river. Currently, only 797 ha (17%) are being cultivated with rainfed agriculture. No new dam would be constructed because of lack of an appropriate site, and gravity irrigation would be practised. Existing infrastructure includes one dam and one distribution canal, but they are not operational at present.

The past impacts include environmental deterioration due to the construction of roads, cutting of trees, construction of temporary settlements for the workers, and absence of solid wastes disposal. The chapter on past impacts is very superficial, and it does not contain any serious environmental analysis. The mitigation measures include reforestation, preparation of a water quality monitoring programme, preventive programmes to avoid the growth of aquatic weeds, proper management of agrochemicals, pesticides and fertilisers, inter- and intra-institutional coordination for the better implementation of the mitigation measures, etc. The report concluded that the environmental conditions in the project area had not deteriorated thus far, which totally contradicted the earlier assertion, and that the only problem for using the water of the La Antigua river for irrigation purposes was the presence of coliform bacteria It recommended that water quality should be monitored periodically.

The diagnosis did not have an Executive Summary. The Introductory chapter does not provide any information on the project, or its objectives or methodologies used for analyses carried out. It contains very general information, forcing the readers to go through the entire report. The chapter on expected impacts is very superficial. It contains long lists of general impacts which could result from any project in any

environment. There are no discussions whatsoever on the potential implications of the impacts, future environmental panorama for short-, medium-, and long-terms, or what could be the most realistic and implementable mitigation measures and follow-up actions.

The chapters on analysis and conclusions mention that most of the negative environmental impacts would result during the construction phase, even though they are likely to be temporary. The project would have positive socio-economic impacts which would improve the economic conditions of the region. This study was carried out in 1990, and by that time, it should have been possible to identify most of the positive and negative impacts that were occurring because of the project. However, none are identified. Nor does it provide any information on construction and operational costs, or costs of implementing remedial measures.

14. Environmental Diagnosis of the San Lorenzo-Culiacan-Humaya Agricultural Project. Prepared by Ambiotec, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA under contract No. SGAA-90-101, September 1990, 88 p.

The objectives of the project is to increase the present irrigated area (not mentioned) to a total of 171,234 ha and the cropped area from 133,630 ha to 165,000 ha; construct distribution systems for 2,355 ha in an irrigation unit; use the regulated flows from the Presidente Adolfo López Mateos and Eustaquio Buelna dams; transfer excess water to the north from the José López Portillo and Sanalona dams through the Humaya canal; link the Humaya canal with Bamoa canal; and increase the maximum capacity of the Humaya canal from 85 m3/s to 120 m3/s;

The project would use the flows San Lorenzo, Tamazula, Humaya and Mocorito rivers, through four already constructed dams in these rivers.

The past impacts included those resulting from the construction of the José López Portillo, Sanalona, Adolfo López Mateos, Eustaqui Buelna, and Gustavo Díaz Ordaz dams, as well as the construction of the canals and other associated irrigation infrastructure. The extent and magnitudes of the environmental impacts are likely to be very significant because of large project area, volumes of water that would be used and areas that would be irrigated.

The dams constructed have contributed to floods control, recharge of groundwater, and in increasing agricultural production. However, sedimentation has been reported, as well as deterioration in the water quality in the reservoirs, including extensive eutrophication. Change in land has devastated the flora. The analysts expected public health conditions have deteriorated, though no data are available at present. Employment was generated during the construction phase of the projects, and also because of increased agricultural and livestock activities. The lifestyle of the population has improved, as has the economy of the region. However, the construction of the dams and filling of the reservoirs resulted in an unbalanced distribution of the population in the region.

One of the mitigation measures recommended proper management of agrochemicals in the irrigated areas, since just 25% of the tomato that is currently produced can fulfil the export requirements.

The report does not contain an Executive Summary. There are no serious review or analysis of the environmental impacts, resettlement of people due to the construction of the four dams, alternatives the may be available and appropriate solutions. There is also no analysis as to how the project would affect the lifestyles of the people in terms of health, education, employment, etc.

15. Environmental Diagnosis the Zocoteaca, Oaxaca Hydroagricultural Project. Prepared by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA under contract AATS-90-115. March 1991, 121 p.

The objective of the project is to construct a dam and irrigate 1000 ha, which would benefit 893 producers. When the diagnosis was carried out, 5.25 km of main canal and 2.01 km of secondary canals were already constructed. Positive impacts identified included higher agricultural production and improvement in the quality of life of the population. The report notes that "the environmental conditions of the project area had deteriorated very seriously, and accordingly the project would cause additional negative impacts." Such an assertion is clearly wrong: environment can always get worse. The reviewers of this diagnosis should had seriously questioned this statement, since it implied that no environmental measures were necessary for the project.

Poverty is a very complex issue. In the rural areas, improvement in quality of life of the local and the regional population does not depend only on the availability of irrigation water. Integrated planning combined with higher standards of living, better education and training, properly planned irrigation systems, etc., would result in the improvement in the socio-economic conditions of the project areas, and even the region. Equally, absence of long-term vision and lack of proper planning which have characterised the irrigation sector in the country for many decades are unlikely to result in benefits that are expected. The report concluded that no severe impacts on the environment could be expected during the construction and operation of the project; only benefits would accrue to the population living at present in extreme poverty.

The report is very poorly written. There are complete chapters on physical, biological and socio-economic conditions, but no attempt was made to integrate these three issues so as to obtain a perspective on the overall impacts of the project.

16. Environmental Diagnosis on the Toma Complementaria Endho, Hidalgo Hydraulic Project. Prepared by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA under contract AATS-91-04, May 1991, 99 p.

The project was for the irrigation district No. 03 Tula in Mezquital Valley, State of Hidalgo. The objectives were to rehabilitate and enlarge the spillway of the Endhó Dam, and to improve irrigation water availability in 31,114 ha in this district, which would benefit 20,403 users. The main projects in the irrigation district are the Endhó Dam (183 millions m^3 of wastewater coming from ZMCM), a 40 m^3/s main irrigation canal, and the distribution system.

The project included a 240 m canal from the Endhó Dam, a 71 m tunnel which would cross the dam, the Tula-Alfajayucan road, the construction of a 120 m canal and a 25 m siphon to cross the railroad Mexico-Laredo, which would be connected to Endhó canal. No modification was planned to enlarge or modify any distribution systems for irrigation.

The quality of water varies in the distribution canals as well as the dam, and the water with the lowest quality is distributed to the users. In general, quality of irrigation water supplied complies with the legislation, except for faecal coliforms, which restricts growing of vegetables that are eaten uncooked. The impacts of the projects were identified to be mainly positive because of employment generation, even though it would be temporary, and increase in agricultural production.

The mitigation measures recommended were for public health issues and salinity problems. A monitoring programme for water and soil quality was proposed. Other programmes recommended included prevention of public health problems; training on management of agrochemicals; restriction of crops, and an awareness campaign for water management and public health risks.

Public health problems were referred to very briefly. People in the irrigation district No. 03 and 100 appeared to suffer mainly of gastroenteritis, diarrhoea, respiratory diseases and influenza. No cholera outbreaks are mentioned, even though they are known to occur. There was also no suggestion to develop an

epidemiological programme for the area even though health issues were identified to be the major adverse impacts..

17. Environmental Diagnosis of Reuse of Wastewater from Huajuapan de León, Guanajuato, project. Prepared by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. AATS-91-04, May 1991, 67 p.

The objective of the project was to irrigate 120 ha, benefiting 48 producers, by using treated wastewater from the city of Huajuapan, Oaxaca. There is a treatment plant for municipal wastewater having an initial capacity of 150 lps, and a power substation. The project included the construction of a pumping plant, 1,063 m of transmission lines, 1,600 m of main canal, 3,105 m of distribution system, expansion of the drainage system, etc. The technical assistance would be provided by the rural district 063 Mixteca.

The past project impacts were considered to be mainly positive. Direct and indirect employment opportunities were created during the construction phase of the project, and the economic conditions of the workers improved significantly, although it was temporary. Agrochemicals have not been over-used so far because farmers did not have money to buy them.

The report concluded that the potential impacts would not be significant because the project is small-scale and because the environment had badly deteriorated due to forest devastation." Thus, massive deforestation was not considered by the analysts as an important negative impact in the project area. Equally, severe deterioration of the environment was considered to be not an issue to worry about. The report concluded that the environmental conditions are so bad that it could not get worse. It is indeed a most strange comment for an EIS.

Deterioration of public health was expected because of the use of treated wastewater and overuse of agrochemicals. Other problems could include land use changes, erosion, and extinction of flora and fauna. The return flow from the agricultural fields may also contaminate the Yosocuta reservoir, which is a main source of drinking water. One community would not receive water any more, and thus a well has to be drilled to continue water supply.

The benefits would include availability of irrigation water, which would increase agricultural productivity, and improvement of the lifestyle of the population because of employment generated during the construction and operation of the project.

The mitigation measures included development and implementation of monitoring programmes for soil and water quality, which could be contaminated by return flow from the agricultural areas; programmes for appropriate management of agrochemicals; regulation to restrict the use of agrochemicals; reforestation; awareness programmes addressed to the users on public health issues; and better irrigation management practices.

The study concluded that the project would benefit farmers who live in extreme poverty, with no environmental deterioration. In addition, treated wastewaters could be used for agricultural purposes, and there would be no discharges to the Mixteco river, thus improving the water quality of the reservoir which is a main source for drinking water. A construction of a new reservoir to regulate wastewaters was recommended to avoid discharges during the dry season.

The diagnosis is very superficial, which contains no analysis whatsoever.

18. Environmental Diagnosis of the Cubiri, Sinaloa, Irrigation district. Prepared by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA under contract No. AATS-90-114, June 1991, 84 p.

In 1976, the local authorities requested the then Ministry of Agriculture to construct a pumping plant on the Sinaloa river for irrigation. There was only a deep well in the area which was in very bad shape. It was drilled by the Ministry of Agriculture to irrigate approximately 40 ha.

The diagnosis did not have an Executive Summary or Introduction. According to this diagnosis, the objectives of the project were "to improve the lifestyle of the population and achieve national food self-sufficiency." It is such a general and major objective that it could not be achieved with only one small project.

The diagnosis is very poor. It contains no analysis, or even any data on the project area. According to the report, the past impacts include "impacts of different magnitudes, both positive and negative." The past impacts included deforestation, erosion, salinity, deterioration of flora, fauna and water quality, etc. There simply was no analysis on the future potential impacts of the project. The chapter on mitigation measures focused mainly on general issues like reforestation, monitoring programmes for soil and water quality, programme for managing agrochemicals, training programmes for farmers, etc. The conclusions and recommendations emphasised that "there would be many social and economic benefits in the project area, and the damages to the environment would not be important." The report also contained a very brief discussion of the importance of good water quality, and training programmes.

This report id not contain any overall perspective of the needs of the local population, importance of the project to improve the socio-economic condition of the region, or how the project, past impacts, and mitigation measures, all fit together.

19. Environmental Diagnosis of the Río Verde, Oaxaca Hydro-Agricultural Project. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. AATS-91-03, July 1991, 193 p.

The objective of the project is to irrigate 13,152 ha which would benefit 3,334 users. The project includes construction of a dam on the Verde river, and the distribution of 16.4 m^3/s of water with 252 km canals; 270 km drainage network; and pumping stations to irrigate 4,737 ha by pumping and 2,455 ha by re-pumping. 5,960 ha will be irrigated by gravity.

Rain-fed agriculture is practised in the area at present. The cropping system includes peanut (363 ha), bean (6 ha), sesame seed (14 ha), joint cropping like maize-bean (488 ha). Some 117 ha is irrigated for maize, and 6 ha each for tomato and green chilli.

When the diagnosis was carried out, 50% of the project was constructed including 90% of the dam and the lateral canal, and 5 sub-lateral canals to irrigate the 3,054 ha. About 130 ha was being irrigated directly from the reservoir. The investment cost of the project was estimated at US $38 millions, while the cost of the mitigation measures would be about 370 million pesos. The mitigation measures were estimated at almost 772,000 pesos. This did not include the programme to regulate agrochemical use.

The main aquatic ecosystem of the area is the Chacahua lagoon, which is part of the Chacahua National Park. It has a surface area of 3,325 ha. The project included several archaeological sites that are still not registered in the National Archaeological Atlas.

The past impacts included modifications of the drainage patterns and the river bed, water quality deterioration, etc. Land use changes already had severe impacts on the archaeological sites. On the positive side, the areas that were earlier affected by flooding, are being irrigated. Agricultural production has increased, and the project has contributed to visible social benefits, contrary to the areas that still are not under irrigation.

The environment in the project area has deteriorated very badly, and assessment concludes that "thus, the future impacts are not expected to deteriorate it further. On the contrary, the project is expected to generate employment and reduce emigration rates." The analysts considered only employment generation, but neglected social and environmental considerations to ensure the sustainability of the project. If the environment is very deteriorated, which includes water contamination, at some stage project benefits would start to dissapear. There would be no more jobs, and the farmers would migrate to another part of the country, or even out of the country. There is no rationality in arguments like employment generation justifies environmental deterioration and short-term benefits outweighs serious long-term costs. Considering the report was supposed to be on the environmental assessment of the projects, the competence of the analysts have to be seriously questioned.

One of the main negative impacts of the project would be the severe degradation of the Chacahua lagoon due to agricultural drainages. The deterioration of the lagoon would have serious adverse impact on the local population, whose main economic activities depend on the lagoon. Many are fishermen and tourism-related activities were an important source of employment in the area. With the deterioration of the lagoon, these sources of income would disappear.

The mitigation measures primarily considers the Chacahua lagoon. Measures include development of programmes for conservation of coastal ecosystems and lagoons, to prevent the expansion of the informal settlements in the irrigation district; proper resettlement of people affected by the project; a conservation programme for the archaeological sites, including an awareness programme for the workers to avoid the pillaging of the archaeological sites; regulation of agrochemicals within the irrigation district; soil and water monitoring; development of agroindustries; regulation of discharges; construction of wastewater treatment plants, application of the polluters pay principle; management of landfills; and training on managing irrigated areas (agrochemicals, solid waste, land management, development of agroindustries, legal aspects of the irrigation districts, and environmental education). It recommends a detailed study on the Chacahua lagoons to determine the appropriate technical and environmental solutions for its protection.

The report concluded that the project would not result in severe environmental deterioration, and since it would economically be beneficial to the local population who are living at present in extreme poverty, its implementation can be justified.

The report is very poorly written. It contains very little analysis, even though there are complete chapters dealing with the physical, biological and socio-economic characteristics of the project area. The analysts need to be trained on integral water resources management. It concludes that the project would be beneficial because of employment generation, which would improve the economic conditions of the area. It completely ignored the consequences of the characteristic lack of management in the irrigated areas of Mexico, which is highly likely to result in the severe contamination of the lagoon. In the medium- to long-term, the project may actually reduce the employment potential of the area instead of enhancing it.

20. Environmental Diagnosis of Hermenegildo Galeana, Guerrero-Michoacán Hydro-agricultural Project, Final Report. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No.AATS-91-03, July 1991, 139 p.

The project will irrigate 16,400 ha, which would benefit 4,604 families. The project includes a dam having a 25 m^3/s spillway, 102 km of main canals, 375 km of secondary canals, 41 km of roads, clearing of 3,520 ha (with bushes at present), 33 km of drainage canals and a pumping station. The project was started in 1972, and nearly 70% was constructed when the environmental diagnosis was carried out. About 9,000 ha was under irrigation. The cropping patterns would be maize, sorghum, vegetables, fruits and grass. Technical assistance to the farmers was a component of the project.

A monitoring programme was developed to evaluate the quality of water of the Cutzamala river during the operational phase of the project. However, monitoring was done very seldom and the parameters selected were not the most appropriate. The fauna and flora in the project area has disappeared, and the natural drainage patter has been modified. Most of the impacts identified were positive but temporary, since they refer mainly to employment generated during the construction phase.

The positive impacts include increases in agricultural production, permanent employment generation, and improve in lifestyle of the local population. The impacts expected in the future are soil erosion, salinity, soil and water contamination due to increase use of agrochemicals, health risks, and higher investment requirements for treating the water of the Cutzamala river. The project area of the project requires special attention because it is in an archaeological zone. The mitigation measures recommended included proper management of agrochemicals, soil and water quality monitoring programmes, solid wastes disposal, reforestation programme, training programmes for farmers, and conservation of archaeological sites.

The assessment concluded that the project would be beneficial because of the improvement of the lifestyle of the local population, and also for the country due to increases in agricultural production. Since part of the project was already constructed, the investment cost/ha would be lower compared to a new project.

The diagnosis is superficial and not very objective. It contains no serious analysis of the real social and environmental costs and benefits. It concludes that lifestyle of the farmers would be improved but provides no serious analysis to justify this conclusion. The rural areas have historically been marginalised from a centralised decision-making processes, and extreme poverty has plagued millions of people. Until and unless these issues are identified as major problems, they would not be solved.

21. Environmental Diagnosis of El Grullo, Jalisco Hydro-agricultural Project. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. AATS-91-03, July 1991, 153 p.

The objective of this project is to increase the irrigated area of the Irrigation district no. 094 to 18,284 ha, which would benefit 4,132 families. The project includes the Tacotán dam and enlargement of the El Corcovado dam (both already completed), construction of the Trigomil dam, construction and rehabilitation of irrigation and drainage canals. About 60% of the project was completed when the diagnosis was carried out. The irrigated area would benefit directly due to construction of roads, 13 pumping stations, and enlargement and rehabilitation of existing irrigation infrastructure.

The past environmental impacts include major changes in land use due to the construction of dams and the resulting inundation; salinity problems; and severe deterioration of existing infrastructure, because no maintenance programme was ever considered. The report provides no information on the quantity or quality of land that was inundated. It provides no information on productivity of the soil, impact of inundation on agricultural production, or resettlement of the population. The analysis also ignored issues like compensation, unemployment and quality of life of the population.

Deterioration of the quality of surface and groundwater was considered to be a main negative impact. The report noted that the volume, quality and dynamics of the groundwater varied, but no analysis was presented to justify this conclusion, or what were its implications. Reasons for the deterioration of the surface water quality are excessive use of agrochemicals, contamination with solid wastes, and trees which were not cut during the impoundment of the reservoir. The analysts did not realise that in most cases trees are left in the inundated area, but it is not a major factor for water contamination.

The mitigation measures recommended, included appropriate management of agrochemicals, and training programmes for farmers; monitoring of soil and water quality; protection of local flora and fauna; solid wastes management; erosion control and reforestation.

According to the analysis, the socio-economic conditions of the project was poor, which contributed to increasing emigration. However, the report did not contain any analysis of the benefits due to the construction and operation of a significant portion of the project which should take increased agricultural production and thus an improvement in the socio-economic conditions of the population. The report notes that the benefits in the project area would be partial, because the Trigomil dam would provide irrigation water during the dry season only. Consequently, the socio-economic benefits would be "relatively low, but in order to assess them accurately, it is necessary to carry out other studies." No reason is given as to why an overall evaluation could not be carried out for the report, and why it is necessary to have an additional assessment. Even though the socio-economic impacts of the projects were not assessed accurately, the report concludes that the negative impacts of the projects would be "minimal" and the benefits for the region in economic terms justified the investment costs, and thus the construction of the project.

22. Environmental Diagnosis on the La Pólvora, Jalisco Hydro-agricultural Project. Prepared by Ingenieros Químicos de Procesos, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA. under contract AATS-91-04, July 1991, 78 p.

The project will irrigate 4,637 ha, which would benefit 18,679 people. It includes the La Pólvora dam (already constructed), El Maluco dam and an irrigation area of 3,879 ha. When the environmental diagnosis was carried out, the El Maluco dam was 20% constructed. New infrastructure would be constructed and existing infrastructure would be rehabilitated. The crops grown include sorghum, maize, vegetables, alfalfa, fruit trees, beans, wheat, barley, and oat.

The past environmental impacts included changes in land use, increase in erosion, deterioration of water quality, disturbance of flora and displacement of fauna. The main negative socio-economic impacts expected would be the deterioration in health due to the contamination of water with agrochemicals. The positive impacts would be improvement in economic conditions of the area, and settlement of the workers in the project area. Mitigation measures included a programme on proper use of agrochemicals (including training), and monitoring of soil and water quality.

The Introduction section of the report is very poor. It contains two paragraphs on the "activities of humankind and the importance of the integrated vision of natural resources." It contains no reference to the project.

The report stated that the lifestyle and the financial conditions of the farmers who practised wastewater irrigation have improved noticeably. It also noted that poor sanitation conditions due to such irrigation activities has contributed to the deterioration of the quality of life of the population. However, no information is provided on this issue. Clearly the analysis believe that the improvement in the lifestyle of the population is related only to economic issues, and not to their health conditions or their overall quality of life. The analysts need to be properly trained if usable environmental assessments are to be prepared.

The diagnosis concluded that the project would result in economic improvement of the area, with no "visible" deterioration of the environment. Programmes on communication, information exchange and environmental protection were proposed, without any reference to their objectives, outputs, and costs.

Irrigation with wastewater, unless managed properly, has serious implications in terms of health, deterioration of the environment and quality of life of the local population. Considerable expertise exists in Mexico on the environmental and health impacts of wastewater irrigation since they have been practised widely over many years. Among these impacts are outbreaks of cholera and mortality and morbidity due to

gastro-intestinal diseases. Wastewater irrigation has produced many problems in Mexico because of poor management. This report could have comprehensively reviewed the Mexican experiences in this area. Regrettably, however, wastewater irrigation and its health, social, environmental and economic implications were not considered important both by the analysts and the institutions which cleared the environmental diagnosis.

23. Environmental Diagnosis on the Garabatos, Jalisco Hydro-agricultural Project. Prepared by Ingenieros Químicos de Proceso, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-91-04, July 1991, 78 p.

The objective of the project is to irrigate 1360 ha, which would benefit 20 communities through the construction and rehabilitation of infrastructure. Rain-fed agriculture is currently practised in the project area, which also suffers from serious flooding. The project includes the already constructed Garabatos dam (12 million m^3 capacity), rehabilitation of the La Yerbabuena dam, and construction and rehabilitation of 13.6 km of distribution canals as well as drainage systems and roads. The proposed cropping pattern would include sorghum, wheat, maize, lime, birdseeds, vegetables, and alfalfa.

The main past impacts of the project include changes in land use, increased erosion, modifications in the direction of the flow and the drainage, and severe deterioration of flora and fauna. The expected impacts include are further change in land use, deterioration of water quality due to overuse of agrochemicals, and growth of aquatic weeds. The main socio-economic concern is public health due to poor quality of the water.

One of the main impacts was the inundation of 270 ha of the Garabatos ejido, affecting an unknown number of farmers who are said to have been compensated. The diagnosis does not provide any information on the number of users who were affected, or what was the compensation process, views of the resettlers, and their socio-economic condition before and after resettlement.

The positive impacts identified were increase in availability of food, improvement in the lifestyle of the people, employment generation, and reduction in emigration rates. There is no analysis of the present health and nutrition status of the people, or on the potential impacts that would result from the fact that during the construction phase of the dam, most of the farmers became construction workers. No information was provided on the expectations of the farmers/workers on their present and future activities.

The mitigation measures included regulation and management of agrochemicals, monitoring of water quality (20,000 pesos/year) and soil (270,000 pesos/year), and reforestation. The diagnosis concluded that the negative impacts would be on public health and water quality, and the positive ones on the economy of the area. The conclusions and recommendations emphasised two issues: importance of environmental protection (without any discussion of the reasons, or consideration of alternatives) and the benefits that would accrue due to perennial irrigation.

The overall analysis is superficial, and contains numerous inconsistencies. For example, in the methodological section (chapter IV, p.3), it was noted that the impacts on flora and fauna are very severe. However, in the same chapter, p. 6, it noted "it is important to remember that the land in the area of the project is used at present for rain-fed agriculture. So, the percentage of flora and fauna that will be disturbed can be considered as irrelevant." Thus, if change in land use and deterioration of flora and fauna were critical issues for making a decision on the construction or enlargement of the project, the diagnosis would be of very little use, and thus a new assessment would have to be carried out.

24. Environmental Diagnosis on the La Fragua, Coahuila Hydro-agricultural Project. Prepared by Ingenieros Químicos de Proceso, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-90-115, July 1991, 94 p.

The project is located in the northern part of the country, in the state of Coahuila. The objective is to construct a dam having a storage capacity of 45 million m^3 to irrigate 2,100 ha. 185 farmers are expected to benefit. In the moment the diagnosis was carried out, no drinking water was available in the project area, nor does it had any sewage services.

Identification of the impacts included soil erosion and changes in land use, high use of agrochemicals, deterioration of water quality, health issues (noise pollution, respiratory diseases due to the construction materials and intestinal diseases due to bad quality of water), and destruction of flora and fauna. Farmers became construction workers because of regular income, and this could be detrimental to the regional economy, since its future was expected to be based on agricultural activities. Future likely impacts included accelerated soil erosion, bad quality of water on a permanent basis due to high use of agrochemicals, and improvement in the socio-economic conditions of the area.

The mitigation measures recommended were reforestation, training of users for the operation, maintenance and administration of the projects; efficient use of agrochemicals, water quality and soil monitoring, and proper solid wastes disposal. Users and CNA would share the construction cost of the project: users would pay 30%, and CNA the remaining.

The diagnosis emphasised the fact that the construction and operation of the project, would generate employment, and consequently, there would be less emigration to the United States. The recommendations were very general as well as superficial. For example, it suggested maintenance of the facilities, but it ignored how these are to be planned, how much would be the cost, and who would maintain them. It also suggested that the population should be sensitised to the environmental and health problems that are likely to arise due to improper use of agrochemicals, but it did not refer to the previous experiences on this issues in other parts of the country.

The report is bad and the quality is so poor that one wonders who should be held responsible for it, consultants for preparing it, to ensure the sustainability of the project, or CNA and INE for clearing it without demanding very significant modifications to improve its quality. The Mexican taxpayers paid a high fee to the consultants for an usable paper exercise.

25. Environmental Diagnosis on the Jesus Maria, Guanajuato Hydro-agricultural Project. Prepared by Ingenieros Quimicos de Procesos, S.A de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. AATS-90-115, July 1991, 132 p.

The objective of the project is to irrigate 2,100 ha, which would benefit 3,281 people. The project included the construction of a dam, and 2 pumping stations. There were already 7.2 km of canals and the streams in the project area would be used as irrigation canals. Thus, no more canals would be constructed. The farmers requested the Federal Government to construct the project in 1971, but it approved until 1983. The farmers would pay 30% of the investment cost, and also would provide all non-specialised labour. The balance of the cost would be covered by CNA.

Half of the dam was already constructed when the study was conducted. It had resulted in negative impacts in terms of water and soil quality changes in land use, as well as vegetation losses. Positive impacts identified were mainly employment generation. The project when completed is expected to produce more negative impacts in terms of water quality, soil erosion, destruction of flora and fauna, and very high use of agrochemicals. However, the quality of life of the project areas would improve. Health of the local population would suffer due to the overuse of agrochemicals, and emigration of the population was expected to increase.

Mitigation measures included regulating the use of agrochemicals, water quality monitoring programme, reforestation, technical assistance and training to the farmers on management and use of

agrochemicals, and research programme on conservation of fauna and flora of the region. The report also proposed construction of latrines, redesign of the sewage system; and real involvement of the farmers as well as their organisation.

The farmers are aware of the benefits of the project. They even accept that their lands would be inundated. They should receive fair compensation for their loss. The report ignores the resettlement issue. Considering resettlements have not been properly handled in the past, this issue should have received considerable attention.

The diagnosis concluded that there were some major impacts that were ignored by the project. One example is the likelihood of serious conflicts between the water users because of land tenure. It was noted the quality of life of the local population is so poor that if the mitigation measures are not fully implemented by the authorities, the project would not result in any real benefit. On the contrary, the rural economy is likely to deteriorate further, and thus negatively impacting on the lifestyle of the people.

Even though the report stressed the importance of considering the social issues within the design and implementation of the project in order to assure its sustainability, regrettably these issues were ignored in terms of analysis.

26. Environmental Diagnosis on the Canoas Hydro-agricultural Project. Prepared by Ingenieros Químicos de Proceso, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-90-115, July 1991, 130 p.

The objective of the project is to construct a dam having a storage capacity of 45 million m^3 to provide water to5 ejidos and 17 small-scale owners. This would benefit 465 producers. Local farmers asked the government to construct the project. The beneficiaries would pay for 30% of the cost of the project. It was estimated that by introducing irrigation, the production of apple would increase by 30%. Apple is the main source of income for the local people: the state being the second most important state in terms of production of apple and pear in the country.

When the diagnosis was carried out, 45% of the project was already constructed. The environmental impacts identified included forest clearance, construction of roads, use of heavy machinery, construction of settlements for the workers, etc. The diagnosis claimed that the quality of the environment (air, soil, loss of vegetation, migration of fauna) has deteriorated, but the socio-economic conditions had improved. However, diagnosis did not include any analysis to justify the claims.

The main potential impacts would be air pollution and deterioration of the water quality, which in turn would adversely affect health. The mitigation measures proposed included reforestation (555,000 pesos), training of users, operation, maintenance and administration of the project (30,000 pesos); agricultural extension (30,000 pesos); integrated pest management; water quality and soil monitoring programmes; environmental education; and solid wastes disposal. The report did not consider how the mitigation measures would be implemented.

Even though the diagnosis noted that the environment had already deteriorated because of the construction of the project, “there would be almost no negative impacts on the environment, and the economic and social benefits would make a difference in the area, improving the socio-economic conditions, and decreasing the emigration rate.” It did not explain the rationale behind its assertion that if the previous partial construction of the project had resulted in the deterioration of the environment, why its completion would not have additional environmental impacts. This is probably because the consultants carrying out the diagnosis realised that the diagnosis is a paper exercise and no serious environmental analysis was necessary.

The Introduction did not include any relevant information on the project. It only noted that the "objective is to analyse the environmental impacts that have resulted from the construction of the project Canoas in the state of Durango, as well as the impacts that would be generated when irrigation would be practised." The diagnosis does not provide any information or analysis that could improve the environmental sustainability of the project.

Since it was a diagnosis of a project that had been partially constructed, it should have been possible to assess accurately the impacts of the project that had already occurred from the environmental, social and economic viewpoints so far. The report could have analysed the reasons for the impacts, and what steps could be taken to maximise the positive impacts and minimise the negative ones. All such analyses are missing.

27. Environmental Diagnosis on the Los Reyes, Guanajuato Hydro-agricultural Project. Prepared by Ingenieros Químicos de Procesos, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-90-115, July 1991, 114 p.

The objective of the project is to rehabilitate several water projects, increase storage capacities, and irrigate 625 ha. Only 14.5 ha is being. are irrigated at present The projects would benefit 140 families and the crops would include maize, beans, chilli, fruit trees and vegetables.

This diagnosis is basically a carbon copy of the Environmental Diagnosis on the Hydro-Agricultural Project Jesús María, Guanajuato, which was prepared by the same company, in the same state. The approach, analyses and mitigation measures are identical. It is surprising that two different projects can result in very similar impacts, requiring identical mitigation measures, recommendations and conclusions. It seems that the consultants just made two copies of their report and submitted then for two different projects. This is a good example of the lack of interest and absence of professionalism in the Mexican groups. It is also a damning indictment of the uselessness of the existing environmental assessment process.

28. Environmental Diagnosis of the Tanquien, San Luis Potosí Hydro-agricultural Project. Prepared by Ingenieros Químicos de Procesos, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. AATS-90-115, July 1991, 135 p.

The objective is to complete the construction of the project so that irrigation could be introduced from the Moctezuma river to 1,450 ha where rain-fed agriculture is being practised at present. This would benefit 549 families in 3 different municipalities. The farmers requested this project in 1969. A socio-economic study was carried out in 1975, and in 1976, the project was started. In 1991, when the diagnosis was initiated, the project was still incomplete. In addition, by this time, certain components of the project had already deteriorated very badly. These included the pumping plant, and 31 km distribution canal.

The partial construction of the projects had permanently affected the environment. It has displaced the native flora and fauna, and land is not used for any purpose but it is subjected to erosion. The farmers have not been benefited in anyway. On the contrary, they have abandoned their lands, with the detriment to the local economy and social welfare.

The future negative impacts are expected to be mainly sedimentation, erosion, overuse of agrochemicals, deterioration of water quality, and proliferation of aquatic weeds in the canals. The benefits are expected to be mainly social and economic because of increases in agricultural production, employment generation, and regional economic growth. If absence of coordination continues, the project may not even operate in the future.

The mitigation measures proposed were on reforestation, monitoring of soil and water quality, environmental protection, pest management, and increasing the awareness of the farmers of the benefits of the project, and their organisation into groups.

The diagnosis claimed that feasibility and hydrological studies could not be consulted, since they do not exist. However, unlike most of the diagnosis and assessments reviewed for the current analysis, the analysts actually had some conversations with the users of the project. The users were aware of the importance of the construction of the project, and were willing to assist in the construction, maintenance and operation of the canals. They were convinced that when the project become operational, it would result in crop diversification and increased production. More employment would be generated , and thus their economic conditions would improve. However, the earlier impacts of the project included serious conflicts between the users. The community has divided on the operation of the project, whose construction was stopped because of lack of funds, but mainly lack of coordination. Some of the farmers are against the construction of the project. They have even boycotted meetings, where project benefits and issues were discussed. However, the reasons for these conflicts were not clear.

29. Environmental Diagnosis of the Las Burras, Estado de México Hydro-agricultural Project. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-90-116, July 1991, 143 p.

The objective of the project is to rehabilitate and improve the operational conditions of the existing irrigation system, and to distribute water in 1,530 ha. This is estimated to benefit 1,054 families. The crops grown at present are maize, carnation, pees and avocado. New crops would include chilli, carrots, gladiolas and fruits. Agricultural productivity of the area is expected to increase.

The project would use 800 l/s from the existing Burras dam. Two dams would be constructed, as well as 3 distribution canals, and 8 lateral canals, which would be lined. Nearly 80% of the project was constructed when the environmental diagnosis was carried out.

The project impacts already included sedimentation, deforestation, and water contamination with agrochemicals. The positive impacts thus far have been the temporary employment for workers during the construction phase. The diagnosis claimed that the use of appropriate technology in the irrigated area efficient use of fertilisers would result in less salinisation. However, it is hard to see any linkage between salinisation and increased use of fertilisers. The local economy is expected to improve the trade in agricultural products. However, the consumption of water for domestic purposes could contribute to adverse health impacts due to agrochemical contamination.

The mitigation measures suggested included regulation and management of agrochemicals, soil and water monitoring, solid wastes disposal, reforestation, training programmes for farmers, land use regulation, and construction of roads.

The report argued that the changes in the land use would be positive because of the new construction. From a social viewpoint, some of the benefits would be increases in agricultural activities, construction of roads, employment generation and improvement in lifestyle of the people.

The Introduction section of this report is very similar to the other reports prepared by this group. The technical and socio-economic data used for this report are from 1981-1985.

There are main inconsistencies in the report. Regarding future impacts, the report notes that the overall impacts would be positive. It also stated that the construction of the project would not significantly improve the lifestyle of the population: nor would it increase agricultural production. In spite of these assertions, it concludes that “improvement of life-style would be the main positive impact of the project.”

While the report notes that the lifestyle of the population would improve with the construction of the project (p. iv and 70), elsewhere (p. 73), it claimed that "the positive impacts of the project would result in employment of the local population during the construction phase of the project. However, since the project is small, it would not improve significantly the financial status of the local population, nor would the agricultural production be higher to improve the economy of the region." This clarification is very important. However, neither the analysts preparing the report, nor the governmental institutions reviewing the report appear to even realise that the reports are full of such fundamental inconsistencies. If they are aware of them, then the problem is even more serious because in such eventuality, it is clear that the whole purpose is to give lip-service to the environmental and social issues. This would mean both the governmental institutions and the consulting companies do not take the issue of environmental sustainability seriously.

30. Environmental Diagnosis of the El Xhoto, Hidalgo Hydro-agricultural Project. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-90-116, July 1991, 156 p.

In response to the request of the farmers in 1976, the El Xhoto irrigation project started in 1987. The project would increase and improve the irrigated area of the region, as well as contribute to flood control. It would irrigate a total area of 8,063 ha, and benefit about 2,748 families. The project would be constructed in two phases. The first phase included the partial construction of a main canal, a 226 m siphon, two tunnels, water distribution network, and spillway. The second phase would include completion of the 80.9 km long main canal, and also the enlargement of the lateral canal up to a length of 12 km. More than 4,300 ha of rain-fed land agriculture is now under irrigation. However, the farmers have been working with no technical assistance. A high percentage of the population of the area has worked in the project construction.

The potential negative impacts identified were mainly deterioration of soil and vegetation. The positive impacts would be increases in agricultural production, employment generation, and road improvement, which would benefit the economy of the region.

In some parts of the report, analysts claimed that the construction of the project would not change radically the lifestyle of the people, but elsewhere they affirm the opposite: construction of the project would improve the life style of the population, and the socio-economic conditions of the area. It is highly unlikely that the construction of water projects only would solve the socio-economic conditions of any region, or materially reduce the emigration rate. Even though more than 4,300 ha are being irrigated at present, yields have not increased because farmers have not received any training on irrigation and farming practices. Thus, irrigation development by itself would improve the lifestyle of the farmers who have very limited irrigating skills, and who receive no long-term technical and financial support. It appears that the report was written by different people, with different ideas. These was no coordination between the various authors, and their contributions were simply assembled without any integration. The report lacked any analysis.

The mitigation measures proposed were similar to other projects: regulation and management of agrochemicals, training programmes for the farmers; monitoring of soil and water quality; rescue of species on danger of extinction; solid wastes management; and provision of technical extension services.

The report notes that even though the near-by area of San Salvador is irrigated with wastewater, it has not affected the groundwater quality. This groundwater will be used to irrigate the El Xhoto project, and thus this practise would be safe. The constraints to achieve a good drop yields are soil depth, slope, and erosion. This is why maize and beans are grown at present in non-irrigated areas, and alfalfa and cactus in irrigated areas. During the operational phase of the project, special attention should be given to efficient use of fertilisers and pesticides, management of solid and liquid wastes, monitoring of water quality and proper maintenance of all infrastructures.

The diagnosis is very poorly written. The company "Ingeniería del Medio Ambiente" prepares very similar reports, irrespective of the specific social, economic, technical and environmental conditions of the different project areas. It does not seems to consider the differing conditions and backgrounds of the various projects, expectations of the people, or social, cultural and environmental conditions of the areas. Environmental diagnoses of different projects have very similar introductions, past and expected impacts (both positive and negative) are identical, as are mitigation measures and conclusions. Clearly such generalised and similar diagnoses are unlikely to be of any use to decision-makers to improve environmental sustainability of the projects.

31. Environmental Diagnosis of the Pantepec-Vinazco, Veracruz Hydraulic Project. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, with no contract number, August 1991, 118 p.

The objective of the project is to construct the necessary infrastructure to efficiently use the flow of the Pantepec river to irrigate 1,900 ha, benefiting 222 users and to control floods. The project includes the construction of a 11-km canal, 18.6 km of secondary canals, a pumping plant and siphons, spillways, drainage system, etc. The construction of the project started in 1980, and when the diagnosis was carried out, 80% of the project was already constructed. It was expected to be completed by 1991.

The project area had already deteriorated due to drilling, exploitation and construction of gas and petroleum transmission lines of the Mexican Petroleum Company, which were not properly planned. The project itself has contributed to further environmental deterioration. The report, however, did not outline how the environment had deteriorated.

During the construction phase, temporary employment was generated. Permanent socio-economic benefits were expected once the entire project was operational.

The mitigation measures proposed were reforestation, development of landfill sites, regulation and management of agrochemicals. The report concluded that the project would result be beneficial for the people, providing the mitigation measures were implemented.

The Executive Summary was very general, and not even the objectives were clearly stated. The diagnosis provide conflicting information on water quality. In one chapter, it is noted that water quality would be seriously affected by the project, but it concluded that water quality would not be affected since fertilisers are soluble. It ignored the data from one monitoring station because water was being mixed with sea water, and thus it was not representative of the project area. This leads to the importance of a good and cost-effective programme, which is neglected in all the statements and diagnoses reviewed. Any good environmental assessment must consider the importance of a good monitoring network, as well as discussions of alternatives available for improving the existing system.

The socio-economical analysis did not consider how the project had benefited the people in the project area so far. Like all such analyses, it only referred to temporary employment. It would be very risky to clear the construction of a water project primarily because of temporary employment created during the construction phase. The report mentions that some construction materials were donated to certain schools during the construction phase of the project. This is really an irrelevant consideration for project clearance. What could have been important is an analysis of how the project would affect the quality and extent of education on a medium- to long-term basis. Similarly, what would be the impacts of the project, beneficial or adverse, on health, transportation, communication, and regional development.

The main problems of the environmental statements and diagnosis, is that the reviewers do not provide enough information for the lecturers to develop any comparative analyses on the projects: previous, present and future facts, propose alternatives, and consider the implications.

32. Environmental Diagnosis on the Hecelchakan, Campeche Hydro-agricultural Project. Prepared by Análisis y Proyectos de Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-91-01, August 1991, 181 p.

The objectives of this project are to rehabilitate 45 wells, and to irrigate 3,000 ha. which would benefit 982 families. Irrigation water is now pumped from wells that were drilled more than 10 years ago. Each well represents a small irrigation unit, and 93 wells, out of 122, have to be rehabilitated. CNA would rehabilitate 45 wells, another 28 wells would be taken care of by the Campeche state government, and another 20 by FIRCO (a trust fund for rural development). So far, only 459 producers are benefiting from the irrigation, but by the end of the project, 2,032 out of 2,491 producers would be able to irrigate their lands. The local indigenous users (Maya population) have requested the government to rehabilitate the wells and to then hand them over to the region. The users would be responsible for their operation and maintenance.

An analysis of the past impacts identified water quality as the main concern. The water quality in the wells was not appropriate to irrigate all crops, and it could not be used for drinking water because of its high ionic content. Groundwater has not been overexploited primarily because the irrigation project has been under-utilised by 80%. In addition, groundwater recharge in the project area is considered to be adequate (60 l/sec). Thus, pumping is not expected to result in overexploitation of the aquifer. However, over-exploitation may become a serious problem in the future, if no appropriate planning is considered. From a socio-economic viewpoint, the 10 years-old irrigation activities have proved to be very beneficial for the region. The farmers have organised themselves, wells have been rehabilitated, lifestyle has improved, and there is less emigration. There was no analysis as to why and how the lifestyle of the local population had improved, nor any hard data was provided to justify the assertion.

Problems like erosion, salinity, etc., are expected to occur during the operational phase, but not during the construction phase. Benefits are also projected to occur.

The report contained no objective analysis of the impacts of the project on the environment and on the economy of the region. This assessment is likely to be of very little use to the decision-makers since it provided very little information on the short- and long-term impacts of the project.

33. Environmental Diagnosis of the Elota-Piaxta Hydro-agricultural Project. Prepared by Herman Proyectos y Construcciones, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. SGAA-90-91, August 1991, 140 p.

The objective of the project is to irrigate 64,932 ha. Even though the land is of good quality, it was not productive because of lack of water. In the project area, water is available but a delivery system to the field is missing. Attitude of the farmers is very positive to the project, no conflicts are likely between the users, and already a good highway system exists for appropriate transportation. These, plus appropriate management, are likely to result in the improvement of the economy of the area. The total cost of the project was estimated at 4,000 million pesos in 1978. It was expected to be completed within 5 years, but it is unlikely that it would not be finished before the year 2000. The report provides no reason for this delay, or the implications.

Nearly 25% of the project was constructed when the diagnosis, was carried out. The resettled farmers still could not irrigate their lands.

The most important negative impacts identified were social in nature. Seven communities had to be resettled due to the construction of the dam. Three new settlements were constructed between 1981 and 1990, with a total of 440 houses. The new communities had all services, except sanitation ones.

The positive impacts of the project are likely to be improvements in public services and roads in the project area, and temporary employment generation. Among potential negative impacts identified were deterioration of water quality due to agrochemicals, which would have adverse impacts on fish production. The report concludes that the main negative impacts on the environment would be overexploitation of soil and overuse of agrochemicals, inundation of land and consequent resettlement, and loss of fauna and flora.

The mitigation measures would include growing of salt-resistant crops, soil conservation; groundwater and surface water quantity and quality monitoring; proper maintenance of infrastructure; agricultural use of wastewater; and a management programme of agrochemicals. Unfortunately, the mitigation measures proposed were basically laundry list of activities, instead of in depth analyses of the issues, project impacts on the area, both positive and the negative, mitigation measures necessary to enhance the benefits and to reduce the negative impacts of the project, and how these measure be best implemented, by whom and at what cost.

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The report concluded that it was essential to develop a communication strategy in order to keep the population informed on the recent decisions and policies of the government, and establish a flow of communication between the "constructors" and the "users" of the project. It also noted that it was important the coordination between the technical staff who carried out the feasibility studies to avoid inconsistencies.

The report did not contain an Executive Summary. No data were provided on the previous occupations of the people who became construction workers, as well as on the short- and long-term consequences in terms of health, living conditions, education, etc. There was also no information on the resettlement process and the number of people who received financial compensation, but compensation, and how this affected their quality of life and rate of emigration. The report provided minimum necessary information required by law, and decided to ignore issues which could lead to the non-clearance of the project.

34. Environmental Diagnosis of the Sinaloa River Hydro-agricultural Project. Prepared by Ambiotec, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, CNA, under contract No. AATS-91-02, August 1991, 151 p.

The aim of the project was to enlarge and rehabilitate the infrastructure to cover an irrigated area of 105,380 ha which would benefit 10,120 farmers. It included the construction of 7.8 km canals, bridges, roads, and rehabilitation of 209 wells. Nearly 85% of the area was irrigated in the moment the diagnosis was carried out, and rain-fed agriculture was practised in 10% of the land.

The main impacts identified included deterioration of public health due to pesticides and other pollutants; deterioration of coastal ecosystems, especially reduction in shrimp production; contamination of groundwater; erosion and salinity problems. The mitigation measures proposed were integrated pest management; research on toxicity of pesticides; monitoring of pesticides; multiple cropping; terracing; improvement of irrigation management practices; maintenance of water projects; distribution of drinking water to the workers; and landfill sites for organic wastes. The best option, according to the diagnosis, would be to stop the production and distribution of pesticides at the national level, which clearly would be an unrealistic solution. Biological pest control is still a medium- to long-term option.

The diagnosis was very general, and did not provide usable information on the project and its real impacts on the area. Even the chapter on socio-economic issues did not consider specific benefits or costs of the project on the local population. The Executive Summary contained basic information on the characteristics of the project and the geographical area, as well as socio-economic activities. However, the description of the environmental impacts was cursory. It only mentioned that the main negative impacts would be during the operational phase, it contained no analysis of past or expected impacts, or conclusions. The mitigation measures were presented in diagrams with no comments or analyses.

The main problem was improper maintenance of the infrastructure, which has resulted in deterioration of the canals, drainage systems and roads. Aquatic weeds have become an increasing problem. Public health is expected to deteriorate because of overuse of agrochemicals, employment generated would be temporary, and people live in very poor and unhealthy conditions The report concludes that the local and regional economy would improve in the near future as the project becomes operational. However, this is a statement of faith since no analysis was presented as to how this improvement could be made a reality, especially as past experiences indicate that infrastructure invariably deteriorate because of lack of maintenance, or how the extreme poverty of the population could be alleviated. The reports should have analysed the reasons of the earlier failures and then make specific implementable recommendations so that similar problems could be avoided for the project.

The report stated that it did not quantitatively evaluate deterioration of the environmental issues and recommend that more studies should be carried out. Accordingly, even though the consultants were paid to prepare an assessment, neither them nor the appropriate authorities who cleared the diagnosis, considered it important that the study did not include the magnitude of the impacts, and what the implications were likely to be. A tentative list of investment costs were given in the report. However, since many of the costs were not even calculated, let alone budgeted through secure funds, no authority should be expected to cover the expenses for remedial actions. What also is not clear is that when the statements are cleared by the appropriate environmental authorities, whether the actions proposed become mandatory conditions for implementing any project, including provision of adequate budget.

Even though the current conditions in the country indicate that structures would invariably deteriorate due to lack of proper maintenance, the report concluded that the project would be beneficial economically. A graph showed that economic conditions would improve because of increases in agricultural and fish production, as would health in the project area within 2-10 years. However, the report did not explain how this scenario was arrived at and how realistic it is likely to be. It is even concluded that the agricultural production would increase and the area would become “very competitive at the international level.” Such statements are clearly unrealistic. It is impossible for a project that continues to deteriorate steadily become competitive at the international level.

The diagnosis further states that “the project would not affect the environment significantly, provided financing is available for the mitigation measures.” Provision of funds in a timely manner has never been a strength of the Mexican system. This means that the project would deteriorate, and consequently the economic condition of the project area would not improve at all. Advanced planning, management, administration and training are fundamental requirements to ensure the sustainability of the projects, but unfortunately, these are not unlikely to be feasible in the country in the foreseeable future.

35. Environmental Diagnosis of the Matazaguas, Chihuahua Hydro-agricultural Project. Prepared by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, under contract SGAA-92-40. October 1992, 113 p.

The objective of the project is to irrigate 1,300 ha, which would benefit 100 producers. When the diagnosis was carried out, some 70% of the project was constructed. Started in 1990, the project included construction of a pumping station, distribution canals, drainage systems, and roads. The water would be supplied through a canal from the El Mezquite Irrigation district. It was the farmers of the region who asked the CNA and its predecessor Ministry of Agriculture and Water Resources, to construct the irrigation system to increase the production of wheat.

The report concluded that the expected benefits would be mainly positive. These would be employment generation during the construction phase of the project, and improvement in the lifestyle of the local population. No negative past or future impacts were noted. This clearly is impossible.

The report recommended some very general mitigation measures which would be of no use to the decision-makers in terms of the desirability of the project, or in improving its sustainability. A typical example of the mitigation measures proposed was "to develop a programme to recover the original environmental characteristics of the area affected by the extraction of construction material." However, it provided no information on what were the specific characteristics that should be revived, why the deterioration took place, and its magnitude and extent.

The impacts and the mitigation measures discussed were very general for irrigation projects. Negative impacts included soil erosion, salinity, development, and water contamination from poor management of agrochemicals. The mitigation measures proposed were reforestation, training on efficient use of fertilisers and pesticides, water quality monitoring programmes, etc.

The report concluded that the local population would benefit and that there would be no negative permanent impacts, provided the mitigation measures proposed were followed. The list of mitigation measures included costs, time-frame and names of institutions who could be responsible for implementing them.. However, it is doubtful if the consultant even approached the institutions to check their expertise or even interest in implementing the proposed measures. The fact that CNA and INE clear and authorise a report, which requires other institutions in implementing capacity, does not mean that there is any agreement with the said institutions. There should be better coordination between the different institutions to ensure their involvement. Such consultations are essential to determine their interest and agree on major issues like activities to be carried out, funding, time available, etc.

36. Environmental Diagnosis of the Santiago Bayacora, Durango Hydro-agricultural Project. Prepared by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, CNA, under contract SGAA-92-40, October 1992, 94 p.

The objective of this project is to irrigate 2,914 ha, which would benefit 6161 farmers, and to control floods, which would protect 11,500 people. The area is used at present mostly for rain-fed agriculture, and the main concern is emigration of the population both to USA and to the urban areas of Mexico. The project Santiago Bayacora was started in 1985. It includes construction of two dams, main and secondary canals, drainage network and roads. This diagnosis was carried out when 80% of the project was constructed.

The main present and future environmental problems identified were deterioration of water quality due to inappropriate disposal practices of solid and liquid wastes, loss of vegetation, changes in land use, erosion, contamination by agrochemicals, salinity development, resettlement of population. The positive impacts were temporary employment generation during the construction of the project, and improvement in quality of life. Economic development is expected in the short-term. Mitigation measures included reforestation (33,000 pesos/year; only once), technical assistance (4,000 pesos/year, only once), water quality monitoring (40,000 pesos/year), and soil monitoring (3000 pesos/year). The report concluded that the impacts on the environment resulting from the projects would not be important, provided the mitigation measures are implemented on time.

The project included the construction of two dams which have already been built. There are only two paragraphs on resettlement issues. The report noted that "there were no problems for the resettlement of the people, or the conditions in which they live at present. Even though the construction of the project represented a main negative impact, it was solved since people were provided with housing and services like electricity, tap water, sewage, roads, etc. However, in spite of the compensation, their traditions and economy were severely affected." Resettlement of population is now considered to be one of the most sensitive issues during the construction of major water projects, and it often represents a main cause for increasing emigration and poverty. However, the diagnosis contained no information on the number of

persons who had to be resettled, the overall planning process, if any, to resettle them, type of compensations provided, implementation of the national policies on these issues, and views of the people resettled. These are important considerations since there are projects, like Cutzamala which were first started more than 20 years ago, and which provide potable water to part of the Metropolitan Area of Mexico City, where people have yet to be compensated in spite of official statements to the contrary.

One of the main justifications for the construction of all irrigation projects in Mexico is that these would improve the quality of life of the rural population, contribute to employment generation and reduce emigration. However, the construction of the projects and lack of advance planning often promote displacement of people in one way or another instead of reducing it. The environmental diagnosis should be considered as a good opportunity by CNA, SEMARNAP and the consultants, to analyse these issues, identify the strengths and weaknesses, and propose realistic alternatives which would improve the existing bad conditions in the rural areas in the country.

37. Environmental Diagnosis of the Los Carros-Cayehuacán, Morelos Hydro-agricultural Infrastructure Project. Produced by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, CNA, under contract No. SGAA-92-40, October 1992, 101 p.

The objective of the project is to irrigate 3,000 ha, which would benefit 826 farmers. It includes two dams, Los Carros (already built) and Cayehuacán (90% constructed); two pumping plants: La Campana (45% constructed) and Telixtac (60% constructed); 48.506 km of distribution systems (24.716 km main canal, and 23.79 km of secondary and tertiary canals) (60% constructed). By the time the diagnosis was carried out, 1,800 ha were already under irrigation. The roads, with exception to the 4 km road to the dams, have already been constructed. The project was started in 1986, and when the diagnosis was carried out, 85% was constructed.

The yields of rice, maize, sorghum and bean in the area are very low. With the introduction of irrigation, the farmers would also be able to grow sugarcane, rice, onion, tomato, squash and cucumber. This improvement is expected to result in employment generation, higher income, and increased transportation and commercial activities.

The past impacts identified included land use changes (inundation, extinction of flora and fauna); loss of germplasm, since the area that would to be inundated is mainly forest; erosion; changes in microclimate; deterioration of water quality; and resettlement of the Tlazola community. The mitigation measures proposed were are reforestation of almost 300 ha (30,000 pesos, only once); training on irrigation systems and management of agrochemicals ($14,000 pesos, only once); monitoring programme on water quality (3,000 pesos/year); and land restoration (7,000 pesos, only once). The report concluded that the project would be beneficial economically, and the environmental deterioration could be reduced with the implementation of the proposed mitigation measures.

The report noted that the main objectives of the project were employment generation, improvement in the lifestyle of the local population and in the regional economy, and reduction in emigration rates from the region. However, it contains no analysis as to how or even whether these objectives could be achieved specifically in the light of experiences from similar irrigation projects in Mexico, and what have been the reasons for their failures or successes. Unless these issues are properly analysed, the socio-economic condition of rural areas are unlikely to improve permanently through the construction of irrigation projects.

By the time the assessment was carried out, some communities had already been resettled. However, the report contained no information on the resettlement processes for this project, or in general in Mexico. It also made no reference to the number of people that had to be resettled, what were the main problems, how they were solved and how the resettlement and compensation processes could be improved in the future. It

noted that the people were not satisfied with their new living conditions after the resettlement. Even though the settlements had services like potable water, electricity and sewage, the houses were smaller and the people could not keep easily animals like cows, chickens, etc., as they had done before. There were also problems between the families who were resettled together, which created a hostile environment. Irrigation was being already practices, but there was no analysis of its impacts.

The employment generation that normally is mentioned in the statements, refers to the jobs the farmers could have as workers during the construction phase of the project. However important these benefits may be, these are temporary, and not permanent. All development projects should aim to create long-term employment and regional improvement. Instead, all diagnoses and EISs only consider temporary employment generation and projects are often justified on the basis of these short-term benefits. The analysts should also be trained to review projects in an integrative manner, and propose alternatives which would contribute to the sustainability of the projects, and the social, economic and environmental improvements of the region.

38. Environmental Diagnosis of the Oriente de Yucatán, Yucatán, Hydro-agricultural Project. Produced by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Evaluation, CNA, under contract No. SGAA-92-38, November 1992, 167 p.

The document is not a diagnosis. It just includes information on climate, water distribution, agricultural production, cattle raising, flora and fauna, etc. There is a series of questionnaires on possible impacts of the project on the environment and the population. However, it did not note for whom they were addressed, or what was the process.

39. Environmental Diagnosis on the Rain-fed Tapachula, Chiapas, Project. Produced by Coplain Ingenieros, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, CNA, under contract SGAA-92-39. December 1992, 297 p.

The objective of the project was to increase agricultural production in about 32,000 ha in Chiapas, by maintaining 175 km of roads, constructing a levee of 55.3 km along the river Gran Comitán, 167 km of secondary drainage system and 5 warehouses. About 3,600 farmers were expected to benefit. In 1992, 47% of the project was constructed (100% of roads and 14% of drainage). The total investment cost of the project was estimated in 40 million pesos in July 1992.

According to the report, the past impacts have only been positive from environmental, social and environmental viewpoints, which clearly is very unlikely, if not impossible, since the report also noted that the parts of the project that were earlier constructed had already deteriorated because of lack of maintenance. The future negative impacts were expected to be deterioration in water quality, soil, and public health, changes in the traditions of the population, etc. The positive impacts would include use of land that is normally flooded. The Lagunas de Montebello National Park is very likely to be affected if no technical assistance is provided to prevent contamination of its water resources.

The mitigation measures included communication and information programmes on the project for the local population, control and surveillance of excavations, coordination between the farmers and the government, compensation programmes, improvement of water quality, and sanitation programmes. No investment costs were estimated.

The conclusions were very superficial. It is indeed a very sad commentary that diagnosis of 40 million pesos conclude that “it is feasible from the environmental, technical and economic viewpoints, that farmers should be supported, traditions respected, and mitigation measures considered.”

The report is far too long. However, there are some comments which are interesting. For example, it noted that when the diagnosis was carried out, the local population was not aware of the project, and the farmers were not receiving technical assistance. Objectives like improvement in the quality of life and regional economy would not be fulfilled, mainly because of lack of maintenance of any infrastructure. Accordingly, it is highly likely that the lifestyle of the people would remain the same, even after this high investment of 40 million pesos. Not only the farmers would benefit, but also the whole economy of the country would be affected because of such high investments, which could have been used productively for other purposes for the benefit of people at the local, regional and national levels. Such projects, with a high risk of failure, should be seriously questioned by the authorities and modified accordingly. Clearance of his project, in spite of the diagnosis, indicated that neither CNA nor SEMARNAP really cared very much about the quality and/or results of the environmental assessments. The projects are automatically cleared as soon as the legal requirement of preparing a report is complete. Findings and conclusions appear to be totally irrelevant for the decision-making process.

40. Environmental Diagnosis of the Pujal-Coy II Fase, S.L.P. y Tamps. Project. Prepared by Coplain Ingenieros Civiles, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, CNA, under contract No. SGAA-92, April 1993, 355 p.

The project is to irrigate more than 200,000 ha. It included the construction of 609 km of roads, 511 km of drainage canals, 12 pumping plants, warehouses and 17 new communities with all the necessary services to benefit almost 18,000 people. It also included land preparation, nutrient and pest control, commercialisation of products, technical support, and maintenance activities. In 1992, 34% of the project was constructed, primarily in terms of roads (84%), drainage (51%) and new settlements (58%). The investment cost of the projects was estimated at 1,000 million pesos in 1992.

Some of the past impacts of the project that were considered to be beneficial to the area included flood control activities and development of new settlements with basic services like housing, hospitals, education facilities, etc. It appears that the construction workers coming from outside the project area were the primarily beneficiaries of the services, which unfortunately was not the case for the local people, who still do not have access to adequate services. The negative impacts also included changes in land use, and "adverse impacts on fauna, traditions and the organisational structure of the local communities, agricultural production, and on the local and regional economy." According to this paragraph, the project overall had negative impacts on the social life and on the local and the regional economy. If this is correct, the project should have been seriously questioned, and its construction should have been stopped until these issues were clarified.

One of the main concerns which could hinder the success of the project was the social and cultural differences within the population, which have resulted in the isolation of the farmers within the community. In addition, lack of planning in terms of expropriations, compensations, land tenure, and establishment of population centres may result in the significant delay and in the completion of the project, and may even contribute to its failure.

Farmers living in this area are facing many constraints. According to the diagnosis, the proposed cropping patterns are not appropriate, since they are contrary to the commercialisation trends in the national markets. Products like meat and sugar are being imported to the area, even though they are produced locally. There are no agroindustries which could assist in the commercialisation of the products. There is a typical situation which indicates an absence of an integrative approach to planning in the country. This is further deteriorating the serious conditions which already exist in the rural sector.

In order to better understand and appreciate the consequences of the project, it would be necessary to

review the report on the Phase I of the project, which was not available in the library so that I could analyse it.

The main constraints to the successful implementation of the project were identified to be the lack of institutional, financial and technical support and the absence of integrative planning at the national level. Other important issues were inappropriate cropping patterns; land tenure; lack of progress in establishing new settlements; and most importantly, poor planning for providing compensations to the people who were to be resettled. Some people even received legal protection against the government to keep their lands, and thus prevent inundation.

The mitigation measures should focus mainly on the objectives and goals of the oject, considering the economic benefits of the cropping patterns selected, along with the market tendencies, and the development of social programmes for the new settlements. Other measures include water quality monitoring programmes, development of information and communication strategies for the project, protection of the archaeological sites, conservation of riparian vegetation, and floristic studies.

The diagnosis is poorly written, including numerous spelling errors. In addition, there was no overall analyses of the past and expected social, economic and environmental impacts. It is impossible to get a clear perspective from the report on the main problems of the project, and also what could be the feasible alternatives. For example, the report provides no information as to why people are receiving legal protection. Is it because the compensations offered are unfair, or they would not receive any payment before they were resettled, or because they are reluctant to leave their ancestral homes.

The report recommended that several groups should be considered responsible for implementing the mitigation measures, like the then Ministry of Agriculture, CNA, local authorities and users. However, no commitments from any of the institution suggested appear to have been obtained.

41. Environmental Diagnosis of the Cutzamala System, Phases I, II y III Project. Prepared by IDDEC, S.A. de C.V. Submitted to General Subdirectorate for Technical Issues, Area of Water Quality, CNA, under contract No. GSCA007/96, 1997, 156 p.

The analysis of this diagnosis is included in the chapter no. V, Water Supply and Distribution in The Metropolitan Area of Mexico City: A Case Study

Environmental Impact Statements

42. Environmental Impact Assessment on the Aguacatal Project, General Level. Prepared by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-91-115, no date, 197 p.

The objectives of the project are to irrigate 1,561 ha using the water from the Chumpán river to produce rice, maize, melon and water melon, generate employment, and improve quality of life of the local population (98 families). At present, rain-fed agriculture is practised in the project area to grow rice (3.5 ton/ha/year).

In 1982, the local farmers requested the then Ministry of Agriculture to develop irrigation in the project area. The project includes construction of a pumping station, 17.03 km of distribution canals, 18.74 km of drainage canals, and 13.11 km of roads, with a total investment cost of almost 7,000 million pesos in June 1990. The investment was estimated to be recovered within 6 years.

The feasibility studies included consideration of issues like hydrology, present and future land use, and socio-economic characteristics. Infrastructure for irrigation existed in the area from 1984, but was not enough to cover the increasing needs of the local population. The project was expected to be completed within 3 years. According to the original estimate 501 ha would be irrigated in the first year (59.46% of the investment cost), 664 ha in the second year (27.24% of the investment cost), and finally, 396 ha would be irrigated in the third year (13%). In 1995, five years after the construction of the project, the irrigated area was expected to produce agricultural products worth almost 4,000 million pesos.

The impacts were expected to occur mainly during the operation and maintenance phases. The main negative impacts identified were deterioration of the environment in terms of water and soil quality, salinity and erosion problems, and lack of services for the growing population. The positive impacts would be multiple cropping, improvement in agricultural practices; economic improvement of the region, and employment generation.

The mitigation measures proposed included solid waste management, reforestation, water quality monitoring, management of agrochemicals, improvement of irrigation practices, development of an operation manual for the workers, technical support to the farmers, awareness campaigns for the farmers on sustainability and health issues, and research on certain specific issues. The report provided an overall estimate for the mitigation measures, but costs for specific measures were not given.

The report concluded that the project was necessary for the region, since the increase in agricultural production would improve its economy, and thus, the lifestyle of the people. The main problem in the project area when the EIS was carried out, was contamination of groundwater and surface water, which had severe impacts on the economy of the region. It also concluded that the project would not have serious adverse environmental impacts. However, water quality-related issues should be analysed more in depth since they may represent a major problem in the near future.

The report pointed out that some independent reports existed which contradicted official reports on the construction and operation of the project. Thus, the feasibility study of the Aguacatal project on technical and economic issues should be re-evaluated and up-dated, taking into consideration the independent reports.

43. Environmental Impact Statement of the Project El Cuchillo dam and Oriente China-General Bravo-Cadereyta-Monterrey Aqueduct. Prepared by Coplain Ingenieros Civiles, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract SGAA-89-19, December 1989, 200 p.

The objective of the project is to increase the supply of drinking water to the Metropolitan Zone of Monterrey City up to 10 m^3/s in two-phases. The first phase included the conduction of 5 m^3/s in the Cuchillo-San Roque section, with an investment cost of 1.2 billion pesos. Sanitation aspects would also be considered within this project.

In order to supply the drinking water to Monterrey City, the El Cuchillo dam would be constructed on the San Juan river, and the water would be distributed through an aqueduct with five pumping stations. The reservoir capacity would be 676 millions m^3.

Expected impacts included environmental and socio-economic-related issues. The main social conflicts were likely to result from the resettlement of several communities, changes in land use, lack of employment, etc. The economic activities would change, and the farmers would have to work as construction workers at least during the construction phase. Permanent employments are expected to be generated during the operational phase, although their numbers would be much less. Other problems included the lack of water during the filling of the reservoir, and changes in the cultural and social patterns. In spite of all these impacts, no serious social opposition is expected against the project, because the communities are

unorganised and individual attempts would not result in any meaningful action. The main benefit of the project would be water for the urban population in Monterrey.

The mitigation measures included the development of cooperation agreements between the different institutions responsible for the technical, economic and social support during the construction and operational phases of the project; multiple cropping; development of programmes by CNA on environmental protection, including construction of wastewater treatment plants; monitoring programmes for water quality and solid waste management; drainage; aquaculture and reforestation; awareness programmes addressed to the construction workers on environmental protection; local involvement in the project; resettlement; communication and information campaigns on the project; and development of a specific programme on the implementation of the mitigation measures.

The report did not contain an Executive Summary, which would meant that senior decision-makers would not be aware of the implications and costs of the projects to take any decision. The statement included a detailed explanation on the justification of the project, including the need for several other water sources for the City of Monterrey.

One of the main impacts of the dams is resettlement. The report provided detailed information on the technical aspects of the project, as well as the need for integrated management to ensure its sustainability. However, it did not contain even a single sentence on the resettlement process that should be followed, or the compensations that should be paid. There are also no comments on previous resettlement experiences, their failures and successes.

44. Environmental Impact Assessment on the Babisas (Las Burras), Chihuahua Project.,General Level. Prepared by Anáhuac Ingenieros Consultores y Supervisores, S.A.de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, CNA, under contract AATS-91-07, 1991, 130 p.

The objective of the project is to provide irrigation to 1,420 ha, which would benefit 71 users. The land which would be irrigated, is used at present for raising cattle. Irrigation water would be pumped from the Conchos river, downstream of the Chuvíscar river, and would have a high degree of pollution because of agricultural runoff and discharge of municipal wastewater.

The Executive Summary is very poor, and even the objectives of the report are not clear. It noted that "the objective of the assessment is to identify and define the reasons and consequences which could limit the achievements of the goals of the project Babisas, as well as to propose the mitigation measures for such impacts." Not surprisingly, the assessment is neither analytical nor useful for anybody.

The descriptions of the area of the project and the environment were also very poor. The chapter on socio-economic issues did not provide an overall perspective of the current situation in the project area; the mitigation measures did not address any specific problem; and the conclusions contain only a general statement to the effect that "the main problems that would result from the construction and operation of the project would be salinity, erosion, water contamination, and diseases."

After reading the EIS, one is no wiser as to what would be the real impacts of the project, and how these would be mitigated, or whether they would be mitigated, and finally, the desirability of constructing the project. A major limitation for implementing the mitigation measures, and thus improve the sustainability of the project is the absence of advance planning to develop national programmes on irrigated agriculture. Budget represents another major constraints. Investment costs of mitigation measures are normally not considered within the budget for a project. Accordingly, very few of the mitigation measures needed are ever properly implemented. This contributes to deterioration of the infrastructure, which in turn affects socio-economic development of the area and quality of life of the local people. Not even a single diagnosis or EIS

reviewed analysed the problems associated with the implementation and funding of the mitigation measures, as well follow-up activities. The environmental reports are normally cleared automatically, with no substantive modifications, and then promptly shelved to never surface again.

45. Environmental Impact Statement of the San Miguel Temapache, Veracruz Drainage Project, General Level. Prepared by Eco-Ingeniería, S.A. de C.V Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-91-05, May 1991, 91 p.

The objective of the project is to drain 3243.6 ha of land which is flooded periodically by the Tuxpan river, rehabilitate the land, and use it for citrus production. Some 6,700 people live in the project area where the main economic activities are agriculture and commerce. The site preparation and the construction of the infrastructure was expected to be completed within two years. The main drain and 10 km of roads would be constructed during the first phase of the project. The second phase included construction of secondary and lateral drains and the remaining 10 km of roads.

The San Miguel project is expected to result in minimal negative impacts on the environment and the population of the area, provided appropriate mitigation measures are implemented. Excavation and land clearance for the project would result in negative impacts on soil, fauna and flora. The overuse of agrochemicals once the project is functional, may contaminate the water of the drains.

The mitigation measures proposed included reforestation, solid wastes disposal, monitoring of water quality, regulation on the use of pesticides, and training of the farmers on the appropriate management of agrochemicals and land conservation practices. It appears that all the mitigation measures proposed are the unilateral views of the consultant, since no discussions take place between the consultant and affected project-people. Public participation and involvement are not components of Mexican environmental assessment process.

The farmers of the area requested the government to construct the drains in 1978, but the EIS was not initiated until 1991. Thus, it took the authorities 13 years to start the process which, according to the report, would only result in benefits for the local communities. If the project was expected to be so fantastic, one wonders why it was not promptly started.

46. Environmental Impact Statement of the Baluarte Presidio, Sinaloa, Irrigation Project, General Level. Prepared by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-90-114, May 1991, 264 p.

The objective is to irrigate 56,523 ha and improve the life style of 4,389 farmers. The project includes the construction of the Santa Maria dam and the El Tamarindo dams (80% constructed), reforestation, wastewater management, compensation for the farmers who are to be resettled, management of agrochemicals, protection against noise, salinity and erosion, environmental protection, and mitigation measures to protect the lagoons.

The socio-economic aspects of the project include the resettlement of the population and the employment of local and non-local population during the construction of the project, as well as the reduction in the emigration rate. However, the report ignores the resettlement processes for the people who had to move involuntarily because of the construction of the dams, as well as the problems that were faced in terms of compensation, how they were solved or even if they solved.

The major negative impacts were expected to be on the coastal lagoons Huizache-Caimanero and Agua Grande. The aquacultural-related activities around the lagoons are very important for the regional economy, mainly in terms of shrimps production. These activities, loss of aquatic flora and fauna, and

variations in the hydrodinamics of the water bodies, are expected to be affected negatively because of the new agricultural activities and consequent pollution due to agrochemicals.

Other expected adverse impacts identified were erosion and salinity problems, noise contamination, deterioration of water quality in the Baluarte and Presidio rivers due to disposals of solid and liquid wastes, and agrochemicals, resettlement of communities, etc. The positive impacts included employment generation, improvement in life style, and reduction of emigration from the region. The mitigation measures proposed were reforestation, management of solid and liquid wastes, construction of drainage system, training on the use of agrochemicals, and awareness campaigns for environmental protection. Regarding the resettlement of the communities, a planning process should be developed in order to identify the needs and requirements of the population, and a fair and appropriate compensation process should be considered for the farmers in exchange for their lands. A 50% unemployment in the project area is noted the EIS. So, even though temporary jobs would be created during the construction of the project, lack of planning may lead to a higher unemployment and emigration rates in the future, which may negatively affect the population, instead of contributing to better economic conditions and lifestyles.

If properly planned, the development of the irrigation district can result in the social and economic improvement of the region. However, the negative impacts on the environment could be so serious, that they could deteriorate the productivity of the lagoons, which may have adverse economic impacts on that sectors of the population whose livelihoods depend on aquaculture, without necessarily developing alternative economic activities that could be pursued.

47. Environmental Impact Assessment of the Bajo Usumacinta Campeche-Tabasco, Project, General Level. Prepared by Análisis y Proyectos de Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-91-01, May 1991, 76 p.

The objective of the project is to irrigate 100,000 ha. for rice production. The irrigation activities would be based on management of rainwater (10,200 ha/year), pumping from wells (14,500 ha/year) and extraction from the Usumacinta river (5,300 ha/year). The project included construction of roads, canals and levees.

Only 151 people live in the project area. However, this number is expected to increase due to temporary employment opportunities. For the project to be successful, it is important to plan properly its construction, operation and maintenance, as well as the agricultural and human activities, so that they do not result in the deterioration of the environment, on which development depends.

Some of the mitigation measures recommended to avoid environmental deterioration of the area centred on conservation of natural resources (600,000 pesos/year, just once); monitoring programme for water quality (150,000 pesos/year, every three months); forest management (3 million pesos/year, during five years); solid waste management (100,000 pesos/year, only once); improvement of agricultural practices; and establishment of an ecological reserve.

The report concluded that the project would be beneficial for the region, provided the mitigation measures were implemented, because the area is very rich in natural resources, and the environment is already disturbed. In order to ensure that the project and the mitigation measures would be properly implemented, the producers have organised themselves into a team to deal with the problems.

The report noted that the project would improve the regional economy, promote self-sufficiency in rice production at the national level, and improve the life-style of the local people. It is indeed paradoxical that irrigation of only 100,000 ha would make the country self-sufficient in rice. Clearly such statements are totally erroneous as well as irresponsible. An EIS is not expected to justify the construction of a project at

any cost and irrespective of its impacts. The report must analyse the project objectively, and propose best alternatives for its implementation.

48. Environmental Impact Assessment on the Tecnificación de Temporal Llanos-Guadalupe Victoria, Durango Project, General Level. Prepared by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-91-05, June 1991, 113 p.

The project affects an area of 120,000 ha and 42,000 people. The objectives of this project are to establish a rain-fed agricultural area, introduce technology, increase the cultivated area, and thus the total production. This project resulted from a 1980 Vision exercise on rehabilitation, construction and maintenance of roads, conservation of soil and water, and construction of infrastructure for livestock-related activities.

The rain-fed agricultural activities were started in this region in the 1940´s. The consequent deforestation has already resulted in serious environmental deterioration of the area.

There were no up-to-date social, economic or environmental feasibility studies for the project. In fact, the projects that may be constructed have not been decided yet, and no contract has been signed with any construction company. There is no future plan of the region, based on the construction and operation of the proposed project. According to CNA, by the time the assessment was carried out, the only proposal available was a 10-years old planning study. No projects were constructed at that time on the basis of the planning study. Simply some wells were drilled and certain roads were constructed or rehabilitated.

If the project is to be implemented, soil erosion is likely to be a serious problem. The recommendations included the best use of the soil of the project area, development of activities that were not agriculture-related, restoration of the native vegetation, and development of a training programme on soil conservation for the local people. The mitigation measures were estimated to cost annually 33,000 pesos/year (only once) for reforestation; 40,000 pesos/year water for the quality monitoring programme and 3,000 pesos/year (only once) for soil monitoring; 42,000 pesos/year (only once) for training programmes; and 5.000 pesos/year for land use planning (only once).

This EIA concluded that the project was not feasible because of the environmental conditions of the area, and the likely impacts of the project. The main constraints were shallow depths and rocky conditions of the soil, and the rainfall is low. Agricultural activities could not be recommended under those conditions. The best alternative would be to raise livestock and not practice agriculture.

Instead of proposing mitigation measures for the project as planned, the report emphasised that the design and construction of the project should be reconsidered. It concluded that the project was not feasible for the region, and also recommended the best alternatives for the development of the area.

49. Environmental Impact Statement of the irrigation district Bajo Alfajayucan, Hidalgo, Project. General Level. Prepared by Eco-Ingeniería, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, and Area of Water Quality, CNA, under contract AATS-91-05, June 1991, 116 p.

This project is part of the Water Plan for the Centre of the country (PLHICEN), which focuses on regional development based on water resources management. The water that could be used to develop the project area may come from the Tula river basin, and the sewage from the ZMCM. This development programme is linked to the increasing population growth and consequent higher water demand in the ZMCM, which would result in higher volumes of wastewater production. This wastewater could be used for irrigation. This project would irrigate 2,043 ha by pumping water from the Tula river.

The potential impacts of the project were predicted by a matrix methodology. The main negative impact expected was changes in land use. The land is very rocky and the soil cover is thin. Nutrients and organic matter content of the soil are low. Soil conservation practices are thus essential to maintain the productivity of the land. The project should also include the protection of several species of cactuses which are rare and in danger of extinction. The deterioration of the water quality was an important concern, since it would be affected in the long-term by return flow from the agriculture. The mitigation measures considered were soil conservation, management of wastewater, water quality monitoring and awareness campaigns.

The report concluded that the project would be very negative for the land, since it was not appropriate for agricultural activities. Even then its construction was recommended because of employment generation and the expected development. It is also stated that with proper management and implementation of the proposed mitigation measures, it should be possible to develop irrigation which was benefiting the area.

50. Environmental Impact Statement of the Tablón de Primavera, Oaxaca Hydro-agricultural Project. Prepared by Ingenieros Químicos de Proceso, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Evaluation, CNA, under contract AATS-90-115, July 1991, 129 p.

The objective of the project was to construct a 58 m dam, having a capacity of 125 million m^3. About 5,100 ha would be irrigated, of which 2,300 ha would be rehabilitated and 2,800 ha would be irrigated for the first time, with appropriate distribution and drainage systems. Roads would be both constructed and rehabilitated.

The local river can receive a maximum flow of 250 m3/sec. However, during rainy season, the flow is a much higher one. Thus, the local population and the agricultural areas are flooded frequently. This situation is expected to be solved with the construction of the project.

The report noted that there was no access to the project proposal, and accordingly many technical issues could not be analysed. The impacts of the project were likely to be overwhelmingly negative. This is because the economic activities in the project area would change, less land would be available for cultivation, farmers would become construction workers, and would work in small-scale commerce during the construction phase of the dam, etc. The compensations that would be paid to the farmers for their inundated lands were not expected to be invested productively. The money was likely to be spent on superficial things, and thus farmers were expected to end up without any land or money even for their basic needs as housing or education. In fact, unplanned resettlement of communities represented the main problem, since their life-style is expected to deteriorate after their resettlement.

The mitigation measures proposed included a conservation programme for biodiversity; reforestation with native species, water quality monitoring programme, control of aquatic weeds, management of agrochemicals, an appropriate programme for the resettlement of the local community, and support for income-generating activities like production of handicrafts, commercialisation of regional products, etc., training programmes, cooperation between the different institutions to support the implementation of the mitigation measures; and development of a programme on communication and information.

The construction of the project was first started in 1965 but it was interrupted for unknown reasons, until 1991, when the EIS was prepared. The report noted that it may be because of the acute ethnical, agrarian, social, and political conflicts prevalent in the area. There are serious conflicts over land tenures and negative influences of strong political groups with vested interests, who promoted conflicts between the communities.

According to the EIS, the total investment costs of the project was very high (the amount was not mentioned) compared to the number of hectares that would be irrigated and the local population that would benefit. The project was not justifiable, unless the present policies changed in terms of lack of availability of credit and technical assistance. The construction of the water project would not improve the life-style of the population by itself; on the contrary, it may seriously affect the lives of thousands of families who live out of fishery-related activities because fish production in the lagoon may be reduced.

This project is linked to the enlargement of the irrigation district No. 19, which has a very low productivity, and 35-40% efficiency. In addition, it was noted that there were very few human and economic resources for the conservation and maintenance activities of most of the hydro-agricultural infrastructure in Mexico. Accordingly, the cost-benefit ratio for this project was not attractive because of land tenure problems which should be solved first. The report concluded that the project should be analysed not only from the technical viewpoints, but also from economic, environmental, and mainly, social viewpoints.

This EIS presented an analysis of the very severe social problems that existed in the region and lack of institutional, human and economic resources which would certainly result in the failure of the project. It is highly unlikely that the people in the project area would benefit in the long term, unless it becomes part of an integrated rural development programme, instead of an isolated activity. It concluded that the construction of this project should be seriously questioned by the authorities.

The document did not contain an Executive Summary. Without such a summary, the readers are likely to miss the good social analysis of this EIS, and the fact that the construction of this project was not recommended.

51.Environmental Impact Statement of the Huites, Sonora-Sinaloa Hydro-Agricultural Project, Volume I. Specific Level. Prepared by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Evaluation, CNA, under contract SGAA-91-05, June 1992, 266 p.

This is a major project in terms of construction, investment costs and impacts. The objectives were to: i) irrigate 70,000 ha to produce 386,000 tons/year of different crops with a value of US $25,000 millions; benefit some 7,000 families; 1,000,000 jobs would be created in the agricultural area/year; ii) support the development of several districts which were already operational, by improving the irrigation in 242,000 ha from the waters of the Miguel Hidalgo and Josefa Ortiz de Domínguez dams; iii) increase the capacity to generate hydropower from 290 to 875 GWH/year; and iv) control the flow of the Fuerte river and thus avoid floods.

The Huites dam is 162 m high, with a storage capacity of 4,023 million m^3. The new hydropower station would have an installed capacity of 400 MW and would generate 875 GMW/year, which would be used during peak hours. In addition, the power that would be produced would be worth 135,600 million pesos/year. If the same amount of power was generated in a traditional oil-fired thermal station, it would represent an annual consumption of a million barrels of oil. The investment would be recovered in the following way: CFE would pay 228 pesos/kwh (199,500 million/year); the users of the new irrigated area, 27,866/pesos/ha/year (there are 70,000 ha), which makes 1,950 millions/year; other users, 8,000 pesos/ha/year (1,720 million/year).

According to the report, all services would be provided to the communities that would be resettled, including housing, schools, hospitals, sports centres, etc. Results of some interviews with the local people were included, which were to be welcomed since social aspects are generally not considered to be relevant in the country. In general, the local communities were in favour of the project, but their main concern was to be resettled in fertile land to continue with their agricultural activities. However, no specific information was given on the way in which the interviews were conducted, who were involved, sample, etc. The structure and

method of the interviews are very important factors in order to learn if they represented the feeling of the local people. In spite of the importance of the resettlement and compensation issues, the report did not contain any comments or analysis on these aspects.

The mitigation measures were very well structured, but only technically-ones were considered. No social measures were discussed. For such a major project, a deeper social and environmental analysis would had been desirable. The report is very good from a technical point of view; however, environmental and social issues were ignored for all.

52. Environmental Impact Statement of the Macrocircuito-Cutzamala Project. Specific Level. Prepared by IDDEC, S.A. de C.V. Submitted to General Subdirectorate of Technical Issues, Area of Water Quality, CNA, under contract GSCA 013/96, 1997, 173 p.

The analysis of this statement is included in the chapter no. V, Water Supply and Distribution in The Metropolitan Area of Mexico City: A Case Study

Land Use Planning Studies

53. Ecological Land Use Planning of the State of Chiapas, Methodological and Cartographic Annex. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to . Subdirectorate of Water Administration, CNA, under contract AATS-90-116, February 1992, 116 p.

This report is an ecological land use planning study. It is mainly technical and descriptive. It does not include any analysis. The report contained an Introduction, technical description of the methodology used for the ecological analysis, classification of the natural regions; flora and fauna; environmental indicators (water, agroecological capacity, etc.,), socio-economic indicators, etc.

54.Ecological Land Use Planning for the State of Sinaloa. Prepared by Coplain Ingenieros Civiles, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract AATS-90-113, February 1992, 233 p.

The objective of the ecological land use planning for the state of Sinaloa, located in the north west region of the country was mainly to define the criteria to regionalise the state from an ecological point of view; describe the environmental problems by regions; and to define the potential use of the land to decide on its best management within the environmental policies of the country.

The study included the following information: description of geographical areas; physical characteristics (climate, geomorphology and geology, edaphology, surface hydrology, groundwater hydrology, oceanography); biota (flora, rain-fed agriculture, irrigated agriculture; description of the different ecosystems, aquatic flora, and fauna); description of the socio-economic characteristics of the area (population, agriculture, livestock and silviculture, fishery, aquaculture, industrial, commercial and tourist activities, health, education, infrastructure, characteristics of the main cities); land use, and the division of regions according to ecological criteria.

The objectives of the report were not achieved, since no criteria were proposed as to how the country would be regionalised according to its ecology, no analysis was provided on any specific environmental problems of the area; and no management programme was proposed based on the environmental policies of the country. In addition, no environmental policies as such existed in Mexico in 1991. It was in 1994, when the Ministry on Environment, Natural Resources and Fisheries started the national environmental

programmes for the country. Thus, no management programmes based on available environmental policies could have been achieved.

The report was mainly descriptive and contained no analysis. It did not discuss or analyse any environmental problem and also not on the environmental policy of the country. It seems that it was prepared by different people, and the chapters were put together without any coordination, since many statements contradicted each other. For example, in the case of the industries in Sinaloa, it noted that "the industries were not very developed in Sinaloa," "industry is one of the main activities of the state," and "the industry does not influence the economy of the state."

There was no Executive Summary, or a chapter on Conclusions and Recommendations. The only statement the report made on a 29,337 km^2 coastal state, one of the most important states from the agricultural and fishery points of view in Mexico, was that "based on the analysis of the economic activities of the state, as well as the natural resources, it is evident that the physical, biological and socio-economic conditions are distributed heterogeneously."

The objective of preparing land use planning studies should be seriously questioned. It is not worth spending money on the preparation of reports which do not provide any analysis, propose any alternative for achieving the objectives, and ignore implementation aspects.

Study on Agrochemicals

55. Study to reduce the Environmental Impacts resulting from the Management and Application of Agrochemicals. Prepared by Diseños Hidráulicos y Tecnología Ambiental, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Evaluation, CNA, under contract No. AATS-90-112, May 1991, 113 p.

The background information included an interesting description of the rural areas in Mexico. The overall objectives of the study were to identify the main negative impacts resulting from the use, application and disposal of agrochemicals in rural agricultural areas; develop solid criteria to reduce these impacts, propose alternatives for a better surveillance and follow-up actions; and develop a manual which could be used by several public institutions.

The study was based on field work in several areas to determine both municipal and industrial discharges, as well as the quality of the corresponding bodies of water. The report included interviews with farmers; visits to several irrigation districts; identification of negative and positive impacts based on the actual use of agrochemicals; overall assessments on health and agrochemicals related-issues; visits to universities and research centres to identify research programmes on the use of agrochemicals; interviews with sellers of agrochemicals, etc.

Even though no toxicological studies were available which prove that certain diseases are related to the use of agrochemicals, it is important to note that the health of rural population appear to deteriorate with the use of agrochemicals, especially when it is done from air. An increasing number of children who live near agricultural areas, suffer from Leukaemia and other types of cancer. In addition, direct discharge of agricultural runoff into rivers, lagoons, estuaries and bays contribute to severe deterioration and contamination which may affect seriously aquatic as well as terrestrial fauna and flora. Lack of training and adequate management, absence of appropriate equipment to apply agrochemicals, and unacceptable disposal practices have resulted in the severe deterioration of the health of the local population and the environment.

Some of the recommendations of the reviewers for good management of agrochemicals were as follows: i) programmes on the use and management of agrochemicals; security measures; ii) training of workers, farmers and technical staff on agrochemicals and pesticides, and doses to be used; iii) training of workers, farmers and technical staff on the proper storage; iv) disposal of containers and pesticide residues; and v) strategies to protect water, land, and crops.

Among the main concerns in the rural areas of Mexico, are the overuse and bad management of agrochemicals and pesticides, lack of training, absence of security measures, etc. Most of the water bodies, as well as soil, fauna and flora in the country are affected by agrochemicals. There are often serious adverse impacts on health of the local population. Thus, a study like this to identify the main problems and alternatives available for their solution, is very much needed. It is now necessary to find out if the manual was written and distributed, if the recommendations were implemented, and if so, what were the results. The report did not contain an Executive Summary.

Other Assessments

56. Hydro-biological Study of the Baluarte River, Sinaloa, Final Report. Prepared by Diseños Hidráulicos y Tecnología Ambiental, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Evaluation, CNA., under contract SGAA-92-43, December 1992, 280 p.

The National Programme on Irrigation districts, which considered their enlargement and modernisation, included the construction and operation of the Baluarte-Presidio hydro-agricultural project to irrigate 56,523 ha in a semi-arid area, where rainfall is less than the evapotranspiration. A volume of 2,404 million m^3/year of water from the Baluarte river would be used for irrigation purposes. The project also considers the construction of the Santa Maria dam for flow augmentation during the dry season.

When the analysis was carried out, 13.24% of the land was already under irrigation (rain-fed agriculture accounted for 31.64% of land, and 55.12% was for other uses). The project is expected to result in higher agricultural production and improvement of the economic conditions of the region and the population.

The objective of this study was to existing ecological conditions of the Baluarte river and its area of influence. In order to analyse the future impacts of construction of the Santa Maria dam, the hydrological variations of the river and the fishing activities were to be evaluated.

The abstract of the report is comprehensive and well written. In order to forecast the impacts of the construction of the dam, and the possible implications under different scenarios, the analysts developed good physical, biological and social frameworks of the region. The analysis included the following issues: physical characteristics on the estuary-lagoon-coastal system; hydrology and water quality of the Baluarte river; description of the construction and operation of the project; potential impacts in the Baluarte river due to the construction of the dam during both the rainy and the dry seasons; impacts on the lagoon system during the rainy and the dry seasons and socio-economic framework.

The mitigation measures included good technical proposals, and the conclusions provided a summary of the analyses carried out on site preparation, construction of the dam and its operation; and operation of the irrigation district. Even though the study is good from a technical viewpoint, consideration of the integral management of the physical area, as well as its natural resources, and the needs of its population was missing. This technical report would enable the decision-makers to manage the region purely from a technical point of view. It would have been desirable if the analysts had made recommendations

based on their field work, which covered not only the technical aspects of the project, but also on what could be implementable based on the environmental and social conditions of the area.

57. CNA. Hydrodynamic Assessment of the Teacapan-Agua Brava, Nayarit Lagoons Complex, Annexes, Volume II. Prepared by Construcción y Estudios, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Assessment, CNA, under contract SGAA-92-48, 1993, 127 p.

This report contains only graphs and tables on climate, tide and bathymetry. Environmental assessment is conspicuous by its absence.

58. Hydro-biological Study of Chacahua-La Pastoría lagoon, Oaxaca, Final Report. Prepared by Ingeniería del Medio Ambiente, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, CNA, under contract No. SGAA-92-53, April 1993, 221 p.

This project was developed when CNA was promoting the implementation of the Río Verde hydro-agricultural project, which is located to the north of the Chacahua-La Pastoría lagoons. The Rio Verde project uses the flow of the Verde river, and the drainage discharges into the lagoon system to irrigate 13,152 ha. Some drains are connected with the San Francisco and Chacalapa rivers, which end up in the Chacahua-La Pastoría lagoon. A levee was constructed on the left bank of the Verde river to protect the irrigated area and the population against floods.

The main objective of this report was to evaluate the negative impacts of the Río Verde hydro-agricultural project on the Chacahua-La Pastoria lagoon. The study recommended the use of the flow of the Verde river into the lagoon to promote the recovery of the lagoon, analyse the interchange of water between the lagoon and the sea, and surface run-off; and study the hydrological and ecological needs of the biota in the lagoon .

The Rio Verde project cannot be analysed from a technical viewpoint only, the social context and the surrounding environment have to be considered. There are many issues that have already contributed to the current severe deterioration of the lagoon, among which are population increase, lack of sanitation, building of water, agricultural and marine infrastructures, construction of roads, tourism, use of pesticides, deforestation, and lack of monitoring in terms of fishery, animal husbandry, and devastation of the national park. The Chacahua lagoon suffers from eutrophication, and the La Pastoria is mesosotrophic. There is very limited interchange of water between the lagoon and the sea, which has resulted in the deterioration of the lagoon. This in turn has affected the communities which depend on fishery.

The study concluded that: i) the source of water in the Chacahua-La Pastoria lagoons is the rainwater from the San Francisco sub-basin, and the Verde river during the rainy seasons; ii) agricultural drains discharge into the lagoons during the entire year; and iii) the water quality in the lagoons is not homogeneous.

Based on the results of the analysis, three alternatives were proposed to improve the management of the lagoon. The most feasible solution recommended that the surplus surface water should conveyed to the natural drains of the National Park during the rainy season, by using the project infrastructure and by constructing small projects to ensure better distribution of water. This would be a medium- to long-term alternative and its objective would be to compensate the mangrove ecosystems and to improve the water quality in Chacahua lagoon. The volume of water that could be diverted was at 8.97 m^3/s, plus water available from the agricultural lands.

The study emphasised the importance of the involvement of the different public and private institutions who are interested in the management of the Verde river basin and the San Francisco sub-basin

to improve the conditions in the whole area. Also, any strategy that would be developed to improve the quality of life of the population and the regeneration of the environment should be on a long-term basis, and should include a programme on the environmental protection of the area.

The report though interesting, is mostly descriptive. It included a general evaluation of the hydrology of the area, lagoon system, agricultural activities, and the importance of the mangrove ecosystems in the coastal area. What is most regrettable, however, is that even in this case, where extensive research was carried out on certain areas, the recommendations were not considered. It is well-known that the management of the resources of the Chacahua-La Pastoría lagoon was inadequate, that deforestation has been extensive, and that the area suffers from extensive environmental devastation. The waters of the lagoons are highly contaminated, as a result of which the fishermen had to abandon their activities with consequent serious financial hardship.

59. Hydrodynamic Study of the "Guadalupana and Concepción bays (Ceuta bay), Sinaloa, Final Report. Prepared by Herman Proyectos y Construcciones, S.A. de C.V. Submitted to General Subdirectorate of Water Administration, Area of Water Quality, Water Reuse and Environmental Evaluation, CNA, under contract SGAA-92-46, May 1993, 85 p.

The objective of the report was to define the hydrodynamics of the bays, and analyse the implications of constructing or not constructing hydro-agricultural infrastructure in the San Lorenzo river to initiate irrigation activities (San Lorenzo-Humaya and Elota-Piaxtra), and to identify appropriate mitigation measures.

The hydrodynamic study included development of models, and their simulation under different alternatives. However, even though it was an explicit objective, the report did not contain any analysis of the implications of constructing or not constructing the projects.

ANNEX II

WATER SUPPLY AND DISTRIBUTION IN THE METROPOLITAN AREA OF MEXICO CITY: A CASE STUDY

The Mexico City is the capital of Mexico. It is located in the Federal District (Distrito Federal, D.F.), in the south-western part of the Valley of Mexico, surrounded by mountains reaching an altitude of over 5,000 m. above the mean sea level (msl). The Federal Government, and much of the industries, educational and employment facilities and cultural centres of the country are concentrated in this area (National Research Council et al., 1995).

The Mexico City represents 0.1% of the surface area of the country, but accounts for nearly 10% the national population (8.6 million inhabitants) (INEGI, 2000, a). It is located in a high, naturally closed basin, at 2,240 msl and most of the urban area lies in the flat and lowest levels of the basin. Historically, the city has faced severe water problems, which have become more acute due to continuous increase in population and the contamination of surface and groundwater within and around the city.

In order to meet the escalating water demand, the Government has almost exclusively relied on supply management and engineering solutions, which have resulted in investments of hundreds of millions of dollars and the construction of major infrastructure projects for interbasin water transfer. Long-term economic, social and environmental strategies still have to be developed to achieve an appropriate development of the basin and to improve the lifestyles of its millions of inhabitants.

The water supply of the metropolitan area depends mainly on the local groundwater sources and on the transfer of surface waters from more and more distant basins. In order to meet part of the water needs of the population, a total volume of 2,453.19 thousand m^3/day is abstracted from 414 wells (1,476.31 thousand m^3/day), 30 springs (76 thousand m^3/day) and 93 sources of snow-melt (900.88 thousand m^3/day) (INEGI, 2000, b). The second main water source is the Lerma-Balsas and Cutzamala river basins.

The water is distributed to the users through a primary network of 882 km of pipelines and a secondary network of 12,042 km. The water supply system includes 16 dams having a total storage capacity of 207,527.90 thousand m^3 (INEGI, 2000, b). Information is not available on the infrastructure for water distribution in the case of the State of Mexico.

The quality of life of the population living in the Mexico City area has decreased dramatically over the recent years, primarily due to the high density of population (ranging from 131 persons/km^2 up to 18,075 persons/km^2) and extensive air and water pollution. The increased urbanisation and high population growth within the city have resulted in the designation of an area known as Mexico City Metropolitan Area (Zona Metropolitana de la Ciudad de México, ZMCM). Thus, Mexico City can no longer be considered to be an independent unit for water planning and management. This ZMCM includes Mexico City and 34 of the municipalities of the State of Mexico, which surrounds the north, east and west of D.F.

Mexico City Metropolitan Area

The ZMCM is one of the most rapidly growing urban centres in the country, with a surface of 4,902 km^2 and about 21 million inhabitants (INEGI, 1999). The total population is not known reliably because of

the very high rate of immigration as well as numerous illegal settlements (National Research Council et al., 1995).

The State of Mexico is the most populated area in Mexico (13 million inhabitants according to 1995 reports), followed by Mexico City, with nearly 8.6 million people (INEGI, 2000, a). The State of Mexico has an annual growth rate of 3.75% (compared to the national growth rate of 2.43%), an average population density of 545 inhabitants/km^2, and some 3000 industries (CNA, 1997, b).

The per capita water supply in the ZMCM is 364 litres/person/day in Mexico City and 230 litres/person/day in the State of Mexico, which would represent average a daily consumption of 297 litres/person (Table 4, National Research Council et al. 1995). However, the actual amount received by the individuals is significantly less, because the average includes water use by industries and services, and leakages of more than 40% (INEGI, 1999), differences in distribution patterns to the different areas of the ZMCM, etc. (Casasús, 1994; CNA, 1997, b).

The total water consumption in the ZMCM is about 65 m^3/s for domestic, commercial and service uses: 35 m^3/s in Mexico City, and 27 m^3/s in the State of Mexico (CNA, 1997a; INEGI, 1999). About 70% of this volume comes from 3,537 wells officially registered and operated by CNA, and the governments of both Mexico City and the State of Mexico (Birkle et al., 1996). Legal wells are located in four different well fields in and around the ZMCM (National Research Council et al. 1995). It has not been possible, however, to calculate the exact volume of water abstracted from the aquifer due to the existence of illegal wells, which could number from 5,000 to up to 10,000 in the entire basin (Cruickshank, 1994; INEGI, 1996).

The management of both drinking water supply, distribution and wastewater collection within the ZMCM is shared by Mexico City and the State of Mexico governments. Political divisions of Mexican states are known as “municipios”, while the Distrito Federal is divided into 16 political “delegaciones”. These “municipios” and “delegaciones” are not autonomous. They can not establish their own guidelines for water planning and management, or decide how to maintain the water supply, distribution and sewage networks. All the decisions are taken by both the governments of Mexico City and the State of Mexico.

Table 4. Characteristics of the ZMCM and use of water supplied to Mexico City and the State of Mexico.

	Mexico City	State of Mexico
1. Total area of the ZMCM (km^2)	1504	2269
2. Area served by the common water distribution, and wastewater disposal systems (km^2)	667	620
3. Population (millions)	8.5	12
4. Daily per-capita use (litres)	364	230
5. Water used by category (%)		
• Domestic	67	80
• Industrial	17	17
• Commercial and Urban Services	16	3

Source: Departamento del Distrito Federal, 1992b; Comisión Estatal de Aguas y Saneamiento, 1993; INEGI 1991a. *In* National Research Council et al. 1995; INEGI, 1996.

At present, CNA supplies about 24 m^3/s of water to the ZMCM. CNA is also responsible for constructing and operating distribution systems to transfer water from other basins to the basin of the Valley of Mexico. It operates also some of all the existing deep wells, while others belong to the State of Mexico and Mexico City governments (CNA, no date a). Both Mexico City and the State of Mexico share water service areas, and each one of them has five water service districts. Water enters the distribution system at specific points at one or more locations. The groundwater abstracted, the water withdrawn from the wells and the few surface water sources located within the basin, enter directly into the distribution system (National Research Council et al., 1995). This

distribution system has become so big and complex that the water extracted from wells in one part of the ZMCM does not necessarily enter the system within the same service district.

At present, 97% of the population in D.F. and 90.5 % in the State of Mexico have access to water, either with a water connection directly to the house or from common faucets in the neighbourhood (National Research Council et al., 1995; INEGI, 1999). However, most of the aquifers, springs and rivers which supply water to the ZMCM are located to its west, north and south. Thus, water supply is somewhat irregular and unreliable for the population living in the eastern part, who are most affected by water shortages. More than 3% of the people living in the ZMCM still have to buy water from either public or private tank trucks. The cost of water (200 litres containers) represents from 6% to 25% of their daily salaries (Restrepo, 1995). In 1994, poor people buying water from trucks were paying 500% times more than registered domestic consumers.

In 1997, the Mexico City had 2040 km of primary sewage network and 10,223 km of secondary network. The volume of wastewaters that was discharged in 1997 was 1,637 million m^3/year (INEGI, 1999), of which no more than 9% is treated. There are 24 wastewater treatment plans in Mexico City and 41 in the municipalities of State of Mexico which are part of the metropolitan area. These 65 plants have an installed capacity of 10,174 l/s (6,412 l/s in Mexico City and 3,763 l/s in the State of Mexico). Some 1,637,000 thousand m^3 of wastewaters are produced annually only in Mexico City, of which no more than 9% is treated. There is no information available on the wastewater that it is produced in the State of Mexico (INEGI, 1999). It is not known whether all the treatment plants are currently functional, or the extent to which their capacities are used.

Main Problems

The three existing sources from which water is abstracted for the ZMCM are the aquifer of the Valley of Mexico (71%), Lerma-Balsas and Cutzamala river basins (26.5%), and the very few surface water bodies that still exist in the basin of the Valley of Mexico (2.5%) (CNA 1994; UNAM 1997; CNA 1997b). The annual rate of withdrawal from the aquifers is significantly higher than the recharge rate: 45 m^3/s is abstracted but natural recharge rate is only 20 m^3/s, leaving an overexploitation of 25 m^3/s (UNAM, 1997).

The overexploitation of the aquifer has contributed to the lowering of the water table by about 1 m each year. This has contributed to land subsidence at the rate of 10-40 cm/year in some parts of the city. It is estimated that the central area of ZMCM has subsided by 7.5 m during the last 100 years (World Resources Institute, 1996). The soil of Mexico City is basically clay, and thus susceptible to dewatering and compaction. Accordingly, the higher the volume of water abstracted, higher is the rate of land subsidence (CNA, 1997, b). The sinking of the city has resulted in extensive damages to the city´s infrastructures, including water supply and sewer systems and degradation of the groundwater quality. It has also resulted in the construction of costly pumping plants to remove both wastewaters and rain waters from the city (Departamento del Distrito Federal, 1991).

However, the problems related to water supply in the ZMCM extend beyond the sinking of the city. The entire hydraulic system, for example, has become not only very big and complex, but also obsolete in many areas. Water distribution to the population varies in the different parts of the city, the tariffs are still very highly subsidised, and the population wastes enormous amounts of water. People living in the richer areas consume up to 600 litres peer capita per day, while the corresponding rate is about 20 litres.

A very high percentage of water is lost from the distribution networks due to leakages. It is because of the age of the pipes, absence of proper maintenance over prolonged periods, poor construction practices and continuing land subsidence in the ZMCM. It is estimated that more than 30% of water is lost in the

network due to leakages (National Research Council et al., 1995; CNA 1997, b). The amount that is lost would be enough to provide water to more than 4 million people (UNAM, 1997). Only in the ZMCM, the government repairs about 4,000 leaks in the distribution system each month (World Resources Institute, 1996). The efficiencies of the water distribution systems all over the country leave much to be desired: the investment requirements are very high and so are the volumes of water that are being lost. In general, water loses due to leakages varies from a low of 24% to a high of 60% in different Mexican cities (Table 5) (Arreguín-Cortés, 1994).

At present, one of the goals of the central and local governments is to promote water conservation. One option would be to charge more realistic prices to the domestic and industrial users. This would reduce the level of high subsidies used as at present, and much, if not all, operational and maintenance costs could be met from the user fees. In 1991, users charges represented only about 27% of the operation and maintenance costs of the water supply systems (Departamento del Distrito Federal, 1991).

Until the middle of May 1997, the price charged to the domestic users in Mexico City was $\$0.2/m^3$, when the cost of supplying water was about $\$1/m^3$. Since then, according to the new pricing policies, tariffs have been actually reduced from 17% to 64% (Table 6), depending upon consumption. Strangely, the City government claims that it "will contribute to the better economy of the users and will strength the public finances." (Excelsior, May 24, 1997). The fact remains that as long as the government continues to subsidise the users heavily, it would be very difficult, if not impossible, to promote water conservation, reduce water wastages, and recover the operation and maintenance costs.

Table 5. Results on some leakages studies in Mexico, 1991.

City	Volume Supplied (l/s)	Faucets with leaks (%)	Volume lost in Faucets (%)	Volume lost in the Supply system (%)	Total loses (%)
Guaymas	488	30	23.4	1.8	26.23
Querétaro	1783	14	13.5	2.8	29.96
Veracruz	2869	17	24.2	0.1	24.34
Xalapa	1215	9	34.4	8.9	43.32
Los Cabos	268	34	22.6	12.0	37.63
Oaxaca	721	24	59.2	1.1	60.34
Cancún	940	38	24.1	15.6	39.95
Chihuahua	3489	5	15.8	25.7	41.50
Cd. Juárez	4147	19	29.9	5.8	35.70
Average		21.1	27.4	8.2	37.66

Source: Arreguín-Cortés 1994.

Table 6. Tariffs per average consumption in Mexico City, in pesos, 1997.

Consumption (m^3/2 months)	Consumption (litres)	1996 (pesos)	1997 (pesos)	Difference (%)
30.1	500	10.25	3.75	- 64
40.0	666	13.75	6.75	-51
50.0	833	17.12	9.75	-43
60.0	1,000	20.5	12.75	-38
60.1	1,001	24.62	12.75	-48
70.0	1,166	28.62	18.62	-35
80.0	1,333	32.75	24.62	-25
90.0	1,500	36.87	30.5	-17

Source: Excelsior, May 24, 1997.

Water is charged per cubic meter, and it varies as consumption level increases. There are numerous faucets which are not registered, and thus consumption through them are neither recorded nor charged. For example, in 1991, there were about 1.9 million faucets in Mexico City, out of which 1.3 million were registered; and out of millions of users, only about 900,000 water meters were registered.

Macroprojects

In order to supply the necessary water to the most important cities in the country, the Federal Government has decided to build more water projects starting from 1997, in the Valley of Mexico, Guadalajara, Monterrey and Tijuana, together with the local governments and the CNA. The main objective is to solve most acute water problems in these cities. However, the government has no alternative but to consider seriously demand management on the near future, along with supply management. There is simply no other long-term alternatives.

In the Valley of Mexico, the water projects would mainly include the enlargement of the distribution system known as Cutzamala; the construction of two aqueducts (Macrocircuit and "Aquaférico"); the construction of four wastewater treatment plants; and to cover 86 km of the presently uncovered main sewage line in the ZMCM. The investment cost would be about $1,800 million over a 3 ½ year period. It would include a $500 million loan from the Interamerican Development Bank (IDB), and other financial assistance from Japan, the Mexican Federal Government and governments of the states of Mexico, Hidalgo and Mexico City (El Universal, May 21, 1997).

Cutzamala System

In 1976, the project known as "Cutzamala System" (Sistema Cutzamala) was planned to supply water to the ZMCM from both the Cutzamala and Lerma-Balsas River (in the State of Mexico), and to reduce the overexploitation of the aquifer of Valley of Mexico (CNA 1997, b). The Cutzamala System is the second source of water to the ZMCM. It supplies water to the north of Mexico City and to the State of Mexico. The water has to be transferred from 60 to 154 km away and pumped to a height of more than 1000 m, which makes this operation extremely energy-intensive and expensive (SEDUE, 1990; CNA 1997, b).

Due to the magnitude of the project, its construction was initially planned into three stages. The first one has been under operation from 1982 (4 m^3/s), the second from 1985 (6 m^3/s) and the third one from 1993 (9 m^3/s) (CNA no date, b). In 1997, the fourth stage (Temascaltepec Project) was expected to be initiated. However, the government has not been able to start the construction of the project due to severe social problems (CNA 1997, b). People living in the areas that would be affected by the construction of the fourth stage have opposed the project since they think it would supply water to the people of Mexico City, and thus they should not suffer because water is needed in another part of the country. Governmental institutions have generally neglected the potential social conflicts which could result from interbasin transfer, nor have they carried out any analysis on the nature of the beneficiaries and the people who may have to pay the cost. In fact, even the Environmental Impact Statement (EIS) for the fourth stage of Cutzamala System (CNA 1997, b) does not consider any social implications. As most EISs carried out in Mexico, it considers almost exclusively technical factors: social issues are conspicuous by their absence.

The Cutzamala System utilises seven reservoirs comprising of one pipeline, a regulatory reservoir, a 127 km aqueduct long, which includes 21 km of tunnels, 7.5 km open canal, and one water treatment plant (24 m^3/s capacity) (CNA no date, c). Six pumping stations are necessary to raise water by 1,300 m. This requires a total energy of 1650 kWh/year (CNA 1997b). The water is first treated at the source in the "Los

Berros" treatment plant (pre-chlorination, alum coagulation/flocculation, gravity sedimentation, and rapid sand filtration) and then it enters the Cutzamala System (National Research Council et al., 1995).

Initially, what was later to become the Cutzamala System, was planned as a hydropower project. Cutzamala was started by taking advantage of the infrastructures that already existed for hydropower generation, but the planned water use was changed. Currently, only 3 m^3/s is used to generate hydropower during peak hours and to satisfy the local energy requirements for the agricultural and industrial energy sectors (CNA, 1997, b). The programme on drinking water, drainage, and sanitation of the ZMCM now expects increased water supply from the Cutzamala System to the Valley of Mexico from 0.6 km^3/year (19 m^3/s) to 0.76 km^3/year (24 m^3/s), and to treat 1.3 km^3/year (42 m^3/s) of wastewater (CNA, 1994; CNA, 1997, b).

According to the EIS carried out for the fourth stage, the total investment cost of the first three stages was $965 million (1996 estimates). If the estimated cost of the facilities from the previous hydroelectric plant that would no longer be used is added, the total investment cost becomes $1,300 million. The cost of the cancelled hydropower system having a total installed capacity of 372 Mw has been estimated at $325 million, at an average cost of $875,000/Mw. The reservoirs of the earlier hydroelectric plants represent a volume of 840 million m^3 (CNA, 1997, b).

The total surface affected by the construction of the Cutzamala System during the first three stages is approximately 710 ha, with a land value of $3.55 million (CNA, 1994; CNA, 1997, b). One of the main adverse socio-economic impacts of the Cutzamala has been the relocation of the affected communities, who, as of February 1999, had not received the expected compensation.

In addition to the construction of the Cutzamala, about 190 so-called social projects have been built to benefit some of the people living in the municipalities that are most affected by water shortages (CNA, 1994; CNA, 1997, b). These projects were built jointly by CNA and the communities, and consist mainly of construction, enlargement and rehabilitation of both water supply and sanitation systems, as well as construction and rehabilitation of houses, schools, and farms. Equally important is construction and rehabilitation of roads by CNA, both for Cutzamala and for social benefit. The cost of these so-called social projects was estimated in 1996 to be equivalent to 5% of the direct investment of the Cutzamala, which would represent an additional $45 million (CNA, 1997, b).

It is worthwhile to note that the total cost of the Cutzamala System at $1300 millions (mainly construction and equipment costs) was higher than the national investment in the entire public sector in Mexico in 1996, including education ($700 million), health and social security ($400 million), agriculture, livestock and rural development ($105 million), tourism ($50 million), and marine sector ($60 million). Up to 1994, the Cutzamala System alone represented three times the annual infrastructure expenditure of the Ministry of Environment, Natural Resources and Fisheries for 1996, which was more than $470 million (CNA, 1997, b).

The annual energy requirements to operate the Cutzamala System is about 1,787 million kWh, which represents an approximate cost of $62.54 million. The investment would increase significantly if the investment costs in personnel ($1.5 million/year) as well as the water treatment process costs are added (CNA, 1997, b).The energy consumed by the system, plus the energy that could have been produced if the system was operated as the hydropower plant as was originally planned, it could have supplied electricity to about 2.59 million people.

If only the operational costs for running the Cutzamala System are considered (about $128.5 million/year), supplying 600 million m^3 of water (19 m^3/s) would mean an average cost per m^3/water of $0.214 and an energy consumption of 6.05 Kwh/m^3. The later figure represents more than seven times the consumption of power in the locations near ZMCM. The price charged to consumers, about $0.2/$m^3$, is not

enough to cover either the operational costs of the Cutzamala System, or the purification or distribution costs of water to ZMCM. According to the EIS (CNA, 1997, b), for the fourth stage of Cutzamala, the minimum water price per m^3 to cover the expenses should be over \$0.3 dollars/m^3. It would be even higher if the treatment and distribution costs were included.

Once the fourth stage of the Cutzamala is operational, the water supplied will increase from 19 m^3/sec to 24 m^3/sec. This last stage includes the construction of a reservoir having a capacity of 65 millions m^3 to regulate an approximate flow of 5,000 litres/s, a 15 m^3/s pumping station, and construction of 18 km of canals and 12 km of tunnels (CNA, 1997, b).

Some studies indicate that if the leaks in the distribution system from the Cutzamala to the ZMCM were repaired, there would be no need to construct the fourth stage of the project. This means that the additional water supply of 5 m^3/s that is being planned with very high investment, social and environmental costs, would not have been necessary. However, this type of integrated planning and management is basically absent in Mexico at present. The government has so far not made any public statement on this issue.

The Cutzamala-Macrocircuit and the Cutzamala-"Aquaférico"

The Federal Government, as well as the government of the State of Mexico and CNA, are constructing two distribution lines in order to ensure efficient distribution of water coming from the Cutzamala System. The Federal District is at present constructing a water distribution system known as "Aquaférico" (an aqueduct) which will distribute water from the Cutzamala System. It would come from the west, and will supply water to the southern and eastern parts of ZMCM (National Research Council et al., 1995; CNA, 1997, d).

In the State of Mexico, the water distribution system is known as perimetrical aqueduct "Cutzamala Macrocircuit". It is expected to be completed by the year 2000 and will be built around most of Mexico City towards the north, and will carry water to the northern, southern and eastern parts of the city (CNA no date, d,e,f). The first stage of the Macrocircuit distribution system was inaugurated in October 1994. Both the first and the second stages of the Macrocircuit are now in operation, providing a continuous supply of 4m^3/s of water which would benefit 1,382,400 people with 250 l/capita/day. The operation of the third and fourth stages of the Macrocircuit will increase the drinking water supply by an additional 7m^3/s (total volume of 11m^3/s), benefiting 4,752,000 inhabitants who live in the eastern and northern areas of the State of Mexico at about 200 l/day/person (CNA no date d,e,f;, CNA 1994; CNA 1997c). The Macrocircuit includes the construction of two pipelines having a total length of 168.28 km. This would join 58.28 km of pipelines already built. The two pipelines will require a surface area of 336.56 ha, plus 71 ha for the storage tanks (CNA, 1997, c).

The total investment for the Macrocircuit between 1987 and 1997 was \$78 million, while the estimated cost for the third and fourth stages (1997-2000) is expected to be about \$190 million, making a total investment of \$268 million. This amount represents almost half of the total public sector budget at the national level for 1995 (\$563 million) in the areas of urban development, ecology and drinking water (CNA, 1997, c).

Drainage System

Between the beginning of the century and 1936, parts of Mexico City was sinking by about 5 cm/year. However, higher water demands resulted in the construction and operation of deeper wells between 1938 and 1948. Steady lowering of the groundwater level increased the land subsidence rate, initially to 10

cm/year, and later up to 30 to 40 cm/year. The sewage system, which was working until then on a gravity basis, was severely affected by this settlement. The uneven settlement of the sewage network meant it was necessary to pump wastewaters up from the small sewage lines to the level of the main wastewater collector of the city, thus significantly increasing both maintenance and operation costs.

However, continually increasing population in ZMCM rendered the sewage collection and treatment capacity insufficient. Accordingly, it was decided to build another main collector for wastewaters for both Mexico City and the State of Mexico as a combined sewage and rainwater network (*Drenaje profundo*). This system had to be constructed up to 300 m below the ground level so that it is no longer affected by the subsidence (Departamento del Distrito Federal 1990)

This main collector carries an annual average of both rain water (14 m^3/s) and wastewater (48 m^3/s) through primary and secondary networks. The secondary network is used to transport municipal, industrial and rain waters in pipes of up to about 6.5 m in diameter. The primary network is connected to the secondary network which stores, transports and disposes of the wastewater into the Gulf of Mexico through four artificial channels located at the northern end of the basin (UNAM, 1997; National Research Council et al., 1995).

The networks have 66 pumping stations, regulatory tanks for flow control, storm tanks, 111 km of open canals, piped rivers, dams, lagoons and 118 km of underground collectors and tunnels (National Research Council et al., 1995).

Because of being located within a naturally closed hydrologic basin, the City is specially vulnerable to flooding. Throughout history, artificial channels had to be built to take the wastewaters and rain waters out of the city. The rainy season in the ZMCM is often characterised by storms of short duration but high intensities, which could produce up to 70 mm of rainfall in three hours time, representing 10 % of the total annual precipitation. The main collector was designed to carry about 200 m^3/s of water over a 45-hour period, even though it has carried up to 340 m^3/s (National Research Council et al., 1995). Such sudden fluctuations in the amounts of water that have to be drained create serious problems for the design and operation of the infrastructure.

The sinking of the city has also affected the sewage system due to pipe fractures and the loss of the hydraulic gradient, which have significantly reduced the efficiency of the whole urban sewage system as well as contributing to groundwater contamination. The new investments include covering 86 km of the presently uncovered main collector, which would prevent dumping of garbage, and also eliminate environmental and health risks resulting from an unlined and open collector.

Water Resources Management Constraints

The management of water resources in ZMCM is very complex. There appears to be an uncontrolled race between the water and wastewater needs of an increasing population and the budget, technology and management expertise required to construct, operate and maintain all the necessary systems efficiently.

The problems of water quantity and quality in ZMCM are directly linked to the regional economic development policies and continual increases in population. The government policies in recent years have attempted to promote the development of other urban centres to alleviate poverty and to provide better standards of living as well as quality of life. The policy appears to be working, since the migration rates to ZMCM as a whole have declined in recent years. However, even though the population growth rate in Mexico City during the early part of the 21st century is expected to decline to 2.1% per year, the growth

rates in the municipalities of the State of Mexico around Mexico City are expected to increase even further (Cruickshank, 1994). This would be unlikely to resolve the overall problem.

Unless the current trends and management practices change, the future scenario will include very high investment costs to transport more and more water from increasingly distant and expensive sources, higher land subsidence due to increasing groundwater withdraws, reduction in the quality of the water extracted from the aquifer, higher subsidies and higher investments to cover operation and maintenance costs, etc. The result can only be "lose-lose" situation for every one concerned.

Another constraint stems from the fact that the demand for living spaces from the continually increasing population of the ZMCM has contributed to major changes in land use. Concrete and asphalt now cover areas that are essential for groundwater recharge. For example, the southern area of the city is a good recharge area since the soil is broken basalt. However, it is now heavily urbanised, representing also one of the main sources of groundwater contamination because of the absence of a sewage system that cannot be economically constructed due to the presence of volcanic rock (CNA, 1997, b). Houses are thus built only with septic tanks. The changes in land use also contributes to higher volumes of rain water which enter the sewage system, requiring higher drainage capacities.

The risk of aquifer contamination is enhanced due to the disposal of untreated industrial wastewaters directly into the sewage system, inadequate waste treatment facilities, leakage from the sewage pipes, and wastes illegally dumped in landfills and in unlined sewage canals (World Resources Institute, 1996). The 1990 census indicates that some 82% of the houses in the ZMCM are connected to the sewage system, 6% use septic tanks, and 12% discharge their solid and liquid wastes directly to the land or the water (CNA, 1997, c).

In the State of Mexico poor quality drinking water has been detected in the taps due to the infiltration of unclean water into a leaky distribution system, and the precipitation of salts (mainly calcium, magnesium, iron and manganese) (National Research Council et al., 1995).

Water contamination has serious public health impacts. The gastro-enteric diseases which result from the consumption of polluted water is the second major cause for child mortality (278 per 100,000) in the country (UNAM, 1997); the third leading cause of death for children in the State of Mexico (450 per 100,000) and the fourth in Mexico City (157 per 100,000) (National Research Council et al., 1995).

In terms of water reuse, much of this occurs informally through the use of untreated wastewater for irrigation. Wastewaters from the city end up in the Endhó Dam in the state of Hidalgo, located 109 km north of Mexico City, where it is used for irrigation. The agricultural potential of this area, Mezquital Valley, was very poor due to the semiarid climate. However, wastewater irrigation from 1912 has significantly improved production yields of this Valley. This area is currently known as the "bread basket" of the country, and has more than 85,000 ha of irrigated area (Gutiérrez-Ruiz et al., 1995). A current decree limits the maximum quantity of wastewater that could be delivered to the Mezquital Valley to 400 millions m^3/year. In spite of this decree, however, different sources affirm that the Valley is still receiving about 1,700 million m^3/year, and the farmers have been assured that they will continue to receive all the wastewaters from the Valley of Mexico (Gutiérrez-Ruiz et al., 1995).

Because of the salinity of wastewater, its productivity is very low. Accordingly, it is compensated by overirrigation. The main crops grown in the the Mezquital Valley are alfalfa and corn, representing some 60-80% of the total irrigated area. Cultivation of raw vegetables that are consumed raw is forbidden by law, but this is often ignored (Gutiérrez-Ruiz, 1995). Another concern is the infiltration of contaminated water from the unlined channels. This is why the open channels will be replaced by pipes.

This practice of wastewater irrigation has been beneficial because it has provided added nutrients to soils and it has been a source of water in an otherwise semiarid region. However, it represents a very high risk to the health of not just the population that live and work in the irrigation districts, but also to the consumers (National Research Council et al., 1995; SEDUE, 1990).

The new macroprojects include the major investments for the construction of four treatment plants which will treat all the wastewater generated in the ZMCM. The operation of the plants will undoubtedly improve the quality of the wastewater that would have to be disposed. There is also a proposal to reinject the treated wastewater into the aquifer. There are some environmental and health concerns as well. At present, the Endhó Reservoir is completely covered with water hyacinths, with consequent environmental and health risks to the neighbouring population. This is in addition to the overall health risks due to irrigation with raw wastewater. The farmers in Mezquital Valley are already worried about the potential economic impacts if water is injected into the aquifer, since it would significantly reduce their water availability. The quality of water will also change, since the nutrient content of the properly treated wastewater is likely to be less. This means the farmers may have to increase their use of fertilisers which would increase their production costs.

An aquifer recharge programme was started in 1943 to reduce flooding. It included runoff retention, surface spreading, channel modification and infiltration wells. An artificial recharge programme using injection wells was initiated in Mexico City from 1953. However, the quality of the water used was not monitored, and hence wells had to be closed subsequently due to contamination problems (National Research Council et al., 1995). The future scenario thus appears to be not very optimistic. Before implementing any programme on injecting treated wastewater to the aquifer of the Valley of Mexico, many precautions will have to be taken. Equally, current users of wastewater in the Mezquital Valley need to be consulted properly. Otherwise it could contribute to social tensions and conflicts.

In 1998, the newly elected government of Mexico City cancelled the plans for the construction of the treatment plants. Several issues were considered. First, the investment costs for treating the wastewater and transferring it hundreds of kilometres from the source to the Mezquital Valley are extremely high. Second, Mexico has not developed a cost-effective technology to treat the wastewater and reinject it into the aquifer. Third, construction of only the treatment plants, without proper water resources management and planning, would not solve the acute sanitation problems of Mexico City and Mezquital Valley.

Other activities on water reuse include watering of green areas used for recreational activities, irrigation of farmlands, and filling up of lakes. This reuse amounts to about $4m^3$/sec of treated wastewater from Mexico City. In the State of Mexico, most of the treated wastewater is reused for industrial activities (UNAM 1997). The Government has given concessions to the private sector for operating treatment plants, and they are now considering potential users of the treated wastewater (Departamento del Distrito Federal 1991). The Government is also promoting the use of more efficient water closets, which could save more than 70 million litres/day. Land also also been appropriated by Mexico City to create green areas which would facilitate aquifer recharge (Departamento del Distrito Federal, 1991; UNAM, 1997).

Conclusions

Clearly the present approach to the management of the water supply and wastewater in the Valley of Mexico is neither efficient nor sustainable. In order to fulfil the needs of the population in the ZMCM in terms of water quantity and quality, and to simultaneously maintain a proper balance between the people, natural resources, environment and health, it is necessary to develop and implement an integral management plan which should explicitly consider the interests of the different sectors as well as appropriate economic, social, technical, political, environmental and institutional factors. The importance of public consultation and involvement in preparing and implementing such plans should not be underestimated.

The CNA has developed a plan that is currently under review. Known as the "Project on Sanitation for the Valley of Mexico," it is expected to comply with the environmental policies by the year 2000. The complexity of the problem in ZMCM and the financial requirements will eventually force the authorities to search beyond the purely engineering solutions and construction of more and more infrastructure. Appropriate demand management strategies need to be considered simultaneously..

The Valley of Mexico Basin Council already exists. It will have to work with the representatives of the Federal Government, governments from the neighbouring States of Mexico and Hidalgo, CNA, and other institutions associated with the local decision-making in the area of water planning and management. The institutions concerned will have to realise that the environmental and the social issues are important factors to consider for developing and implementing long-term strategies for managing water supply and wastewater disposal. Realistic policies and programmes on water use, reuse and conservation will have to be implemented within the next decade. Massive efforts will be needed to increase public awareness and understanding of the seriousness of the water problem, and the role they have to play for its resolution. Issues like cost-recovery and appropriate levels of water pricing can no longer be ignored. For example, at the present average price of about $\$0.20/m^3$, for water for domestic uses in the State of Mexico, more than 25 years would be needed to recover the investment costs of the Macrocircuito. This does not include the operation and maintenance costs for the system.

The future of the ZMCM do not appear to be very bright. Clearly some hard decisions will have to be taken in the near future. It is no longer a feasible long-term option to continually increase the investments in water supply and wastewater treatment in the ZMCM at the expenses of the people living in other parts of the country, or at the expense of other types of social investments. The problem is complex, but given the political will, it can be resolved. However, it would not be an easy task.

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