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TERMINAL EVALUATION REPORT
OF GEF PROJECT No GF/1100-99-14

**“INTEGRATED MANAGEMENT OF LAND-BASED ACTIVITIES IN
THE SÃO FRANCISCO RIVER BASIN”**

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CONTENTS

1. INTRODUCTION.....	1
1.1. Project Background.....	1
1.2. Scope of this Evaluation.....	1
2. REGIONAL BACKGROUND	1
2.1. Brazil Water Resource Development.....	1
2.2. The São Francisco Basin	4
2.2.1. Main Features of the River Basin.....	4
2.2.2. Institutional Development.....	4
3. SCOPE, OBJECTIVE AND EVALUATION	5
3.1. Project Objectives and UNEP Mandate	5
3.2. Project Components	7
3.2.1. Diagnostic Analysis of the Basin	7
3.2.2. Strategic Action Programme	8
3.3. Evaluations	9
3.3.1 Methodology	9
3.4. Project Performance	9
3.4.2. Overall Evaluation and Evaluation of Sub-Projects.....	9
3.4.1. Project Management.....	11
3.4.2. Achievements	12
3.4.3. Stakeholder Involvement.....	15
3.4.4. Sustainability.....	15
3.4.5. Scope, Quality and Significance of Project Outputs.....	16
4. FINDINGS AND CONCLUSIONS.....	18
4.1. Environmental Assessment	18
4.2. Water Resource Management	19
4.3. Institutional Arrangements.....	19
4.4. Conclusions	19
5. LESSONS LEARNED AND RECOMMENDATIONS.....	20
6. OVERALL CONCLUSIONS AND RECOMMENDATIONS.....	21
7. REFERENCES AND BIBLIOGRAPHY	23
ANNEX A - EVALUATION OF SUB-PROJECTS	27
ANNEX B - SFRB BASIN COMMITTEE	39
ANNEX C – COFINANCING	
ANNEX D – TERMS OF REFERENCE FOR THE EVALUATION	

EXECUTIVE SUMMARY

BACKGROUND

Project: The Ministry of Environment of Brazil requested the United Nations Environment Programme (UNEP) to arrange for GEF (Global Environment Facility) support for the preparation of a water resources management programme for the São Francisco River Basin. A project proposal for improving water resources management in the basin was prepared and, in July 1999, the GEF approved grant funds to conduct planning and feasibility studies required to formulate a Water Management Programme that will promote environmentally sustainable development of the basin as a means of reducing environmental degradation of the coastal zone. This project has been under implementation since September 1999 with the Organization of American States (OAS) as the Executing Agency. At the national level, the Brazilian Secretariat of Water Resources (SRH – Secretaria de Recursos Hídricos) was the executing agency up to 2000 when, following government reorganization, the National Water Agency (ANA – Agência Nacional de Águas) assumed national responsibility for the project.

Water Resource Development in Brazil: The Water Resources Law (Law 9433/97) was approved in 1997 following lengthy negotiations among the sectors involved. This legislation created a national policy for water resources management. The law establishes a framework for the basin committees to regulate water rights and water charges.

Later, a second reform was adopted, leading to the creation of agencies for the control of sectoral development, within which the ministries had defined policies and responsibilities. ANA was created in July 2000 by Law 9984 and its mandate includes implementation of the Water Resources Law 9433/97.

It can be said that the construction of the first phase of institutional development of Brazil's water resources has been concluded. Legal elements have been established at the federal level for water resources management and institutions for governance have been set up. At the State level, almost all States have passed legislation. In this period, committees and agencies for Federal and State basins were also established with varying degrees of success.

The implementation phase has progressed on a variety of fronts and one of the main developments was the *Implementation and development of management instruments* that included the establishment of *basin committees* and *agencies* with resources provided by *charges* for water use.

The São Francisco River is the third largest river in Brazil with a length of 2,700 km. The São Francisco River Basin (SFRB) covers an area of about 640,000 km² representing nearly 8 % of the Brazilian National Territory. The river headwaters are located in the state of Minas Gerais and it also drains areas of the States of Goiás, Bahia, Pernambuco, Alagoas, Sergipe and part of the Federal District. This includes areas of 503 counties with a total population of about 15 million inhabitants most of them concentrated in the upper watershed.

Along its path, the river drains a diverse area, climatically, physically and in terms of environmental and social diversity. Accordingly, the watershed is usually divided into 5 regions: Upper; Middle; Lower Middle; Lower Sub-Basins; and Estuary and near Coastal Areas. The main water and environment issues of these SFRB regions are:

Upper basin: Urban development impacts include floods, urban drainage and sewer effluents, heavy metal releases from untreated industries and processing mill discharges; natural vegetation removal for agriculture; soil erosion; and hydropower impacts on the natural environment.

Middle basin: High water demand due to irrigated agriculture; agriculture impacts due to the use of pesticides from irrigated perimeters; shortage of water outside of the main river; sediments transported to the river (causing sedimentation and silting of the river channel).

Lower Middle: Sediments trapped in the reservoir; evaporation corresponds to about 20% of the mean flow; shortage of water outside of the main river during most seasons; strong rainfall variability from year to year and high impact on basin flow yield.

Lower and Coastal: Sediment transport has been reduced from 6 to 0.4 million tonnes/year. Clear water and reduced channel depth have caused the proliferation of toxic algae affecting river biota. The absence of floods due to reservoir regulation has reduced the access of fish to the marginal or riparian lagoons for hatching. The number of families that depended on fishing has been reduced from 38,000 to 20,000 in recent years. Coastal erosion has been caused by the reduced supply of river sediment to the mouth of São Francisco River.

SCOPE, OBJECTIVES AND EVALUATION

Objectives and UNEP Mandate: The objective of this GEF-GPA demonstration project is to assist the Government of Brazil to promote sustainable development of the SFRB and its coastal zone based upon the implementation of an integrated approach to management of the watershed and the coastal zone.

The GEF São Francisco project meets the objectives of GEF Operational Program #10 on International Waters Land-based Activities Demonstration Project component. The project identifies specific strategies, investment projects and activities that meet GEF criteria, catalyzes preparation of an integrated Watershed Management Program (WMP) and serves as a demonstration project for the implementation of the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities in Latin America.

The anticipated results of the project were: (a) Improved river basin and coastal zone environmental understanding among the public and scientific awareness and knowledge of the basin and its coastal zone; (b) Improved public and stakeholder participation through hands-on involvement of communities in remedial measures; (c) Improved organizational structure and staffing capacity essential for implementing financial mechanisms for water rights and water charges as provided for under Federal Law 9433/97; (d) Improved quantification of water use, hydrological management and reduced use conflicts and; (e) Improved integrated management and environmentally sustainable development of the SFRB.

Project components: The project was developed through the Diagnostic Analysis of the Basin (DAB) of which the main components were specified in the project document. This leads to the formulation of a Strategic Action Plan (PAE) (equivalent to a *Strategic Action Programme* or *SAP*).

The DAB was prepared based on the execution of 28 sub-projects. These projects were selected in the PDF Phase through a number of seminars in different areas of the basin. The projects were organized into four components: I - Environmental Assessment of the Basin and its Coastal Zone; II - Public participation and stakeholder consultations; III - Development of the structural organization; IV - Formulation of the Strategic Action Programme.

The SAP Strategic Action Programme has two components: Implementation of the Integrated system of Water Resources Management of the basin and coastal zone, sustainable use of water resources and environmental rehabilitation of the basin and its coastal zone.

Methodology of evaluation: Each sub-project was evaluated to determine its success on a scale from 1 to 5, with 1 being the highest (most successful) rating and 5 being the lowest. In rating the projects, the following criteria were considered: *Timeliness:* how the project met the schedule and implementation timetable cited in the project document and later revisions thereof; *Achievement* of results/objectives (the extent to which the project's environmental and development objectives were achieved); *Attainment of outputs;* *Completion of activities;* *Project executed within budget;* *Impact created by the project;* *Sustainability;* *Stakeholder participation/Public Involvement;* *Monitoring & Evaluation.* The evaluation was developed based upon the documents, interviews developed by visiting the area and agencies and my knowledge of the basin and issues.

Results of the evaluation: The overall rating awarded was “*Excellent*” with an achievement rating of 90 – 100%. The highest ratings (“*Excellent*” – 90 -100%) were related to attainment of outputs,

completion of the activities, impacts created by the project, public participation and monitoring. The timeliness of project development, budget and sustainability were rated as being “very good” (75-89%).

FINDINGS AND CONCLUSIONS

The findings were subdivided into three major components: environmental assessment, water resources management and institutional arrangements.

Environmental assessment:

- (1) The overall belief was that there was a process of desertification in Cabrobó semi arid region of Pernambuco in the Lower Middle region of the São Francisco. Subsequent study showed this not to be true (Project 2.1).
- (2) One of the major issues mentioned by some professionals and members of the population was that the saline intrusion of the São Francisco increased following dam construction upstream. Project studies showed this to be untrue. In fact, the dams decreased the extension of the influence of the saline intrusion (Projects 1.1a and 1.1b).
- (3) The knowledge developed about sedimentation and erosion processes, nutrient loads and mitigation practices for the recovery of the ichthiofauna of Lower São Francisco were important findings for the region.
- (4) Evaluation of mining impacts on the water resources in the Velhas River near the Metropolitan Region of Belo Horizonte has provided valuable support for discussions and decisions related to the control of such impacts in Upper River Basin.
- (5) The development of a water quality index, training of the population and creating a cadre of volunteers in evaluating the water quality of the rivers are important successes.
- (6) The evaluation of Basin Land Use, its change with time, sediment yield evaluation and bed modification together with the dams and hydrologic behavior allow an understanding of the impacts in the lower river and coastal zone. The reduction of sediment transport is due to the combination of hydrologic conditions (low floods in a sequence of years) and effects of the reservoirs that reduced the sediment in the lower reaches to a value of about 10% of that of former years. This has resulted in a decreased supply of nutrients, increased coastal erosion and decreased river turbidity, which allows the proliferation of macrophytes in the river.
- (7) The practice of recovering natural vegetation mainly near the rivers has been developed successfully in a pilot project, in cooperation with NGOs, with concrete results (Project 2.2b). This activity represents important experience with public participation that can be transferred and replicated.

Water Resource Management:

- (8) The contribution of navigation to the development of agricultural competitiveness will support governance decisions.
- (9) The use of models to evaluate the basin behavior taking into account the hydropower and other water uses is an important experience in the synergic integrated environment assessment which can be used in other basins.
- (10) The impact of water use in agriculture was evaluated together with its efficiency and the value of the water in terms of the production and export of goods. This chain of economic value is an important input into decisions regarding basin development.
- (11) Water resource management plan developed under a pilot project (Project 3.3b) was an important product for the future development of SFRB management plan.

Institutional Arrangements:

- (12) Substantial public participation (~12,500 persons) in the projects and in the development of the Strategic Action Plan has been important to validating decision-making processes in the basin.

- (13) Capacity building at different levels has been one of the major assets of the project in the areas of: (a) soil conservation; (b) water quality evaluation; (c) understanding of environmental and water resources issues and sustainability; and (d) public participation in committees.
- (13) Development of a proposal for updating the hydrologic system network is a relevant aspect that requires special attention in basin development since, without reliable information, it would be impossible to develop a sustainable management regime.
- (14) The establishment of the São Francisco River Basin committee and its consolidation during recent years has been a most important output from this project. The development of any public participatory process is both complex and lengthy involving the building of trust among the people and resolving conflicts of interest. The following steps are the consolidation of the interactions among the sub-basins, the establishment of regional committees and implementation of the basin agency and the social and economic sustainability.

Conclusions:

Overall, the project has been successful with many achievements related to environmental assessment, water management and institutional capacity. Some of the main conclusions are as follows.

- The development of a project document addressing most of the main issues in the basin. It is very well orientated document that has provided a firm basis for successful development of the project. It should, however, be noted that one important issue was not fully included, namely human sustainability in semi-arid areas outside of the main river of SFRB water supply influence in the sub-basins. In this region, water is the basis of life in economic, social and environmental terms. The population of these sub-basins is very poor mainly because of the lack of water. The reduction of poverty has a direct link to the improvement of environmental conditions.
- Project management by the leading agencies was conducted very well with good standards in report preparation, review of products, development of collaboration among researchers and technical professionals in the various sub-projects and the preparation comprehensive documents, folders, videos and other media for public information purposes.
- The project has led to some very important outcomes and impacts on the basin community, federal institutions such as ANA, SRH, State administrations and the public including the following: (a) increased collaboration and integration among research groups working in the basin on similar or interrelated issues; (b) promoted strong interactions among stakeholders in the basin committee allowing improved decision-making that has been extended to State administrations in the Basin; (c) improved the coordination of investment of national, state and international funds; and (d) raised awareness of the population on the issues and mitigation measures and encouraged its participation in decision-making processes at all levels.
- Continued support for this project is very important in order to build on the results achieved in this project. The results obtained so far would not be lost if this project would come to an end at this stage, however, such a stoppage would slow down the achievement of the long-term planned goals.

LESSONS LEARNED AND RECOMMENDATIONS

The lessons learned through the implementation of the project relate to project management, environmental assessment, water resources management and sustainability. Some of the most important are the following:

- In the development of this type of project, it is important to promote integration of sub-projects through workshops, specific visits or meetings among a few projects having common interests and experience as well as promoting the use of common equipment and laboratories.

- It is important that, beyond meeting project objectives, the development of sub-projects creates synergy with other projects or sources of funding in order to enhance the sustainability of institutions and research groups.
- The inter-relationships among climatic variability, dam operational conditions and soil use in a basin are a complex non-linear combination that can lead the ecosystem to different levels of stress. By understanding such processes, this knowledge can be used *inter alia* to formulate terms of reference for impact assessments of reservoir for hydropower development, multiple water uses of the system and to improve the characterization of processes through modeling.
- Learning how to enhance public participation in the assessment process and mitigation measures on a voluntary basis was an important achievement and constitutes a lesson that can be disseminated. Participation was developed in the basin committee through capacity building in schools and raising public-awareness on the environmental issues related to its local neighborhoods in rural and city areas.
- The São Francisco River is a large basin in a federal country with many states. The federal legislation (water law and constitution) together with the State legislation has been the basis for institutional arrangements. However, these legal instruments do not explicitly address how to develop the institutional decentralization of basin management through basin committees and agencies. The experience developed in the SFRB project is singular in this respect (see main aspects in annex B) and provides experience for other countries to construct similar mechanisms. Institutional arrangements are always unique due to the combination of legal, social and economical circumstances but the successes and failures of the Brazilian development process constitute a major asset of experience for development of similar arrangements elsewhere.
- The DAB showed the importance of, and the needs for, integrated environmental impact assessment in large basins and how synergistic interactions between the system and climate variability can affect both the environment and the population
- The public participation processes for the development a Strategic Action Programme was a very good example of decentralization and stakeholder participation in the preparation of a plan. The participation was developed in the following ways: (a) participation of organizations in the basin committee – (b) in the committee of the sub-basin - (c) workshops convened in different cities of the region - (d) in the State basin committee integrated to the Federal Basin.

OVERALL CONCLUSIONS AND RECOMMENDATIONS

Some of main conclusions and recommendations related to the framework of activities are:

- The investments of this project have already improved research and institutional capacity that can make an important difference in the basin development. The project showed that these funds were an important first step in the development of integrated water resource and land management and has engendered enhanced technical and research capacities.
- The GEF project was the main instrument in the institutional development of the WMP. It was not only important for the purposes of water management but also for environment protection in the basin.
- The future sustainability of basin water resources development depends on government investment in future phases of the PPA and the GEF project. The PPA investments are more in the direction of human needs and efficiency in water development but with important consequences for the environment, such as increased treatment of municipal wastes and increased efficiency in water use.
- Due to the financial situation and structure of the governments, major portions of the funding in the budget depend on the approval of the Minister of Economy. The PPA funds and ANA budget will have limits with regards to the development of basin activities. Because the basin region is one of the poorest in the country and one of the main government policies is to increase

investment to improve social indicators, it is likely that funds related to social investments (such as water supply and sanitation) will have less restrictions.

- ANA has been the institution within which the project has successfully developed. This is a new institution created in 2000. Its directors have a mandate approved by the senate that is not synchronous with political terms. The director who has been in charge during this phase of the project was appointed by the former president Fernando Henrique and his relationship with the government has improved with time. The president of ANA was subsequently appointed as president of another Agency, the “Agência Nacional de Energia Elétrica” (ANEEL) (National Electrical Energy Agency). The new government appointed the new president and a new director of ANA at the beginning of 2005. They are both supporting the continuance of technical and institutional developments that have taken place during the last four years.
- It is recommended that in the future development of the program the human water sustainability in the semi arid sub-basin could be addressed by the project.

1. INTRODUCTION

1.1. Project Background

In 1996, the Secretariat of Water Resources under the Ministry of Environment of Brazil, requested the United Nations Environment Programme (UNEP) to submit a request for GEF (Global Environment Facility) support for the preparation of a water resources management program (WMP) for the São Francisco River Basin. Initial funds provided by the GEF through a PDF Block B Grant (US\$ 341,000) helped prepare a project proposal for improving water resources management in the basin. In July 1999, the GEF approved grant funds to the value of US \$ 4,430,000 to conduct planning and feasibility studies required to formulate a WMP to promote environmentally sustainable development of the basin as a means of managing and reducing environmental degradation of the coastal zone. This project has been under implementation since September 1999 and was originally scheduled to end in April 2003. The Organization of American States (OAS) has been designated as the executing agency for the project. Since its formation in December 2000, ANA (the Brazilian Water Agency under the Ministry of Environment) has taken over, from the Secretariat of Water Resources, the responsibility for the national coordination of the execution of the project.

In accordance with UNEP/GEF policy, all UNEP GEF projects are subject to mid-term and terminal evaluations by external evaluators contracted by UNEP. A Mid-term Evaluation of this project was undertaken during the period 25 November 2002 to 17 January 2003 and the report was presented in March 2004.

This report is a *Terminal Evaluation* of the project based on a review of the documents, discussion with the lead consultant, who is responsible for preparing a consolidated overview of 5 GEF International Waters projects in Latin America, as well as field inspections and discussions with community leaders and sub-project participants.

1.2. Scope of this Evaluation

Terminal evaluations specifically assess the main outputs, outcomes, findings, key lessons and best practices of a GEF project. The results are used to benefit the design and implementation of future projects in the country and the region as well as providing insights to the implementing and executing agencies and the GEF.

The scope of this evaluation covered all key activities undertaken in the framework of the GEF São Francisco project. It compares planned outputs of the project to actual outputs and evaluates the actual results to determine their contribution to the attainment of project objectives.

The evaluation highlights lessons learned and best practices thus far from the implementation of the project that would improve the future work in the basin and assesses the appropriateness of this project in meeting the long-term objectives of the GEF. In this regard, the evaluation assesses the extent to which: (i) sources of environmental stress in the basin have been adequately addressed through project activities; (ii) mechanisms for joint management of the basin have been put in place or strengthened through execution of the project; and (iii) there has been a change in environmental state as a consequence of the project intervention.

The following chapter presents the country and regional background of the project. In Brazil, water resource development is the base for regional development. Basin issues related to water use and environment and the institutional development of the basin are subject to national decentralization through the creation of basin committees and the National Water Agency. Chapter three presents the main aspects of the project and an evaluation of sub-projects and outputs. Subsequent chapters discuss the findings, lessons learned and recommendations.

2. REGIONAL BACKGROUND

2.1. Brazil Water Resource Development

Up until the 1980s, Brazil was a country in which water resource management was conducted sector by sector without any integration. The active sectors were: energy (the sector best organized in respect

to sectoral planning); irrigation (during this period, the country even had a Ministry for Irrigation to develop water use for irrigation purposes, principally in the North-East); the environment (with the passing of environmental legislation (1981) and the creation of State agencies for control); water supply and sanitation (represented by water and sanitation companies); and navigation (a more marginal sector within the Ministry of Transport). Matters such as flooding and water-borne disease were dispersed within the government structure but without receiving much priority.

In terms of institutional structure, only the water code approved in 1934 existed and projects were approved by sectoral organs. The hydrological database was part of the Ministry for Mines and Energy and projects were developed with a single objective, without any basin-wide vision being adopted by sectoral entities, and with limited attention to the environment. The only planning was undertaken by the hydroelectric sector that adopted the following steps for each undertaking: assessment of hydroelectric potential, inventory of the entire basin and feasibility analysis, followed by basic project design and execution of each hydropower initiative.

In the water and sanitation sector, State companies significantly extended water supplies but paid little attention to the collection and treatment of sanitary waste, whilst urban drainage and solid waste were of no account, despite frequent urban floods.

In the second half of the 1980s, principally after restrictions were imposed on hydropower development by the international funding agencies and the beginning of funding for environmental control in cities and biomes (*e.g.* the Amazon and the Pantanal), there was increased discussion about the need for integrated water resource management within the country. The process was mainly discussed within the Brazilian Association for Water Resources (Associação Brasileira de Recursos Hídricos: ABRH) in technical terms and without party political components that might have impeded its evolution and consolidation. The ABRH created a forum for discussion at various events and set out the elements for consensus in its letters from Salvador in 1987 (multiple uses, decentralization, national system for water resource management, improved legislation, development of technology and human resources, information systems and national policy for water resources) and from Foz de Iguaçu in 1989 (national policy for water resources, national management system, legislation, technology and human resources and information systems: ABRH,1995). All the principles approved in Dublin, on which Agenda 21 is based, were present in these documents.

In 1990, the sector managed to pass legislation that came to be the basis for sectoral funding in spite of it serving the interests of States and townships more fully. The law concerning financial compensation for flooding of productive agricultural land withheld 6% of the value of energy produced by an installation to compensate the State and townships. However, a part of this resource was earmarked for hydrological data collection, science and technology, and hydrological studies. Nevertheless, the destination of these resources is the energy sector, which guarantees the creation and maintenance of a hydrological database in permanent form. This was the first great success because, independent of budgeting, resources are guaranteed by law for the collection of data and basic studies.

In this same period, some sectors had more weight than others in negotiations over legislation the key players were:- the energy sector, which through its organization and resources, always dominated water resource development; the environment sector, which countered with its assessment of potential impacts and wished to participate in management processes; irrigation, because of the circumstances at the time that resulted in the creation of a dedicated ministry on this topic. The water supply and sanitation sector was less influential and was distanced from the process, principally because it acted more at a state level while the focus of discussion was at the federal level.

With the reforms in the decade of the 1990s, a Secretariat for Water Resources (Secretaria de Recursos Hídricos: SRH) was created in 1995. Working together with Congress, it became possible to draw up a law that contained the principal technical elements of previous discussions, although some points of discussion remained outstanding. In 1997, the Law on Water Resources was finally approved after lengthy negotiation among the sectors involved (Law 9433/97). This legislation created a National Policy in Water Resources. The law establishes the framework for the implementing basin committees to regulate water rights and water charges.

Within government, a second reform was drafted, leading to the creation of agencies for the control of sectoral development once the ministries had defined their policies. The National Water Agency (Agência Nacional das Águas: ANA) was created at this time of politico-institutional governance in July of 2000 by Law 9984. Its mandate includes implementing the Water Resources Law 9433/97.

With the creation of this agency, the law concerning compensation for flooded land by dams was changed to provide funds for the water management sector. The levy on the industry being 6.75% of the value of energy generated and ANA receives 11.1% of the total levy. Science and Technology applied to water resources received 3.67 % of the compensation funds. These are considerable sums for a sector that, until the passing of legislation, had been funded by budget leftovers.

It can be noted that the first phase (here termed Phase I) of the institutional development of Brazil's water resources has now been concluded. In it, legal elements have been established at federal level for management and institutions for governance have been established. At state level, almost all States have passed legislation and some have set up agencies for development, although at present these are few in number (Tucci, 2003).

In this period, committees and agencies for Federal and State basins were also set up, with varying degrees of success. Most basins have just a committee, which has limited activity. In the sector of Science and Technology, there has been considerably increased investment in research that focuses on problems and is provided with continuing resources.

The subsequent phase has developed (here called Phase II) on various fronts. These are outlined as follows (Tucci, 2003).

Sectoral Legislation: Legislation and the management of water resources must be considered together but the sectors still need elements that allow socio-economic development and promote sustainable environments. Principally, water supply and sanitation sectors, together with the energy sector, are developing the legal basis needed to ensure sustainability of development. This is the present phase of legal construction that provides compatibility between the objectives of water resources law and sectoral development. Various problems have been identified and actions are being taken in the search for this legal framework and for the construction of an integrated basis for the management of water resources.

Implementation and Development of Management Instruments: Establishment of *basin committees* and *agencies* with resources given by *charging* for water use. For this development to happen it is necessary for the three elements to exist (as described below); if they do not, success is difficult.

National Plan for Water Resources, State Plans, and Basin Plans: Integrated management of water resources will be developed when the plans have been drawn up. In this way, it is possible to reconcile sectoral interests, establish concessions and control the environment. This phase is under development at the Federal level, in a few States and in some basins.

National Information System: The hydrological information system has existed for a long time but needs to be extended and modernized. At present, information is easily accessible to society. Extension and modernization of the database involves: (a) inclusion of information besides that provided for basic hydrological purposes; (b) extension of the networks for data collection to cover a wider and more representative scale of basin sizes; and (c) modernizing the data bank and access to information.

Capacity Building and Science and Technology: Investments have been made and it is important that they be continued as the demand rises for qualified personnel to serve in basin agencies. In addition, development of knowledge relating to instruments for management and to water systems is essential if critical problems facing the nation are to be solved.

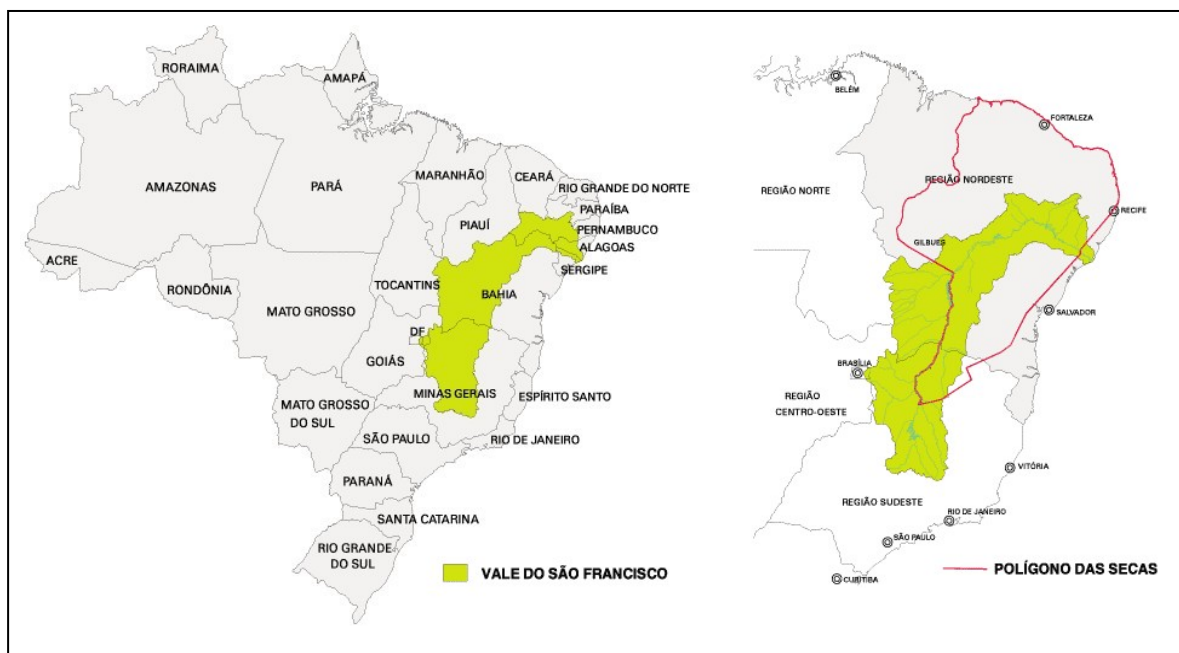
2.2. The São Francisco Basin

2.2.1. Main Features of the River Basin

The São Francisco is the third largest river in Brazil having a length of 2 700 km. Its drainage basin covers an area of about 640 000 km² representing nearly 8% of the Brazilian National Territory (Figure 2.1). The river headwaters are located in the state of Minas Gerais and also drain areas of the States of Goiás, Bahia, Pernambuco, Alagoas, Sergipe and part of the Federal District (Figure 2.1). The basin contains areas of 503 counties with a total population of about 15 million inhabitants; most of them concentrated in the upper watershed.

Figure 2.1.

São Francisco Basin: Map (a) (LHS) location in relation to Brazil and States of the country. Map; (b) (RHS) location in relation to the northeast drought polygon (CODEVASF, 2000).



Along its path, the river crosses a diverse region, both in climatic and physical characteristic as well as in environmental and social diversity. As a result, the watershed is usually divided into 5 regions: Upper; Middle; Lower Middle; Lower Sub-Basins; and Estuary and near Coastal Areas (Figure 2.2).

Table 2.1 shows the main physical characteristics of each of the regions. It shows that: (a) the upper basin is wet and yields 70% of total basin flow where urban development, agriculture and hydropower are the main water uses; (b) In the middle region, water sustainability in the left margin is supplied by an important aquifer but water demand has increased in agriculture and it constitutes an important water use conflict together with its environmental impact; (c) In the lower middle and lower sub-basins, the important features relate to changes in the environment due to hydropower exploitation, the lack of the water outside of the main river and population sustainability.

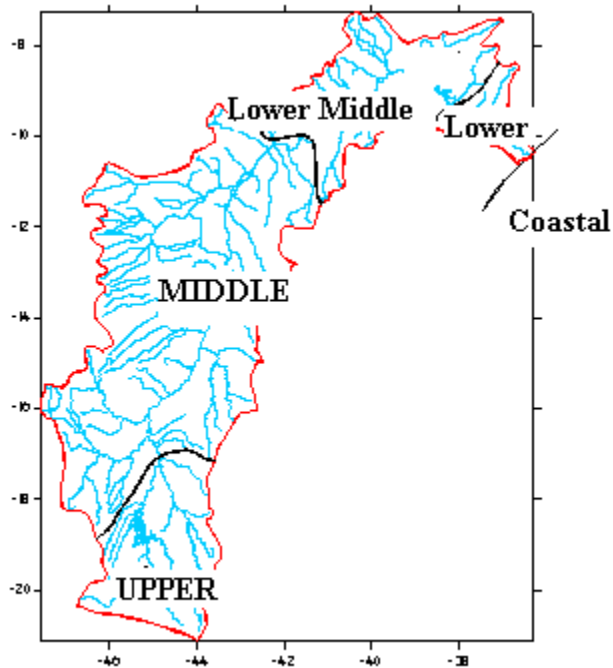
Hydropower production plays an important role in the basin. It is one of the national energy sub-systems. The total installed hydroelectric power capacity in the entire basin is 10,433 MW(e). A cascade of 8 hydroelectric power dams control most of the annual floods originating in the upper and middle São Francisco basin regions.

2.2.2. Institutional Development

The Master Plan for the Development of the São Francisco Valley (PLANVASF) was concluded in 1989 by the government and was designed to provide incentives to both the public and private sectors

for the development of the basin. The plan included the development of water and natural resources, irrigation, power generation, water supply and sanitation, navigation and environmental protection. However, the Plan was not implemented due to differences in state interests, institutional and political changes and lack of an integrated systems approach. Regional economic development has been the main concern in the watershed and environmental issues have been a secondary priority.

Figure 2.2.
Sub-regions of the São Francisco River Basin



Despite the existence of the Basin Master Plan, investment and overall development was made through sectoral interests such as agriculture, energy and industry. Because the basin lies in six States, there were also State investments in urban development as well as those related to industry, agriculture and infrastructure, such as roads, urban water supply and sanitation. The São Francisco Basin Committee was created in the 1980s but its role was minimal due to lack of legislative support, government commitment and economic resources.

As discussed in the previous section on Brazilian water development, the country is at the stage of decentralizing and improving water management through the Basin Committee. The commitment to this institutional development increased after 2000 with federal support in which the State Secretariats provided strong involvement. This project played an important role in this ongoing water development phase in the San Francisco Basin as described below.

With the creation of the Basin Committee and sub-committee, comprising the stakeholders, during the period of the project, the future challenges are the institutional development of the Basin Agency that will implement the decisions and measures adopted by the Committees and the decentralization of basin management through the State Basin Committee and sub-committee.

3. SCOPE, OBJECTIVE AND EVALUATION

3.1. Project Objectives and UNEP Mandate

Main physical characteristics of the sub-regions

Region	Water Physical Characteristics	Socioeconomics	Main water and environment issues
<i>Upper:</i> Headwaters to the city of Pirapora	About: 1,500 Annual mean rainfall; altitudes ranging from 1,600 to 600 m; 20 l.s ⁻¹ km ⁻² of mean annual flow and the Q ₉₅ 5 l.s ⁻¹ km ⁻² Rain period is from November to March; Drought period from June to August.	<ul style="list-style-type: none"> • Large urban development in Metropolitan area of Belo Horizonte; • Mining; • Hydropower production (Três Marias reservoir); • Agribusiness: crop production and cattle ranching. 	<ul style="list-style-type: none"> • Urban development impacts: floods, urban drainage and sewer effluents; • Heavy metal releases from untreated industries and processing mill discharges; • Natural vegetation removal for agriculture: soil erosion; • Hydropower impacts on the natural environment.
<i>Middle</i> Pirapora to Sobradinho	Great rainfall gradient, ranging from 1,400 mm to 600 mm in the its downstream limits; left margin basins have great natural regular flow and right margin basins aquifer are more limited; 12 l/(s.km ²) of mean annual flow and the Q ₉₅ 3 l/(s.km ²) ¹ ; same wet and dry season as Upper Basin;	<ul style="list-style-type: none"> • Agriculture: left margin annual crops at Barreiras; irrigation perimeters at right margin in Jaiba and tributaries • Navigation: main river; • Cattle ranching: mainly at upstream part. 	<ul style="list-style-type: none"> • High water demand due to irrigated agriculture; • Agriculture impacts due to pesticides from irrigated perimeters; • Lack of water outside of main river in the right margin; • Sediments transported to the river (causing sedimentation and river siltation).
<i>Lower Middle</i> Remanso to Paulo Afonso	Rainfall 350 – 800 mm and Pot. evapotranspiration ~ 2200 mm; Wet period is from December to April; Dry period from July to September; minimum flow in the main river, without the dams would be 523 cms, however with the reservoirs; the minimum annual flow is 1798 cms; In the sub-basins the mean annual flow is 3 l/(s.km ²) and the Q ₉₅ is near zero ¹ ;	<ul style="list-style-type: none"> • Hydropower: 10,154 MW or 97.3% of the total is generated in this region (including the Xingó Hydropower Plant located just downstream of Paulo Afonso); • Irrigated agriculture near the main river. 	<ul style="list-style-type: none"> • Sediments trapped in the reservoir; • Evaporation on the reservoir represents about 20% of the mean flow; • Lack of water outside of the main river during most of the time; • Strong rainfall variability from year to year and high impact on basin flow yield.
<i>Lower and coastal</i> Paulo Afonso to the Atlantic Ocean	Mean annual rainfall between 800 – 1,300 mm; Wet period is from January to May; Dry period from August to October.	<ul style="list-style-type: none"> • Hydropower at the upper region limit; • Agriculture; • Navigation; • Fishing • Tourism 	<ul style="list-style-type: none"> • Sediments reduction was from 6 to 0.4 millions tons/year. Clear water and reduced channel depth have caused proliferation of toxic algae affecting river biota; • Lack of floods due to reservoir regulation impacted access for the fishes to the marginal or riparian lagoons for hatching. The number of families that depended on fishing reduced from 38,000 to 20,000 in recent years; • Coastal erosion due to the lack of river sediment supply to the mouth of São Francisco River.

1 – 5% of the time the flow is below Q₉₅, obtained from the flow duration curve.

The major SFRB needs were presented in the project document as follows:

- Urgent need for incorporation of land-based environmental concerns into development policies, plans and programmes for the São Francisco River Basin for the purpose of protection of its coastal zone.
- Urgent need for implementation of an integrated approach to management of the SFRB watershed and coastal zone.

The GEF São Francisco project meets the objectives of GEF Operational Program #10 in International Waters specifically in respect to Land-based Activities Demonstration Projects. The project identifies specific strategies, investment projects and activities that meet the GEF criteria, catalyze preparation of an integrated Watershed Management Program (WMP), and serve as a demonstration project for the implementation of the Global Programme of Action (GPA) for the Protection of the Marine Environment from Land-based Activities in Latin America. The proposed actions are consistent with the GEF principle of linking project elements with major cross-cutting issues, such as land degradation, with the UNEP Environmentally Sound Management of Inland Waters (EMINWA) integrated watershed management planning process and related Regional Seas Programme. The proposed actions are also consistent with UNEP's role under the GPA.

The results planned were:

- Improved river basin and coastal zone environmental information to the public and scientific awareness and knowledge within the basin and its coastal zone.
- Improved public and stakeholder participation through hands-on involvement of communities in remedial measures.
- Improved organizational structure and staffing capabilities needed to implement financial mechanisms for water rights and water charges as provided for under federal law 9433/97.
- Improved quantification of water use, use conflicts and hydrological management.
- Improved integrated management and environmentally sustainable development of the SFRB.

3.2. Project Components

The project was developed through the Diagnostic Analysis of the Basin (DAB), of which the main components were specified in the project document. This was to be followed by the formulation of a Strategic Action Plan (PAE). The overall planned studies specified in the project document and the anticipated results are given below.

3.2.1. Diagnostic Analysis of the Basin

The DAB Diagnostic Analysis of the São Francisco River Basin and Coastal Zone was initiated in January 2000 and presented a causal chain of the problems and the specification of remedial actions. The DAB preceded the PAE – the Strategic Action Program for Integrated Management of the Basin and Coastal Zone – and was presented in a published report (Brasil, 2003).

The DAB was prepared based on 28 sub-projects developed in the period referred to above. These projects were selected in the PDF-B phase of the project based on a number of seminars in different areas of the basin. The projects were organized into four components:

- I. *Environmental Assessment of the Basin and its Coastal Zone:* Quantification of environmental issues identified in the preparatory phase; identification and quantification of the impacts of land-based activities and flow regulation in the São Francisco river; identification of the most likely changes of the river bed, fauna and changes observed; development of a quantitative basis for the determination of strategic action for multiple water use.
- II. *Public participation and of the stakeholders:* Evaluation of land use; identification of the roles of individuals and institutions in the basin; development of a case study demonstrative of sustainable water use in irrigation; development of a capacity building program.
- III. *Development of the Structural organization:* Development of the institutional capacity for the creation of the São Francisco Basin Committee.
- IV. *Formulation of the Strategic Action Programme for the Integrated Management of the Basin.* Based on the results of the three other components develop the Strategic Action Programme for the Basin.

3.2.2. Strategic Action Programme

The SAP was developed from July to November 2003. This programme was developed based on a strong public participation of about 12,000 participants and 404 institutions through 217 events such as workshops (Brasil, 2004).

The structure of the SAP is based on Strategic Actions and components. The two components are the following (Brasil, 2004):

- I. Implementation of the integrated system of Water Resources Management of the Basin and Coastal Zone (SIGRH). Four actions are related to this component:
 - I.1. *Strengthening institutional relationships* among programmes and institutions at different levels: federal, state, municipal, basin committee and agencies. This cooperation is to improve regulation, criteria, strategies, monitoring, conflict management and water permitting. This action has two activities: (I.1.1) links between programmes run by federal bodies and water resources and environment management systems of the federal, state and municipal governments, and other stakeholders in the basin; and (I.1.2) support for the setting of licensing criteria, water-use charges, guidelines for management of conflicts and the definition of monitoring strategies.
 - I.2. Implementation of institutional instruments for the SIGRH and public participation: Implementing an effective system of public participation at different levels. This action has the following activities: (I.2.1) Support for the São Francisco Basin Committee through implementation by the Water Basin Agency and the establishment of an inter-institutional research network, state water resource management systems, and the provision of training for members of the Integrated Basin Management System; (I.2.2) Support for the implementation of a planned system of models providing for interactions among sectoral policies.
 - I.3. Development of technical instruments of the SIGRH: Developing the tools required for databases and monitoring; and hydraulic, hydrologic and water quality mathematical models for basin management. This action comprises the following activities: (I.3.1) Support for regularization for water resource use, for monitoring and registering uses, implementation of an information system for the São Francisco River Basin and its coastal zone, and for establishment of a database for integrated basin management; and (I.3.2) development of hydrologic, hydraulic and water quality models and decision-making support systems.
 - I.4. Social mobilization and environmental education taking into account the regional characteristics and historical values. The activity associated with this action is: (I.4.1) Promotion of social mobilization and environmental education. It includes the drafting of a plan that respects regional differences and the creation of a metadata base for the basin, which includes historical documents.
- II. Sustainable use of water resources and environmental rehabilitation of the basin and its coastal zone.
 - II.1. *Promotion of multiple uses of water and its rational water use*: Development of activities to improve the rational use of water, efficiency and environment conservation. This action has the following activities: (II.1.1) Support for rational use in irrigation; (II.1.2) Follow-up for hydro-environmental and operational studies on multipurpose use of dams, including the generation of artificial floods, with the aim of providing support for shipping and resolving problems in the coastal zone; and (II.1.3) support for rehabilitation of ichthyofauna and fostering of fisheries and aquaculture.
 - II.2. Conservation of water, soil and biodiversity: Erosion control, recovery of degraded areas, control of non-point pollution, conservation units and vegetation recovery. This action comprises the following activities: (II.2.1) Support for the restoration and preservation of remaining vegetation, control of erosion, restoration of degraded areas and measures to

control specific sources of point and non-point pollution; and (II.2.2) Support for the creation of a conservation unit at the mouth of São Francisco River and its Coastal Zone.

II.3. Access to environmental sanitation and flood control measures: Support poor communities for sanitary sustainability and develop emergency measures for extreme events. This action has the following activity: (II.3.1) Cooperation for access to environmental sanitation for poor communities and the adoption of measures to manage floods and droughts;

II.4. Sustainable use of groundwater: Sustainable use and groundwater protection for the basin aquifer. This action has the following activity: (II.4.1) Dissemination of knowledge on the management, utilization and protection of aquifers in the basin, and the establishment of guidelines for sustainable exploitation of the Bambuí and Urucuia aquifers.

3.3. Evaluations

3.3.1 Methodology

Each sub-project was evaluated in terms of its success on a scale from 1 to 5 (Table 3.1) with 1 being the highest (most successful) rating and 5 being the lowest. In rating the projects, the *criteria* used were: Timeliness: how the project met the schedule and implementation timetable cited in the project document and later revisions thereof; achievement of results/objectives: the extent to which the project's environmental and development objectives were achieved; Attainment of outputs, Completion of activities, Project budget, Impact created by the project, Sustainability, Stakeholder public participation, monitoring an evaluation.

The procedure used in evaluating each project was the following:

- (a) Most of these sub-projects were evaluated in the mid-term evaluation. By the time of this terminal evaluation, many of the sub-projects had provided additional results to those available at the time of the mid-term evaluation. In the case of sub-projects completed before the mid-term evaluation, the evaluations have been revised;
- (b) For each project a mean grade based on the scale of table 3.1. was calculated The overall rating was not the mean of each criteria of the project but an overall evaluation of the project based on the visits and interviews.

3.4. Project Performance

Table 3.1.
Evaluation Ratings

Rating*	Qualitative Rating	Achievement of the Project %
1	Excellent	90 -100
2	Very Good	75 -89
3	Good	60 – 74
4	Satisfactory	50-59
5	Unsatisfactory	Less than 59

*the lower the rating, the better is the project

3.4.2. Overall Evaluation and Evaluation of Sub-Projects

The detailed evaluation for each sub-project is presented in Annex A. The evaluation verified the results of sub-projects based on documentation, interviews with individuals involved in a cross-section of projects and visiting the area. A summary of the evaluation ratings for each sub-project is presented in Table 3.2

Table 3.2.
Individual and Overall Ratings of Sub-Projects

Component	Sub-Project		Timeliness	Achievement	Attainment of outputs	Completion of activities	Project budget	Impact created by the project	Sustainability	Public	monitoring	Activity Rating
I	1.1a	Hydrodynamic and Sedimentation Study of BSF, estuary and adjacent coastline. (AL/SE)	2	2	1	1	2	2	2	2	1	1,67
	1.1b	Nutrients level determination at SFRB mouth region and impact of artificial flooding over its control. (AL/SE)	3	3	2	3	2	3	3	3	2	2,67
	1.1c	Evaluation of the potential for navigation to contribute in the increment of the agriculture competitiveness at SFRB.	4	2	2	3	3	2	2	2	3	2,56
	1.2	Impact of mining on water resources in the Rio das Velhas.	2	1	1	1	2	1	1	1	1	1,22
	1.3	Fisheries impacts on Migratory fishes in the middle SFRB.	3	1	1	1	2	1	1	2	1	1,44
	1.4	Development of a water quality monitoring system in the lower middle SFRB.	2	1	1	1	2	1	1	1	1	1,22
	1.5	Impact of agriculture on groundwater in the Rio Verde/Jacare.	5	3	3	3	4	3	3	2	3	3,22
II	2.1	Determination of land use in the Lower-middle SFRB.	1	1	1	1	1	1	2	1	1	1,11
	2.2a	Partnership to improve Ribeirao São Pedro's water quality. (MG)	4	2	2	3	4	2	3	1	2	2,56
	2.2b	Recovering our forests (MG)	1	1	1	1	1	2	1	1	1	1,11
	2.2c	Multi temporal analysis of the dynamic alteration in the river bed morphology.	1	1	1	1	1	1	2	2	1	1,22
	2.4	Study of the bank erosion processes, and the relative effect over the river sedimentation dynamics. (AL/SE)	2	2	2	2	3	1	2	2	1	1,88
III	3.1	Pilot implementation of Federal Water Policy in the Maranhão River.	3	3	2	3	3	3	3	2	2	2,67
	3.2	Conjunctive use of Surface and Groundwater	4	2	2	2	3	2	2	2	2	2,33
	3.3a	Capacity building for participative organization of water resources and environmental education.	4	3	3	3	3	3	3	2	3	3,00
	3.3b	Integrated Managing Plan in the Rio Salitre's basin. (BA)	1	1	1	1	1	2	1	1	1	1,11
	3.5	Support the strengthen of the Water Basin Committee in the SFRB.	3	3	3	3	3	2	2	1	2	2,44
IV	4.1	Promotion of public participation in the SFRB	2	2	1	1	2	1	2	1	1	1,44
	4.2	Evaluation of financing mechanisms for sustainable watershed management in the SFRB.	3	3	2	2	2	3	3	2	2	2,44
	4.3	Needs Assessment for the Quantitative Evaluation of Water Use and Use conflicts in the SFRB	3	1	1	1	3	2	1	2	1	1,67
	4.4	Determination of the Operational Policies for Major Reservoirs in the SFRB	2	2	1	2	2	2	2	2	2	1,88
	4.5	Formulation of an Integrated Basin and Coastal Zone Management Program.	3	2	2	1	2	2	2	2	2	2,00
	4.6	Events of public participation to support the preparation of the Plan of Strategic actions for the management of the SFRB	2	2	2	1	2	1	2	1	2	1,67
	4.7a	Proposal for the Complementation of the SFRB hydrometeorological network	3	2	2	1	2	1	2	2	2	1,89
	4.7b	Proposal for a Piezometric Monitoring Network on Verde Grande river sub-basin	3	3	2	3	3	3	3	2	2	2,66
	4.7c	Metadata-based information reference system	3	2	2	2	2	1	2	2	2	2
	4.7d	Decision Support System	3	2	2	2	2	1	2	2	2	2

The overall rating for the project is “*Excellent*” with an achievement rating of 90 – 100%. The ratings are presented by criteria in Table 3.3 below. It can be seen from this table that the aspects awarded the highest ratings related to attainment of outputs, completion of the activities, impacts created by the project, public participation and monitoring. The timeliness of project development, budget and sustainability were the criteria that were awarded a rating at level 2.

**Table 3.3.
Criteria and Overall Ratings**

Criteria	Description	Overall Rating
Timeliness:	How the project met the schedule and implementation timetable cited in the project document and later revisions thereof	2
Achievement	Achievement of results/objectives (the extent to which the project's environmental and development objectives were achieved).	1
Attainment of outputs.		1
Completion of activities.		1
Project budget.	Project execution within the budget	2
Impact created by the project.		1
Sustainability		2
Stakeholder	Public Involvement	1
Monitoring	Monitoring and evaluation	1

3.4.1. Project Management

Project Management and Monitoring

At the inception of the project its management was housed at SRH Secretary of Water Resource but was later was transferred to ANA National Water Agency. During this period there was some delay on signing of the Terms of Cooperation between the project and the federal, state, municipal agencies and non- governmental organizations, to define roles responsibilities and local coordination approaches.

Local project management at ANA has been a small and effective unit achieved very good coordination with OAS. The project management was efficient based on following aspects:

- (a) There were special emphasis to the project management and monitoring techniques. In January 2002, a seminar was held with the project team, as well as technical and management consultants to evaluate the methodological, technical and financial aspects of each sub-project;
- (b) In 2002, several meetings were held between the sub-project coordinators and the technical coordination including the participation of the National Director and the International Coordinator;
- (c) A Project Operations Manual and a Guide for Preparation of Partial and Final Reports was prepared and distributed. Coordinators and consultants learned to prepare consistent procedures for technical report preparation.
- (d) Technical Coordinator provided guidance to the sub-project coordinators and consultants in the preparation of the Final Reports. .
- (e) The management promoted common activities among sub-project for exchange of experiences, knowledge and cooperation

Financial Management and Co-Financing

The overall financial expenditure of the project shows the following; (a) Technical management unit was small and its cost were low taking into account the overall expenditure; (b) the cost of the activities (sub-projects) were reasonable.

The delays in transferring funds to the projects occurred at the beginning of 2001 during the transition period of the National Coordination of the Project from SRH to ANA. All these issues have been solved. As the sub-projects learn more on report formatting and quality requirements, approval of payments can be performed more expeditiously (UNEP, 2004).

Co-financing is understood here as the quantity of resources supplied by other agencies for the purposes of project implementation. The main investment planned for financing for the project was those of: GEF, US \$ 4,771 million; *WB – PROAGUA*, US \$ 8,645 millions; and the US Government, \$ 8,543 million. GEF investment was implemented together with the Government counterpart investment as presented in Table 3.4. *WB – PROAGUA* was not implemented. There is a distinction between *WB - PROAGUA* mentioned as fund source for this project and *PROAGUA semi arid programme* which is an investment from the WB in the region of São Francisco River Basin. The first are funds from the second and were anticipated as additional funds to address the project objectives.

The funds of *PROAGUA semi arid programme* have been invested in the region of São Francisco, but the funds of *WB - PROAGUA* were available to this project because there was a reduction of about US \$ 100 millions in the funds of the *PROAGUA – semi arid programme* (about 25% reduction). This reduction was due to the country counter-part reduction in the project due to budget limitations. It represented a reduction of about 38% of funds for this project, and which were intended for use in increasing the number of pilot studies in the sampling the components of DAB. However, it is believed that this did not have a major impact on the final conclusions and in developing the SAP.

From the interviews and knowledge of the institutions in the region, it was found that most of the institutions involved in the project provided important support as specified as follows: (a) qualified personnel, as the projects paid only small part of the costs of the personnel; (b) equipment, infrastructure from co-financers such as counties, states and others; (c) funds for travel and other services to complement the project budget; (d) funding for other projects that provide synergy for the conduct of research. Also, there are many projects developed in universities and research centers that receive scholarships for students and research personnel. Estimates were made of these contributions to the project and are presented in the Table 3.4. The project coordination did not present the distribution of the funds of table based “in kind” and “cash” contribution. The amount planned for the project for country counterpart contribution was US \$ 8,543 millions and the total country contribution was US \$ 9,651 which was more than one million above the planned amount.

3.4.2. Achievements

In the project achievement evaluation, the planned activities of the project document (ProDoc) and comments regarding the development of these activities (*in italics*) are presented below:

I. Environmental assessment

- Quantification of priority issues identified during the PDF phase, thereby updating and consolidating older data and providing for the forecasting of potential future scenarios within the linked land, water and marine system.

This activity was developed. An assessment of the environmental scenarios related to sediments in the coast and the relationships of the nutrients, fauna and flora were developed. The project evaluated the environmental scenarios related to sediment transport to the coastal zone and the associated influence on nutrients, fauna and flora.

Table 3.4.
Government in kind co-financing Estimation (Source: project coordination)

Activities	Co-financing
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	US \$ millions
Project component	
I- Environmental Assessment of the Basin and its Coastal Zone	483
II - Public and stakeholder participation	265
III - Development of the structural organization	900
IV - Formulation of the Strategic Action Programme for the Integrated Management of the Basin	807
Coordination	82
Sub-total	2,537
Other government projects in the Basin	
Complementary works of São Francisco waterway	1,270
Works of revitalization and recovery of São Francisco River	2,080
Pilot Plan for physical revitalization and environment of São Francisco in Bahia	270
Program called “Our Rivers: São Francisco”	2,044
Conservation and revitalization of São Francisco Basin	1,451
Sub-total	7,114
Total	9,651

- Identification and quantification of the extent to which land-based activities and river regulation in the Rio São Francisco influence hydrology, water quality (especially, sediment and nutrient transport), fisheries and aquatic ecology throughout the system and, especially, in the coastal zone in the vicinity of its estuary.

Land use evaluation of part of the São Francisco River Basin was prepared. Sediment mobilization and the effects of reservoirs and hydrologic variability were evaluated. The climatic variability reflected in the hydrologic series (i.e., the long-term record of flow in the river basin) and the dam trapping of sediments were the main causes of the reduced sediment supply to lower reaches of the river and its estuary. This change had important impacts on the environment and the sustainability of fisheries.

- Provide the quantitative basis for the determination of strategic actions to optimize the multi-purpose utilization of water resources of the basin and the protection and restoration of the coastal zone ecosystems currently adversely affected by land-based activities.

Some activities were developed as a pilot project to educate the population in land conservation and the development of sustainable practices. This activity was successfully developed with stakeholder participation and coordination.

Component II: Public Participation and Stakeholder Involvement

- Mapping at an appropriate scale to determine land ownership and condition and a framework for establishing water use allocation system.

This activity was developed for part of the basin and in pilot studies. The practices developed improved the expertise and knowledge of the technical and research groups in the basin.

- Identification, and establishment, of coordination among individuals and agencies having commercial or institutional responsibilities within the basin, including within the fisheries, navigation, mining and agro-industrial sectors, the public and all levels of government.

The identification of stakeholders and the development of relationships were the first steps taken in order to construct the Basin Committee and the sub-basin and regional committees.

- Demonstration of sustainable agricultural and stream-bank management measures for implementation under community-based land management programs (supported through the World Bank-financed PROAGUA programme that will demonstrate sound soil and water management techniques, appropriate utilization of agro-chemicals, and improved methods of crop management, irrigation design and maintenance of infrastructure such as roads and irrigation ditches).

This activity was partially developed in two pilot studies. Land conservation and community-based management was mainly developed but crop management aspects were not developed.

- Creation of community-based information and training programmes to support community land management programs.

This activity was developed through pilot projects.

Component III: Development of the Structural Organization

- An evaluation of the efficiency of several policy instruments for implementing the Water Law and related state legislation.

These activities were developed in a few sub-projects that support the SFRB Committee and sub-committee in regional areas, the creation of Basin Agency and the mechanisms of water charge for economic sustainability of the system.

- Pilot-scale implementation in order to relate measured improvements in both the rate of water use and the degree of protection of downstream water quality.

A study related to this activity was developed in the Salitre Basin with important results as a pilot demonstration.

- Development of a framework for the implementation of the Law in other sub-basins.

The Water Law instruments were developed in the regionalization of the basin through the sub-committee and in State sub-basins. These activities were well described in project documents.

Component IV: Formulation of the Strategic Action Programme for the Integrated Management of the Basin

- The conduct of workshops and training programs for officials and community leaders and informational campaigns within schools, civic groups and communities.

These activities were successfully developed with a large number of representatives participating in different parts of the basin.

- The convening of two international seminars to facilitate discussion of water resources issues of priority concern as a means of building appreciation for the unitary nature of the São Francisco river hydrological system and related coastal zone.

The project supported regional events such as the Water Resources Symposium in Northeast Brazil in Maceio, which is the main regional event that occurs every two years, and workshops but there is no mention of international events in project documentation.

- The dissemination of the experience gained in the determination and initial implementation of management actions through the professional literature, seminars, public information meetings and training programmes to enhance the transfer of knowledge as encouraged under Chapter 15 of Agenda 21.

The publication of the results of the project in the technical literature is being carried out by researchers and other professionals. The results will be presented at meetings and conferences including the Water Resources Symposium and other events in Brazil. Dissemination of information to the general public has been done through pamphlets, webpages and videos.

- The use of, and support for, the Inter-American Water Resources Network (IWRN) as a means of disseminating information regarding the conduct and findings of this activity.

The results of the project have been presented by the OAS and other professionals in the network meeting and the documents have been distributed through regional professional events.

- The development of a framework to extend and harmonize the existing hydrometeorological data collection network, unifying data gathering objectives and methodologies in order to enhance the dissemination of data and information throughout the basin.

The plan for an updated monitoring network of data collection in the basin was prepared, a metadata information system was developed and the Hidroweb system (Brazilian hydrologic data bank of the ANA) has become the base for hydrologic information on the basin.

3.4.3. Stakeholder Involvement

This project has maintained involvement of relevant stakeholders in most of the sub-projects. The mean rating of the sub-projects was excellent. The main stakeholder commitments to the sub-projects were in:

- The development of the SFRB Committee, sub-basin and regional committees: The Basin committee was established after many public workshops where all stakeholders were represented. The achievement was attained with the involvement and support of State Water and Environment Secretary (commitment from the authorities) and public awareness on water issues in the basin. The regional committees were developed from the SFRB Committee as a means to decentralize the management in a basin of large dimensions (> 600,000 km²). The sub-basin committee was developed based on the State's initiative and preceded the SFRB Federal committee. A major challenge is to integrate the overall basin issues and management with the local view of the State committee which are from small basins. In order to connect the State sub-basin management to the SFRB basin management The following approaches were adopted: (a) Within the project there were sub-projects focusing on these basins and (b) the State Secretaries, other stakeholders from the States were involved in the Federal Basin Management.
- Development of conservation measures through land use mitigation programmes;
- Discussions and the evaluation of impacts in some watersheds; and
- Identification of primary issues, evaluating and proposing components at different levels of basin planning.

3.4.4. Sustainability

The project had a strong commitment from Federal and State agencies, universities, research institutions, some private companies and NGOs. The strong commitment was due to: (a) involvement of high ranking public officials in many steps of the basin Institutional construction. The State Secretaries participated in the Basin Committee. The presidency of the Committee was the Environment Secretary of Minas Gerais who was also the former Ministry of Environment. This was an important asset in the success of the revised institutional arrangements; (b) the State and Federal Research Institution played an important role in donating infra-structure and manpower; (c) NGO and public workers from all levels donated much of their time for many activities in the committee, workshops and other sub-projects.

The project acted as an important catalyst for the involvement of all these institutions in the development of activities. This aspect was rated as “*very good*” as the mean of all sub-projects.

In the region, there were many investments from different sources for sectoral development purposes in energy, agriculture, transport and infrastructure generally or with a specific focus on research and conservation.

The creation of the institutional framework for the Basin Committee and, in the future, the Agency with its funding derived from water use charges will be the basis for the sustainability of the project and the future implementation of the Strategic Action Plan.

Under current conditions, because the Agency and the mechanism for water charges have not yet been implemented the *economic sustainability of the basin* is still weak. It will be developed in the future activities steps of the project, as planned. Nevertheless, even if funding of the follow-on activities were not forthcoming at this stage, the institutional development of the basin and associated plans would be delayed but the institutional process is strong enough to continue.

3.4.5. Scope, Quality and Significance of Project Outputs

The evaluation presented below was developed by taking the main projected outputs of the project document (ProDoc) and providing commentaries about the results obtained (in *italics*).

Component I: Environmental Assessment of the Basin and its Coastal Zone

- An inventory of the aquatic fauna, flora and hydroclimate in the lower SFRB and historic changes in its characteristics.

The studies developed in the lower São Francisco River Basin permitted important knowledge to be gained of the actual conditions, impacts and required mitigation measures for the environment and social sustainability. The study produced good outputs in achieving this objective.

- An evaluation of the environmental impacts of the river on the coastal zone including wetlands, beaches and fish habitat.

The study identified the impacts of climate and dams in the Lower River and coastal zone. The relationships between the physical effects of the reduction of suspended sediments and fish, flora and coastal sustainability have been identified in the project.

- An analysis of floods and the use of artificial floods as a hydrological management mechanism.

During the last decade, mainly following the 1990s, floods have been of small magnitude in the São Francisco River Basin but have significantly decreased the sediment supply to the Lower River and Coastal Zone. This is the result of a combination of hydraulic structure impacts related to dams and climatic variability over a long period. There were some plans to develop artificial floods but some conditions have changed: (a) previous to 2004, the energy production of the São Francisco was at the limit and the reservoirs were almost empty; (b) In 2004, there was a flood that simulated appropriate flood conditions for improving the environment downstream.

- An assessment of different scenarios for reservoir operation to minimize environmental impacts on the estuary and coastal zone.

Several flood conditions were evaluated and the situation that developed in 2004 provided an example of real flood conditions.

Component II: Public Participation and Stakeholder Involvement

- A sound basis for determining land ownership together with a framework for establishing a water use allocation system will contribute to the rational allocation of water and the setting of water charges.

Land-use evaluation was developed for some parts of the basin in order to understand relationships with impacts. In other sub-projects, evaluations of water use, the basis for water use charges and the mechanisms of basin system sustainability were developed.

- Strengthened community-based and governmental initiatives that contribute to the identification of water use and its impact on the hydrology of the system to facilitate implementation of water use charges, including the creation of public, private and public-private partnerships as appropriate.

The creation of the Committee of the São Francisco River Basin, the sub-committees in the regional reaches of the river and the development of a few State committees (mainly in the Upper River Basin) provided an important institutional mechanism for management in the basin through the participation of public, private and social organizations. Further proposed action involves the creation of the basin agency to ensure the sustainability of these mechanisms.

- Pilot-scale demonstration projects to identify methods of stabilizing degraded lands and riparian areas and the promulgation of appropriate remedial measures.

Some projects were developed with public participation in order to improve soil conservation and to address other environmental issues. Activities were developed to improve conditions mainly through preventive measures.

Component III: Development of the Structural Organization

- A framework for the creation of a financially sustainable basin management agency that will contribute to the sustainable use and management of the water resources of the basin, including the integration of environmental and coastal zone concerns into the overall management strategy for the system.

The Strategic Action Plan has, as a priority, the development of the Basin Agency. During this project, some of the important elements for the Agency framework were developed that will help in the creation of this component of the institutional structure for the basin.

- The establishment of an integrated river basin committee consistent with the spirit of Federal Law 9433/07 and, *inter alia*, the Maranhao River sub-basin, for potential extension to the entire SFRB.

The SFRB Committee was created and has developed an important role in the institutional framework for water use management in the basin.

- A framework for the conduct of inter-agency discussions within a multi-purpose basin through the creation of a forum for the interaction of sub-basin committees and water agencies with members of the public and stakeholders participating in the decision-making process.

Sub-basin committees were created and regional discussions have been held on the institutional base of the committee.

Experience with institutional mechanisms for the management of the basin has provided an important lesson to be learnt in the context of the dimensions of the basin and institutional conditions pertaining to a federated state.

Component IV: Formulation of the Strategic Action Programme for the Integrated Management of the Basin

- Meeting and workshop reports

Meetings were convened in Brasilia and in each basin region where the PAD (i.e, the Strategic Action Programme or SAP) was discussed together with many participants drawn from the public and private institutions.

- A compendium of appropriate methods and the means of integrating community-based decision making into the structure and function of the integrated basin management committee proposed to be created under component III.

The creation of Basin Committee and sub-committee in the context of their relationships with the government committees and the legislative regime at federal and State levels has been one of the major challenges in the development of institutional framework. This is an on-going and continuous process that will result in revisions and adjustments over time.

- A regional water information system, including the publication of a magazine for basin-wide distribution to raise awareness, build participation and inform citizen across sectoral lines.

Some actions were taken related to this output: a webpage for the basin; a metadata system that includes all publications of the institutions related to the SFRB, folders, videos and publications that provide information to the public.

- A framework for addressing priority issues inherent in the management of the SFRB.

In the developing the Strategic Action Programme, a chain of causal relationships of issues was developed that provided a guide to the identification of strategies for the basin and specification of required investments.

4. FINDINGS AND CONCLUSIONS

The findings are organized in relation to three major criteria: environmental assessment, water resources management and institutional arrangements.

4.1. Environmental Assessment

- (1) The prevailing belief was that there was a process of desertification in Cabrobó semi-arid region of Pernambuco in Lower Middle of San Francisco. The study carried out under the project showed this not to be the case (Project 2.1).
- (2) One of major issues mentioned by some professionals and members of the population was that saline intrusion of the São Francisco had been increased following dam construction upstream. The project studies showed that this was not true. In fact, the dams decreased the extension of influence of the saline intrusion (Projects 1.1a and 1.1b).
- (3) The knowledge developed regarding sedimentation and erosion processes, nutrient loads and possible mitigation practices to recover the ichthyofauna in the Lower São Francisco was an important finding for the region.
- (4) An evaluation of mining impacts on the water resources in the Velhas River near the Metropolitan Region of Belo Horizonte. This evaluation has supported the discussions and decisions relating to the control of such impacts in the Upper River Basin.
- (5) The development of a water quality index, training the population and creating a cadre of volunteers for evaluating the water quality of the rivers.
- (6) The evaluation of basin land-use, associated changes with time, sediment yields and bed modification together with improved knowledge of hydrologic behavior allowed understanding of the impacts in the lower river and coastal zone. The reduction of sediment loads due to the

combination of hydrologic conditions (low floods in a sequence of years) and reservoir effects reduced the sediment supply to the lower reaches to levels about 10% of those of former years thereby decreasing nutrient loads, increasing coastal erosion and decreasing river turbidity allowing the proliferation of macrophytes in the river.

- (7) The practice of recovering part of the natural vegetation, mainly near the rivers, has been successfully developed in collaboration with NGOs in a pilot project with concrete results (Project 2.2b). Such practice constitutes an important experience to be transferred.

4.2. Water Resource Management

- (8) The contribution of navigation to the development of agricultural competitiveness will facilitate government decision-making.
- (9) The use of models to evaluate the basin behavior taking into account the hydropower and other water uses is an important experience in the synergetic integrated environment assessment which can be used in other basins.
- (10) The impact of water use in agriculture was evaluated together with its efficiency and the value of the water in terms of the production and export of goods. This chain of economic value is an important requirement for decision-making regarding basin development.
- (11) The water resource plan developed in a pilot project (Project 3.3b) constitutes an important resource for the future development of basin management in the SFRB.

4.3. Institutional Arrangements

- (11) Substantial public participation (~12,500 persons) in project activities and in the development of the Strategic Action Plan has been important to validate the decision-making process in the basin.
- (12) Capacity building at different levels has been one of the major assets of the project in the areas of: (a) soil conservation; (b) water quality evaluation; (c) understanding environmental and water resources issues and sustainability; and (d) public participation in committees.
- (13) The development of a proposal for updating the hydrologic system network is a relevant aspect that requires special attention in subsequent project phases because, without reliable information, it would be impossible to develop a sustainable management mechanism.
- (14) The implementation of the São Francisco River Basin committee and its consolidation during recent years has been a most important output from this project. The development of any public participatory process is both complex and lengthy involving the building of trust among the people and resolving conflicts of interest. The following steps are the consolidation of the interactions among the sub-basins, the establishment of regional committees and implementation of the basin agency and the social and economic sustainability.

4.4. Conclusions

The project has achieved success in several aspects relating to environment assessment, water management and institutional arrangements. Some of the main outputs are:

- The development of a project document addressing most of the main issues in the basin. It is very well orientated document that has provided a firm basis for successful development of the project. It should, however, be noted that one important issue was not fully included, namely human sustainability in semi-arid areas outside of the main river of SFRB water supply influence in the sub-basins. In this region, water is the basis of life in economic, social and environmental terms. Population of these sub-basins is very poor mainly because of the lack of water. The reduction of poverty has also a direct link to environment improvement conditions.
- Project management by the leading agencies involved in project execution was very well conducted with good standards being maintained in the preparation of reports, reviewing of products, developing integration, through researchers and technical professionals, of the

various sub-projects and preparing comprehensive documents, folders, videos and other media for providing public information.

- The project has had some very important benefits for the basin community, the federal agencies, ANA and SRH, State administrations and the public, including the following: (a) increased integration among research groups working in the basin in similar or interrelated areas; (b) the promotion of strong interactions among stakeholders in the Basin Committee has allowed improved decision-making, which has been spread to State administrations in the Basin; (c) increased investment of governments through national, state and international funds; (d) education of the population on water management and environmental issues, mitigation measures and participation in decision-making processes at various levels.
- The development of the future steps such as implementation of the Basin Agency, development of Strategic Action Plan, among others are very important in order to assure the sustainability of the results achieved to date. The results already obtained would not be lost if the momentum is lost at this stage but it would delay the achievement of the long term goals.

5. LESSONS LEARNED AND RECOMMENDATIONS

The lesson learned in the project relate to project management, environment assessment, water resource management and the sustainability of management mechanisms. Among the most important are the following:

Project Management

- In the development of this type of project, it is important to promote integration of sub-projects through workshops, specific visits and meetings among a few projects that have a common interest or focus; benefit from the shared use of equipment and laboratories can be significant.
- It is important to recognize that a GEF project such as this has component activities that provide a vehicle for collaboration and interaction with other projects and activities in the basin. This provides increased probability of sustained attention to the basin and the remediation of problems than would otherwise be the case.
- Technical personnel and researchers learned how to work together, develop integrate investigations and prepare reports and other tangible outputs for both improvement of knowledge and public information. The following factors helped to enhance cooperation: (a) sharing equipment, labs, experience and outputs; (b) workshops and exchange visits between the sub-projects; (c) complementary sub-projects in the same regions.

Environment Assessment

- The interrelationships among climatic variability, dam operating conditions and soil use in a basin constitute a complex non-linear combination that can lead the ecosystem to different levels of stress. By understanding the relevant processes, this knowledge that can be used to prepare terms of reference for impact assessments of reservoirs on hydropower development, multiple water uses of the system and to improve process characterizations through modeling.
- The approaches used to disseminate public information on environmental and water resource assessments and mitigation measures provide useful lessons / experience for wider application in the region.

Water Resources Management and Sustainability

- The São Francisco River is a large basin in a federal country with many states. The federal legislation (water law and constitution) together with the State legislation formed the basis for institutional arrangements. However, these legal instruments are not explicit regarding how to

develop the institutional decentralization of basin management through basin committees and agencies. The experience gained in the SFRB project is singular in this respect (see main aspects in annex B) and provides a useful model or example for other countries to construct similar mechanisms. Institutional arrangements are always unique due to the combination of legal, social and economical circumstances but the successes and failures of the Brazilian development process constitute a major asset for development of similar arrangements elsewhere.

- The public participation processes for the development of a Strategic Action Programme provided very good experience in decentralization and stakeholder participation. The development of basin committee was based on (a) workshops in different places of the basin; (b) important commitment of the Federal and State authorities; (c) representative NGOs, research, educational and private institutions and public.
- It is recommended that in the future development of the program the human water sustainability in the semi arid sub-basin should be addressed by the project.

6. OVERALL CONCLUSIONS AND RECOMMENDATIONS

These conclusions present an overall view of planning and activities in the project and its relationship to governance actions in the Water Resource Plan for the SFRB. Below an overview of the national institutional instruments (legislation and Plans), the main elements of the project and its relationship to the Basin Plan and the economic support mechanism are presented.

The main legal instrument for water resource development in Brazil is the Law 9.433 of January 1997. The legislation objectives and framework are based on sustainable development concepts. One of the main instruments of this policy are the Water Plans developed for the Nation, for the States, and for basins. The National and State Plans are mainly for development of the country and regional water policies based on the physical, social and economic characteristics of a given basin. The country developed its first Water Plan in 1998 and is developing an updated Plan inside the Secretariat of Water Resource. Most of the States in the country have not yet developed their State Plans. The River Basin Water Management Plan is the legal document for the implementation of the Water Resource Policy and management at the local level.

The São Francisco River Basin is a Federal River and its committee includes federal representatives and those of states, counties, users and civil society institutions. The basin committee has been created and, during the execution of the GEF project, received more financial support in order to develop actions relating to water management. The construction of a sustainable water resource management regime for the basin is based on the committee, the Agency, implementation of the instruments (water permits, water charges, among others) and decentralization of this process within basins of the size of SFRB.

The actual and prospective scenario is the following:

(a) SFRB has a functioning committee but does not have a Water Agency to implement the instruments and the actions decided in the committee;

(b) The basin is too large to have only one committee and there are two decentralization processes: (b.1) the sub-committees, which have been created (upper, middle and lower basin); (b.2) the State Basin committee (there are only a few State committees, mainly in the Upper Basin, and there are not yet institutional interactions between the Federal Committee and the State Committees;

(c) The Basin is in a transitional stage of institutional development and there is an important need to implement decentralization and to create the Basin Agency.

There are four major projects and studies for the management of the basin, which are strongly inter-related. They are:

DAB – Diagnostic Analysis of the Basin: which developed studies for a diagnostic of the main aspects related water resources and environment in the Basin.

SAP - Strategic Action Programme: This planned some of the main instruments for the Integrated Management System of the Basin.

Decennial Water Resource Plan for São Francisco River Basin (2004-2013): This is the Legal instrument for basin development that takes into account water and conservation conditions.

PPA –2004-2007: Existing development Plans of Federal and States for the SFRB region.

The first two were developed within the GEF project and the other two are instruments of government (see Figure 6.1). DAB was the first experience of an integrated evaluation of the São Francisco River Basin (Brasil, 2004) based on 29 projects and about 12,000 participants in the discussion of results. It had four main components addressing: environment assessment, public participation, institutional framework and development of the Strategic Action Programme. This diagnostic analysis allowed the development of the SAP that was approved in October 2003 by the Basin Committee. In the same meeting the Basin Committee decided to develop the Water Management Plan based on these results.

The SAP is based on two major actions addressing: the Implementation of IWRM (Integrated Water Resource Management); and Use and Conservation in the Basin (the sustainable use of Water Resources and environmental rehabilitation in the basin).

The Terms of Reference for the São Francisco WMP were prepared based on the SAP Strategic Action Programme developed in the GEF project. The latter has as its main goal the development of an agenda for the basin that identifies management actions, programmes, projects, works and priority investments taking into account government institutions, civil society, users and water resource institutions to contribute to the sustainable development of the basin.

This Water Management Plan has the following objectives: (a) Implement the Integrated System Basin Water Resource Management; (b) establish the framework of water distribution and sustainable water use in the basin; (c) establish a framework for revitalization, recovery and conservation of water and environment; (d) develop an action programme of investment for water, land use and sanitation.

GEF projects are planned and developed to cope with sustainable environmental management; they are not planned to be an Institutional Development Water Resource Plan. In the SFRB, the DAB and SAP were developed taking into account the environment aspects and institutional frameworks to support sustainable development and management. The São Francisco Water Management Plan was developed using inputs from the GEF project combined with other essential elements of a WMP (see Figure 6.1).

PPA is the group of investments planned for the region that should be integrated with the Basin WMP. The objectives of PPA for 2004-2007 are related to social and environment issues, public participation and increased population income. It has a total of about US \$ 660 billion in four years where 90% are for demand project (Brasil, 2004). This number is not very realistic as the Federal and State governments do not have the capacity for such a large investment in four years. The main investments of PPA are related to the improvement of water supplies and waste treatment, efficiency of water use in irrigation; and improving human sustainability in the semi-arid region. The Basin Water Management Plan developed the linkage between the action and the planned investments. It is important that, in this phase, the project increases the links between the PPA and the GEF investments.

Some of main conclusions and recommendations related to the framework of activities are:

- The GEF project was the main instrument in the institutional development of the WMP. It was not only important for the purposes of water management but also for environment protection in the basin. The project covers most of the main environmental issues and its funding and organizational structure constituted support for the development of WMP. In that way the DAB and SAP of the GEF project constructed the strategies and policy for the integrated water management plan for the basin.

- The future sustainability of basin water resources development depends on government investment in future phases of the PPA and the GEF project. The PPA investments are more in the direction of human needs and efficiency in water development but with important consequences for the environment, such as increased treatment of municipal wastes and increased efficiency in water use.
- Due to the financial situation and structure of the governments, major portions of the funding in the budget depend on the approval of the Economy Minister. The PPA funds and ANA budget will have limits in the development of basin activities. Because the basin region is one of the poorest in the country and one of the main government policies is to increase investment to improve social indicators, it is likely that funds related to social investments (such as water supply and sanitation) will have less restrictions.
- The long-term sustainability of water management and conservancy will only be attained when the Basin Water Agency is created, decentralized and its instruments implemented. These actions were included in the SAP under Action I (Actions I.1 and I.2). The current phase of the project was well developed and made considerable progress but completion of this action will require a subsequent phase.
- The best practice developed in the project could constitute useful experience for other regions of Brazil and other countries. This includes: (a) the institutional arrangements for the basin committee developed in the SFRB and the role of the IWRM provides experience for other countries to construct similar mechanisms. Institutional arrangements are always unique due to the combination of legal, social and economical circumstances but the successes and failures of the Brazilian development process constitute a major asset for development of similar arrangements elsewhere; (b) Public participation at all levels and decentralization already developed in the construction of the basin committee was a most rewarding experience; (c) The DAB showed the importance of, and the needs for, integrated environmental impact assessment in such large basin and how synergistic interactions between the system and climate variability can affect both the environment and the population.
- ANA has been the institution within which the project has been successful developed. This is a new institution created in 2000. Its directors have a mandate approved by the senate that is not synchronous with political terms. The director who has been in charge during this phase of the project was appointed by the former president Fernando Henrique and his relationship with the government has improved with time. The president of ANA was subsequently appointed as president of another Agency, the “Agência Nacional de Energia Elétrica” (ANEEL) (National Electrical Energy Agency). The new government appointed the new president and a new director of ANA at the beginning of 2005. They are both supporting the continuance of technical and institutional developments that have taken place during the last four years.

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ANNEX A

EVALUATION OF SUB-PROJECTS

The overall rating for the project was “Excellent”, with an achievement rating of 90 – 100%. The project generated a sustainable product that certainly will be utilized by future initiatives in the region. In this annex comments on each of the sub-projects are presented, the numerical ratings are presented in Table 3.2 in the main text of the report. This evaluation was based on the mid-term evaluation and a review of project reports.

1. ENVIRONMENTAL ANALYSIS OF THE BASIN AND COASTAL ZONE

1.1a Hydrodynamic and Sedimentation Study of the lower São Francisco, estuary and adjacent coastline

Planned outputs: Quantify current sediment transport, estimating new sediment transport and the risks of inundation at different levels of flooding, and make recommendations regarding appropriate mitigation measures.

Outputs: The project analyzed the effects of reservoirs and flow regulation on river geomorphology, as well as effects on marginal lagoons and floodable areas and sediment transport in the river channel. Waves and tides were studied in coastline areas near the river mouth. Coastal erosion of riverbanks and beaches and bar formation was also evaluated. The feasibility of producing artificial flooding pulses has been considered based on the known effects of natural flooding to identify the causes of riverbed degradation and material movement. Studies of phytoplankton, zooplankton and ichthyoplankton occurrence and abundance and reservoir construction as a cause for impacts on riverine fauna were subsequently developed in sub-project 1.3.

The sub-project fully achieved its objectives performing excellent research on key issues of concern, not only to the São Francisco basin, but also to other estuaries of large river systems. The project identified the following: (a) the main production of sediments occurs in the Upper and Middle reaches of the basin. Changes in the flood flow together with the presence of reservoirs lead to a major reduction in river sediment supply at the river mouth. This resulted in an important change in the shore morphology due to increased coastal erosion; (b) The project showed that the main cause of erosion of the river banks is the frequent changes in water level differences between the aquifer and the river bank, due to hourly variations of flow releases from the Xingo hydropower plant; (c) Saline intrusion following the construction of the reservoir is limited to a small reach near the coast as a result of upstream flow regulation. This project has important correlations with projects 1.1b and 1.3.

Coordinator: Arno Maschmann – Main Institution: UFAL Federal University of Alagoas.

Mean Project Rating: 1.67

1.1.b Nutrient Levels in the Mouth Region of the SFRB and the Effects of Artificial Flooding

Planned Outputs: (a) To characterize the load and seasonal variation in nutrients at the mouth of the SFRB; (b) To identify the importance of nutrient enrichment in the river on the adjacent oceanic environment; (c) To determinate the importance of artificial floods on nutrient and chlorophyll concentrations; and (d) To relate the obtained results with available fishing statistics.

Outputs: An evaluation was made, based on sampling and measurement, of the problems caused by coastline, estuarine area and river dam modification, especially the behavior of river flooding and its effect on sediment and nutrient transport. Due to the importance of nutrient enrichment of the SFRB on the adjacent oceanic environment, the effect of artificial flooding as a nutrient enhancer has been evaluated taking account of economic and environmental considerations.

LANDSAT images of the São Francisco river mouth region, field campaigns (for ground truthing), tidal elevation time series and surface wind maps were used to study sediment behavior. Results showed that the highest concentration of suspended sediments was found in a continuous band near the coastline in shallow waters (less than 10 meters). Findings also showed that the interior of the São

Francisco river canal, near the mouth, has low sediment concentration and that the sediment concentrations in the region are not directly determined by river discharge. The project demonstrated the great value of satellite data as auxiliary information for the interpretation of field data and in the monitoring of sediment patterns in the region.

Coordinator: Paulo Peter – *Main Institution:* UFAL Federal University of Alagoas.

Project Rating: 2.67

1.1.c Evaluation of the Potential of Navigation for Contributing to Agricultural Competitiveness in the SFRB

Planned Outputs: To analyze waterway navigation integrated to other intermodal transport as a means of raising agricultural competitiveness in the BSF, especially in the eastern and south-eastern regions of Bahia.

Outputs: An evaluation of the economic, social and environmental benefits and effects of inner waterway transport and the activities and services necessary for the comprehensive use of the São Francisco river waterway as a means of distributing regional agricultural produce. The present water needs of the agricultural sector, and future projections, were taken into consideration to define comparative scenarios for the region's multi-modal transport alternatives (both present and potential).

In order to estimate the alternative use economic value, simulations were made of scenarios using modeling that includes various costs (*i.e.*, transport, environmental, fuel, etc.). The study shows that the river is navigable between Pirapora-MG and Petrolina –PE/Juazeiro-BA year round. It estimates dredging requirements at 150,000 to 250,000 m³/year and demonstrates that navigation transport is cheapest and least impacting on the environment. The project is very rich in information. Initial delays occurred but the sub-project constitutes a very good contribution to regional transport and water resource use issues.

Coordinator: Paulo Godoy *Main Institution:* Transport Ministry

Project Rating: 2.56

1.2. Impact of mining on water resources in the Rio das Velhas, (MG)

Planned Outputs: To identify and quantify the impact of mining activities on water quality and quantity in the Alto Rio das Velhas.

Outputs: An integrated environmental diagnosis that identified the environmental interferences with water resources. Various recommendations were made based on a 20-year time span analysis. On a local scale these include: definition of a hydro-geological model for the development of a management plan for the aquifer systems; elaboration of the environmental zoning of Alto Rio das Velhas and Paraopeba basins; and elaboration of a communication, awareness and socio-environmental education program. On a regional scale these include: evaluation of environmental interferences of the principal mining districts on water resources.

This is an excellent sub-project. It is fully completed and represents a substantial contribution to the project. It showed that mining operations do not impact water quantity in the Upper Rio das Velhas Basin. In respect to water quality, although mining is, undeniably, a potential cause for the mobilization of large quantities of sediments, the results show that the control systems used by large companies minimize impacts. The problem occurs in unprotected environmental sites where suitable control methods have not yet been implemented. These include exploration sites, abandoned mines, mines which are inactive or unlicensed, roads and accesses serving the mines in operation, slopes and other mine sites where the stability of the sub-strata and their mobility were not subjected to adequate corrective and control methods. The study demonstrated that both legal and practical mechanisms are available to protect the environment. A special issue of concern is the availability of emergency/contingency plans in the event that failure does occur. The study also emphasized the differences of opinion between communities and the mining companies and the need for increased environmental awareness and involvement of mining companies in the communities.

Coordinator: Elisa Boechat *Main Institution:* IGAM (Environmental Institute of Minas Gerais – “Instituto Mineiro de Meio Ambiente”)

Project Rating: 1.22

1.3. Impacts on Fish Migration in the Middle SFRB

Planned Outputs: To identify economic viability of native species of the Lower São Francisco and to generate additional elements for a repopulation program at Xingó and at a potential reservoir downstream.

Outputs: The sub-project has analyzed the space and time variations occurring in the Xingó hydroelectric power plant reservoir. Severe hydrological changes and consequent changes in limnology have affected the specific composition and diversity of fish communities. Several measures were considered to re-establish fish population levels in the hydroelectric power plant reservoir. Identification and selection of suitable sites has been made. Some of the main conclusions are: (i) the major fishing production decrease is downstream of Xingó; (ii) fishing by local communities is no longer feasible; and (iii) restoration of the fish stock aims to repopulate, recover biodiversity and to develop aquaculture and to restore traditional fishing habits; (iv) Oligotrophic conditions and water transparency increased the development of underwater macrophytes in the flood plains.

Some initial delays occurred; however, the project achieved its objectives. The project shows how fish production in the lower São Francisco has declined over the years. The total production at eight municipalities in the year 1999 declined 12.8% compared to the previous year of 1998.

The development of a repopulation program for Xingó requires additional data collection on fish eggs and larvae and reservoir ichthyofauna.

Coordinator: Fabio C. Branco *Main Institution:* Institute Xingó

Project Rating: 1.44

1.4. Development of a Water Quality Monitoring System for the Sub-Middle SFRB

Planned Outputs: (a) Evaluate the environmental impacts of the agro industrial activities over surface and underground water quality in the Sub-Middle São Francisco basin region; (b) Evaluate the quality in the context of multiple-uses including agro-industrial, forestry and industrial activities; and (c) Define a methodology for monitoring water quality for multiple use purposes.

Outputs: An Environmental Quality Index was devised, incorporating sustainable environmental components together with physiochemical, biological, economic, social and cultural components. This led to the implementation of a water quality monitoring system for the Sub-Middle basin of the SFRB. The water use environmental sustainability index has been applied to 35 hydrographic sub-basins. The ecological, economic and social profiles were measured using sustainable development indicators. Afterwards, a comparative study was made using a human development index versus water use environmental sustainability index. An important element was the volunteer environmental agent formation program for which water quality measurement eco-kits were prepared.

The sub-project achieved good performance in relation to the accomplishment of proposed objectives. The activity produced excellent results, exceeding the expectations initially set for the activity. It obtained excellent recognition in the community. In addition to the monitoring system development, the activity supported other activities, including the capacity development of students and technicians involved in the implementation and operation of other GEF project activities.

Coordinator: Aderaldo Silva *Main Institution:* Embrapa-MA

Project Rating: 1.22

1.5. Impact of Agriculture on Groundwater in Rio Verde/Jacaré's Basin (BA)

Planned Outputs: (a) Establish a pioneering monitoring and data-collection system on unsaturated groundwater zones in areas with intensive irrigated agriculture; and (b) Evaluate impacts on superficial and underground water quantity and quality in the Rio Verde/Jacaré basin.

Outputs: The superficial and underground water availability and uses were evaluated to assess the impact of intensive agriculture on groundwater replenishment and quality. A hydrogeological flux model was developed for the unsaturated zone, its recharge area, the extraction area and other non-recharge areas to determine the optimum water extraction rate for irrigation. The Verde-Jacaré area is a karstic zone in which agriculture began with underground irrigation (10,000 wells). Pesticide contamination was found.

This project was initially very broad and ambitious. Some of the planned activities (such as setting-up a monitoring network for water quality modeling) were not possible due to delays (mainly due to institutional changes in Brasilia). Nevertheless, the project was successful in managing water availability and irrigation needs in the Irece region by using a known “*decision support system for agriculture*” (in Portuguese, this is referred to by the acronym SISDA). The project presents a good basis for future work on the integrated management of groundwater and surface water in the region. The project also created awareness and participation of individuals from university, State Water Agency, public companies, NGOs and several of the water users. The relations established by the Federal University of Bahia and SRH-BA created new joint projects on the Verde/Jacaré region. University staff and consultants discovered new relevant information on the hydrogeological dynamics in the region. Two Master Theses were developed on the subject. Also a chapter of a book “*Coleção Água*” was written and presented in the IV Inter-American Water Dialogue.

Coordinator: Heraldo Silva *Main Institution:* UFBA Federal University of Bahia

Project Rating: 3.5

2. PUBLIC AND INSTITUTIONAL PARTICIPATION

2.1. Determination of Land Use in the Lower-Middle SFRB

Planned Outputs: To determinate soil use and occupation in the Sub-Middle and Lower São Francisco as a basis for water resources management, preservation and environmental monitoring.

Outputs: This activity completed a very detailed physical and socio-economic characterization of the SFRB. The procedure utilized by the activity subdivided land use into 24 classes detected through radar and satellite images and their interpretation. Mapping included 24 thematic maps and an integrated map was presented describing the preserved natural coverage, the spoiled natural coverage, and areas affected by anthropogenic development.

Excellent quality products were obtained on mapping of the different classes of the land use correlated with existing vegetative cover. The project fulfils all proposed objectives. The study shows that the Lower San Francisco sub-region may be characterized as an intensely anthropized area (approximately 65%) but with a low level of environmental degradation. The environmental impacts of excessive land clearing associated with the semiarid climate must be taken into account for the control of erosion processes. Accordingly, a very useful and important project was developed at reduced cost, using and strengthening local capacities.

Coordinator: Rui Junqueira *Main Institution:* CODEVASF Company for Development of São Francisco Valley – “Companhia para o Desenvolvimento do Vale do São Francisco”)

Project Rating: 1.11

2.2.a Partnership to Improve Water Quality in the Ribeirão de São Pedro

Planned Outputs: To improve the Ribeirão de São Pedro’s water quality by means of partnerships with local citizens and the public sector and also by training in conservation practices.

Outputs: All micro-basin pollution sources were analyzed, both those of agricultural origin (*i.e.*, aviculture, livestock, and agriculture) and those resulting from other agro-industrial and urban activities. To exert pollution control, the following activities were carried out: identification of stakeholders, community mobilization and participation; the formation of rural associations, training in water resources and environmental issues, and strengthening municipal councils in respect to rural development.

There were some delays and budgetary difficulties. However, the project achieved public involvement for solving the main problems in the São Pedro river basin relating to lack of soil conservation. The project identified erosion problems on rural roads that have not been adequately planned and managed, degradation of riparian vegetation, intensive agricultural exploitation and lack of systems of control and enforcement. A basin concept has not specifically been taken into account. The products generated are of good quality, mainly in respect to community participation and public awareness of the importance of water quality improvement and conservation when planning road construction. The project recommends land use mapping, monitoring and enforcement, training and the development and implementation of urban and environmental master plans.

Coordinator: Regina Grecco *Main Institution:* CBHPA (Para River Basin Committee – “Comitê da Bacia hidrográfica do rio Pará”)

Project Rating: 2.56

2.2.b Recovering our forests

Planned Outputs: (1) To recover riparian vegetation; and (2) To promote the practice of soil conservation, environmental education; and strengthening of local organizations in the Luz District in the State of Minas Gerais.

Outputs: To fulfill the objective of recovering riparian vegetation, several programs were developed that included: native species production, riparian areas recovery and forest plantation with native hard wood species that create economic incentives for the local farmers. Great effort was made to raise awareness of current soil conservation practices and to develop and implement a programme of building capacity at community level.

The project was successful in the mobilization of, and capacity building in, the Community of Luz through demonstrating the implementation of soil conservation practices, the production of forest species seedlings, the reconstitution of riparian woods and the creation of economically viable forests. The project demonstrated that environmental degradation is evident, especially in small properties, where farmers, lacking capital and knowledge, look for more fertile areas and for lumber in the remaining woods. This project was very interesting especially in demonstrating the great involvement of the community in land environmental education methodology. The use of local knowledge proved very effective. All educational segments, rural class entities, organized community and social and religious groups participated as partners in this innovative sub-project to change deep-rooted attitudes within the population. The project showed the importance of training several actors who were able to further spread their knowledge within the community and showing that education is a continuous process that needs time to achieve behavioral changes. The project developed and applied useful mechanisms to educate people such as visits, scheduled regular consultation meetings, demonstrating and initiating practical procedures, and the creation of a permanent environmental education forum. The project focused well on key issues such as: (i) understanding social and economic realities; (ii) creating opportunities for discussing environmental issues; (iii) presenting solutions; (iv) making possible the development of participatory actions; (v) establishing partnerships with local organizations; and (vi) disseminating acquired data and information.

Coordinator: Francisco Soares *Main Institution:* ASF

Project Rating: 1.11

2.2.c Multi-temporal Analysis of Dynamic Alterations in Riverbed Morphology

Planned Outputs: To verify a methodology capable of identifying the erosive processes that cause morphologic alterations in the riverbed of the SFRB.

Outputs: Sediment production on the Middle reach of the SFRB was analyzed taking into consideration alterations on the region's productive structure that have been taking place since 1950. A multi-temporal study of riverbed morphology was made through satellite imagery analysis and classification, identifying modifications to channel shapes and cross-sections in quantitative and qualitative form. The procedure allowed inter-relating information among critical hydrological events and evaluating the dynamics of river channel morphology.

The multi-temporal analysis demonstrated various changes that have occurred in river morphology such as changes in hydraulic gradient, sedimentation of riverbanks and growth of river islands due to flow reduction and dam construction. It also showed that the river is in the process of adjusting to new hydrologic conditions. The activity had a superb level of achievement and the final report is of excellent quality. It is very well structured and provides very relevant and sophisticated analytical data and conclusions.

Coordinator: Rui Junqueira *Main Institution:* CODEVASF

Project Rating: 1.22

2.4. Study of Bank Erosion Processes and the Relative Effects on River Sediment Dynamics

Planned Outputs: To identify variations that have occurred, their causes, key variables and the main processes taking place in respect to bank erosion dynamics throughout the Lower São Francisco reach.

Outputs: (a) An analysis was made on the historical evolution of the São Francisco river. It focused on the impacts generated by bed aggradations and lateral migration over fluvial channel morphology on irrigated areas of the Districts of Continguiaba – Pindoba. The conclusions were that, prior to the 1960s, sedimentation was predominant but, in the 1970s, there began an erosive process that has been further aggravated in the 1980s and 1990s by dam construction. (b) The environmental impacts caused by large dams were studied, especially the modifications of natural channels. Prior to dam construction, the sand bars were migrating towards the sea. Following construction of the dams, erosion increased downstream, mainly in the lower reaches of the river. It increased the rates of bed change to a new morphologic condition. The reduction in sediment supply following the creation of the dams and the smaller number of flood periods has had an important impact on the coast. The reduction of sediment transport to the river mouth increased rate of marine erosion thereby adversely affecting the coast and its environment and creating social impacts for those living there. The project achieved its planned outputs.

Coordinator: Luiz Carlos Fontes *Main Institution:* Federal University of Sergipe UFS

Project Rating: 1.88

3. DEVELOPMENT OF THE ORGANIZATIONAL STRUCTURE

3.1. Pilot Study on the Implementation of Federal Watershed Policy in the Maranhão River

Planned Outputs: To evaluate the implementation of Federal Law N° 9433/97 and respective State legislation and other instruments of water resources management.

Outputs: Through this activity a geo-referenced database was established as a means of developing the instruments required for proper water resources management. In addition, it also established a programme for mobilizing the population by facilitating public consultation and discussion. The programme focused mainly on topics ranging from social mobilization to environmental education criteria. As a result, it was possible to revise the Water Resources Master Plan in the sub-basin tributaries of the São Francisco River in the State of Minas Gerais. The inventory of water users in the Maranhão Basin was the basis for the adoption of criteria utilized for the implementation of a system of water rights and costs to be adopted in these pilot sub-basins.

The study provides a good overview of water resources in the Maranhão River basin as well as scenario analysis with full implementation of policy instruments of the Water Resources Law 9433 of 1997, specifically the creation of the Basin Agency. The project provided in-depth analysis and good understanding of the quantitative and qualitative aspects of water resources and associated socio-economics, water uses, existing use conflicts and environmental impacts. Several conclusions are applicable to other sub-basins as well as the whole of the São Francisco basin

Coordinator: Elisa Boechat *Main Institution:* Federal University of Sergipe UFS

Project Rating: 2.67

3.2. Combined (conjunctive) Use of Surface and Groundwater

Planned Outputs: To develop, through the implementation of legal water rights criteria, alternative ways of managing the joint use of surface and underground waters in a selected sub-basin.

Outputs: The activity developed a joint system intending to define the hydrological cycle and interactions applicable to the use of groundwater and superficial waters. Geophysical studies were developed for hydro-geological characterization and hydrodynamic parameter identification and characterization as well as for aquifer well tests. As a result of these hydrological and hydro-geological studies, a base discharge definition was made for the rivers and the aquifer refill or replenishment rate determined. Surface and ground water models was used to elaborate a proposal to establish criteria for water rights use and for joint management of superficial and underground water resources in the sub-basin. There was a high level of community participation in this activity. Some of the important project findings were: (a) natural river flow regulation is quite significant due to the aquifer and there is some influence of year-to-year rainfall variations; (b) the area of the aquifer differs both in size and location to the surface water basin and the aquifer flows to Tocantins some 20 km beyond its spatial limit; (c) the basin water yields are strongly dependent on the groundwater and this has been reflected in the conditions established for the issuance of water permits in the region.

A complete monitoring network was initially planned. Due to financial limitations only some wells were constructed. They provided, however, very valuable new knowledge on the hydro-geological characteristics of the Urucuia region. In addition (but not planned), surface water quantity and quality studies were performed by other States institutions. Studies with radioactive isotopes were not performed because of incompatibility with the chemical conditions of the water in the region. The study gave a whole new perspective on the dynamics of surface and groundwater. Future procedures on water rights will need to be re-evaluated given the new data provided by the project. All project objectives were achieved.

Coordinator: Katia Nascimento *Main Institution:* SRH –BA (Secretary of Water Resources – Bahia)

Project Rating: 2.33

3.3.a Capacity Building and Environmental Education for Organizations Participating in Water Resources Management

Planned Outputs: (a) Evaluate and develop a methodology to create and train User Councils for participatory management of small dams; (b) Provide training for multiplier agents (train the trainers approach) in environmental education activities; (c) Capacity building on multiple and rational use of small dams; (4) Capacity building of farmers for adequate soil recovery and management.

Outputs: Among instruments of efficient management of water resources, an important role is assumed by collegiate organizations of users. It must be emphasized that the results obtained are from areas in Serra Talhada, Pernambuco, where participatory procedures have been installed. Stakeholders from both upstream and downstream of the basin have participated. The activities included training in soil conservation, environmental concerns, management, etc., for members of the Council representing water users.

Initial delays occurred but the project successfully identified problems related to water allocation, water management, excessive losses (specially through irrigation), lack of information on the interactions between river and aquifer, lack of institutional articulation between federal and state policies, lack of education and communication channels, poor exchange of information between the scientific and lay communities. The project proposed to put into practice the water and environmental federal legislation at state and municipal level, intensify enforcement, implement a water user database, implement a water rights system, perform studies on efficient irrigation scheduling and operational criteria for reservoir operation, promote education of water users and ensuring technology and information transfer to water users.

Coordinator: Paulo Dutra *Main Institution:* SRH –PE (Secretary of Water Resources – Pernambuco)

*Project Rating :*3.0

3.3.b Integrated Management Plan for the Rio Salitre Basin. (BA)

Planned Outputs: To elaborate and implement the Rio Salitre Basin Management Plan, using a participative process as a pilot project to be applied to other sub-basins of the SFR.

Outputs: A matrix of water use problems for was prepared taking into account the relationship between water resources availability and demand. A huge effort was devoted to the organization, participation and mobilization of local communities. As an important result, the Salitre River Committee has been established and training activities carried out for the members of this Committee. Another important goal was the elaboration of a set of criteria to define the regime of water use based on legal and institutional considerations. Both actions conducted by a Water Management Plan in the Salitre River. An Association of users of the Salitre River was created, in nine districts within the basin. A technical office was created to implement the decisions of the association and a special training program was held in water quality monitoring and water resources management.

The study confirmed existing water conflicts due to lack of rain, increased population and economic growth. An integrated management plan was developed that addresses all sectors that degrade, or have the potential to degrade, the environment. The plan recommends a series of actions to address these issues.

Coordinator: Yvonilde Medeiros *Main Institution:* UFBA – (Universidade Federal da Bahia)

Project Rating: 1.11

3.4. – Support to SFRB Committee Creation, including the Official Establishment of the SFR Basin Committee.

This project was included in activity 3.5 and was successfully completed.

3.5. Strengthening the Water Basin Committee in the SFRB

Planned Outputs: (1) To provide capacity building for the SFRB Committee for the purposes of ensuring the accomplishment of its mandates as per Law N° 9433/97; and (2) To practice water resources management in a decentralized and participatory manner based on well-established guidelines.

Outputs The Committee of the São Francisco Basin had been established by Presidential Decree of June 05, 2001. This sub-project developed a sequence of meetings and other forms of community participation that finally resulted in an elective process to select committee members.

The project achieved significant results involving a wide range of water user representatives. There were 39 regional meetings involving 6000 participants from the whole basin, 27 state meetings involving 940 participants and also a meeting with the 26 Indian communities. The CBH-SF reflects the anxieties, concerns and expectations of 500 municipalities in 7 states with an approximate total population of 16 million. The Transboundary Diagnostic Analysis (TDA) and the Strategic Action Programme (SAP) will be very valuable for the CBH-SF to learn more of the environmental, social, political and economic aspects of the basin and to prioritize strategic actions for the basin. Projects related to institutional buildup, technical capacitating, and financial sustainability are recommended. A technical office is required to implement the instruments of the National Water Resources Policy, including the establishment and implementation of water rights, water charges, information systems, legal arrangements and, finally, the establishment of the Basin Agency.

Coordinator: Rodrigo Flecha *Main Institution:* ANA - (Brazilian Water Agency – “Agência Nacional da Água”)

Project Rating: 2.44

4. FORMULATION OF THE BASIN MANAGEMENT PROGRAM

4.1. Promotion of Public Participation in SFRB Management

Planned output : This activity was planned based on the following intended outputs: (a) development of the webpage for the São Francisco Basin; (b) promotion of workshops and seminars; and (c) publication of educational texts and videos.

Outputs: The São Francisco River Basin Committee webpage was developed (in Portuguese, English and Spanish) (the address is www.cbhsaofrancisco.org.br). The information derived from the sub-projects and other studies were included in this page. We witnessed the use of the page in a school near Petrolina during the visit to the project. During a few months in 2003, the statistics showed a consultation rate of 1460 per month; 75% from Brazil and 22% from the USA. The project also supported the VI Northeast Symposium on Water Resource held in Maceio, Alagoas, in the period 4 to 6 December 2002. The event main subject was Environmental sustainability and included a total of 187 papers and 493 participants.

In addition, the project produced: (a) educational texts such as: *São Francisco River* with 10,000 copies for distribution among the population and potential members of the committees; (b) a description of São Francisco project in Portuguese and English with 5,000 copies; and (c) a video/CD about the São Francisco River in 250 copies.

Coordinator: José Luiz de Souza *Main Institution*: ANA (Brazilian Water Agency – “Agência Nacional da Água”)

Project Rate: 1.44

4.2. Evaluation of Economic Instruments for Sustainable Watershed Management of the Verde Grande – MG/BA

Planned Outputs: To produce a detailed overview of the economic instruments used for water resources management procedures, including proposals on legislation and strengthening the administrative mechanisms necessary to implement those instruments in the Verde Grande Basin.

Outputs: The basin is under water use stress because the unregulated demand from agriculture is creating conflicts. The risk of failure of the water supply for agriculture is high and there are some river reaches where the water quality is in poor conditions due to the lack of treatment of domestic waste from cities, such as Montes Claros. In addition, pesticides from agricultural uses were detected in the water.

The criteria for water use were analyzed based on the Master Plan of Water Resources of the river Verde Grande basin to establish a monitoring procedures and take account of consumption and effluent releases.

Economic aspects of collection for water uses and feasibility was taken into account for determining the criteria to be implemented. This includes the evaluation of the impact of collection over diverse kinds of users, taking into account their ability to pay. The study evaluated the finances required for the administration of the system (committee and Agency) to enforce water permits and the collection of funds for the management of water uses and impacts.

Coordinator: Devanir G. Santos *Main institution* : ANA (Brazilian Water Agency – “Agência Nacional da Água”)

Project Rating: 2.44

4.3 Needs Assessment for Quantitative Evaluation of Water Use and Use Conflicts in the SFRB

Planned Outputs: (a) Characterize water use by public and private sectors as well as the efficiency of this use aiming to increase water resources availability; and (b) Determine the volume of water exported from the basin expressed as agricultural products.

Outputs: Based on the São Francisco River hydrological data of the last 50 years (1950-1999), water use was quantified and water use efficiency was calculated for specific sites of the basin. Several

technical procedures were taken into account to improve efficiency in different irrigation systems. A large amount of water is “exported” as agricultural goods and technical recommendations have therefore been made to increase the availability of water resources in the basin.

This project was very challenging due to its breadth. Nevertheless, the results are very useful and of excellent quality. All project objectives were fully achieved. The project performed the characterization of agricultural water usage, including efficiency, in the São Francisco river basin. The study shows that, although irrigation has not yet a great impact on the water resources in the basin (exception made to the Verde Grande sub-basin), there is considerable potential for future conflicts in respect to water quality and quantity. The study shows other areas where potential conflicts are also evident (e.g., the Paracatu and Verde Grande basins) in which more detailed studies are recommended. The project recommends updating the water users database; performing a detail analysis of the hydrologic regime; performing soil surveys (for adequate irrigation management); evaluating the impacts of human activities on the hydrologic regime; developing models for multiple water uses; and further developing and implementing training and capacity building programmes for irrigators.

Coordinator: Marcio Mota *Main institution :* UFV (Federal University of Viçosa)

Project Rating: 1.67

4.4. Determination of the Operational Policies for Major Reservoirs in the SFRB

Planned Outputs: To examine operational policies of the main SFRB reservoirs using hydrological data collected in activity 1.1 with the aim of developing a structure for the implementation of operational procedures for multiple use reservoirs.

Outputs: As a part of alternative studies for multiple water uses in the São Francisco basin, the activity contributed to the elaboration of an alternative methodologies for the operation of reservoirs for benefitting multiple uses.

The aim of this project was to present alternatives for operational models of the reservoirs in the San Francisco River taking into account the goal of multiple water use. This very important project will provide great support to the Basin Committees in the allocation of water among the various uses, thus implementing a new approach for integrated water management and sustainable development in the basin. The study demonstrated that hydroelectric power generation, irrigation, navigation, and, in some stretches, flood control, are the main uses. However, hydropower generation and irrigation (including consumptive uses) are the most competitive. The project analyzed in considerable detail the current models used in the operation of the hydropower system in the San Francisco River Basin by the National Operator of the Electrical System (ONS). The models analyzed were those used in the Brazilian Energy system for planning and programming of the whole Brazilian electric system. The project proposed a review of the current operational criteria and demand estimation. The study suggests a new methodology based on the application of non-linear programming (objective function only), that is, using a non-linear objective function (to maximize power requirements) and linear constraints to ensure that other uses are satisfied. The problem is solved (for a 12 month period) on an Excel spreadsheet by successive approximations. The project recommends further development, refinement and implementation of simulation and optimization models for multipurpose operation of the San Francisco’s reservoirs.

Coordinator: Marcos Freitas *Main institution :* ANA (Brazilian Water Agency – “Agência Nacional da Água”)

Project Rating: 1.8

4.5. Formation of an Integrated Basin and Coastal Zone Management Program

Planned Outputs: To identify and harmonize the development of measures in the SFRB and its adjacent coastline and promote rational and strategic integration of these measures for sustainable development in this region.

Outputs: Development of the TDA and SAP. The main sources of problems were evaluated through the use of Causal Chain analysis. Basic sources were identified as those relating to pollution (agricultural or mining-industrial sources); land degradation and desertification; processes originated in the cascade of dams and reservoirs, affecting fish reproduction; changes in fluvial flow (lamination), sediment trapping, aggradations, bank erosion, etc. The principal conflicts were considered as trends in land use and the operational conflicts related with multiple water uses. An evaluation of the root causes was carried out. Basically, these were identified as insufficient volume of water for multiple purposes, lack of planning in use of water (both superficial water and groundwater), changes in land use and inadequate use of soils, sources of pollution, ecosystem degradation and diminishing biodiversity, conflicts in water uses, restrictions on navigation and a lack of institutional mechanisms. Taking into account the objective of sustainable development, the activity prepared an Integrated Managing Program for the São Francisco Basin that includes the activities of coastal zone management, fisheries management, navigation and water resource management, including operational policies for large reservoirs. A very important aspect of this activity was public participation. Taking into account the importance of integration and stakeholder participation, the impact of local community participation in decision-making was also analysed.

Coordinator: Marcos Freitas *Main institution:* ANA (Brazilian Water Agency – “Agência Nacional da Água”)

Project Rating: 2.17

4.6. Public Participation Events in Support of the Preparation of the Strategic Action Programme for the Management of the SFRB

Planned Outputs: Discussion with professionals and stakeholders about water resource evaluation and mitigation measures for environmental problems in the Rio São Francisco Watershed.

Outputs: This Strategic Action Programme was developed based on participation by about 12,000 participants (33% from NGOs and the public) and 404 institutions (51% NGOs and private institutions) through 217 workshop events. The consultation workshops were held in Brasilia and in the four regions of the basin. From the events came 134 recommendations (67 for each component of the SAP). These events support completion of the final version of the SAP.

Coordinator: Antonio Felix Domigues. *Main institution:* ANA (Brazilian Water Agency)

Project Rating: 1.67

4.7.a Proposal for Complementing the SFRB Hydrometeorological Network

Planned Outputs: To propose the optimization of the hydrometeorological and hydro-geological information gathering network of the SFRB.

Outputs The study developed an evaluation of the existing network of hydrologic gauges and information, identified project parameters, presented a proposal for an updated version of the existing network, taking into account the main basin uses and impacts, and developed a proposal for the SAP. In the evaluation of the existing network, the project identified: spatial limitations of the rainfall coverage in the downstream reaches of the river basin; a lack of reliable information about some important variables such as evaporation and evapotranspiration; lack of flow gauges and discharge records in the downstream sub-basins; and limitations in information on sediment transport and water quality. The plan developed to update the network is based on the installation and modernization of 674 stations in the basin.

Coordinator: Augusto Franco M. Bragança *Main institution:* ANA (Brazilian Water Agency)

Project Rating: 1.88

4.7.b Proposal for a Piezometric Monitoring Network in the Verde Grande River sub-basin

Planned Outputs: The activity reviews the actions required for proposing a piezometric monitoring network that will provide improved knowledge of the availability of groundwater resources in the basin.

Outputs: This project includes a piezometric monitoring network plan, with objectives, basic procedures, locations, equipment, data reception and other specifications. It also includes the guidelines for the creation of an information system, including a complementary hydrologic data collection system.

The outcome of this activity consists of a “*Plan for a Piezometric Monitoring Network of the Rio Verde Grande Sub-Basin*”. The project initially gathered and analyzed available documentation on physiographical, hydrological, geological and hydro-geological aspects of the area. The second stage consisted of field reconnaissance including identification of suitable sites for monitoring wells. Based on hydrogeological characteristics, a series of criteria were defined to aid in the identification of target locations. These included: areas with greater concentration of wells for agricultural purposes, adequate production discharges, recharge characteristics; unexploited wells, construction characteristics of existing wells, hydro-geological characteristics; legal conditions (permits) and the willingness of the owners to participate and cooperate in the monitoring programme. Fifteen (15) target areas were selected for guiding field work with the aim of defining the final network of control points. Field data forms were also created.

Coordinator: Fernando Dantas *Main institution:* ANA (Brazilian Water Agency)

Project Rating: 2.66

4.7.c Metadata-based Information Reference System

Planned Outputs: To develop a hydrological information system, based on metadata gathered from representatives of the basin data users linked through an information system.

Outputs: The results were: (a) organize and compile a data bank of references, information and studies about the São Francisco River Basin held in public and private institutions; (b) develop a mechanism for searching information and stimulating the involvement of users; and (c) transfer the system to the public and organizations in the basin.

The software was developed based on an existing product developed for Guanabara bay. The system can be visited at the site www.risf.ana.gov.br. Some institutions were selected to evaluate the information and documents to be listed in the system. A total of 1400 items were initially listed and inserted in the system. Some personnel from institutions were trained in the use of the system. This product requires continuous updating and further participatory development under the aegis of the Basin Committee and agency.

Coordinator: Augusto Franco M. Bragança *Main institution:* ANA (Brazilian Water Agency)

Project Rating: 2.0

4.7.d Decision Support System

Planned Outputs: To provide UNEP/GEF São Francisco Project a computation environment capable of satisfying the project's needs.

Outputs: The activity was organized into planning, execution and management. The outputs were: (a) software for project administration with inputs from different locations of the country; (b) training of professionals; and (d) the supply of information for inclusion in the system.

Coordinator: José Luiz de Souza - *Main Institution:* ANA (Brazilian Water Agency)

Project Rating: 2.0

ANNEX B

SFRB BASIN COMMITTEE

The implementation and management of a basin committee of such large basin is a challenge. In many countries this committee would cover many countries. Brazil is a Federative Country and it covers many States. In the Water Law a basin which covers more than one State, the basin is a Federal Basin, regulated by Federal legislations.

The basin committee has 60 members and its distribution is:

- (a) Five members from Federal Govern;
- (b) Seven members from the State governs (one for each State, including Federal District);
- (c) 8 member from counties (distributed based on the States size);
- (d) 24 member from water users distributed by the type of users: six from water supply and sanitation; five for industry; six for irrigation; 2 for navigation; 3 for fishing and tourism; 2 for hydropower;
- (e) 16 for Social Civil organizations: 2 for inter-counties institutions; 5 for technical, research and teaching institutions; 8 for NGO's and 1 for Indian Institutions.

There are some important aspects to be learned from this institutional arrangement: (a) decentralization; (b) commitment from the members; (c) participation of multi stakeholders in decision process.

Due to the size of the basin there is a decentralization institution process through:

- (a) sub-committee by portion of the Basin and
- (b) State basin committee.

It is a complex institution constructions and the experience of the project is an important lesson to be learned from it.

The success of the institutional arrangement development has been the commitment from govern officials (State secretaries, county major and from State and Federal main organization) NGO's and water users in discussing and decided on the basin studies, actions and proposal through many regional workshops and meetings.

The sequence of the events distributed for regions, the meeting discussion and decision process in order to construction the Basin committee outputs has been an interesting asset from the project.

Additional informations about the Basin is in the site: www.cbhsaofrancisco.org.br

ANNEX C CO-FINANCING AND LEVERAGED RESOURCES

Co financing (Type/Source)	IAown Financing (US\$)		Government (US\$)		EA*1 (US\$)		Other*2 (WBLloan)*3 (US\$)		Totalco-financing(X) (US\$)		TotalGEFGrant Disbursement(Y) (US\$)		GRANDTOTAL (x+y)	
	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual	Planned	Actual
Grants											4,771,000	4,771,000		
Loans / Concessional (compared to market rate)							8,625,000		8,625,000					
Credits														
Equity investments														
In-kind support	175,000	397,624	8,543,000	9,651,656	100,000				8,818,000	10,049,280				
Other (*)														
Totals	175,000	397,624	8,543,000	9,651,656	100,000		8,625,000		17,443,000	10,049,280	4,771,000	4,771,000	22,214,000	14,820,280

* 2 - Other is referred to contributions mobilized for the project from other multilateral agencies, bilateral development cooperation agencies, NGOs, the private sector and beneficiaries.

* 3 - Proagua loan of USD 8,625,00 has been cancelled

* 1- Missing OAS actual level of co-financing

ANNEX D TERMINAL EVALUATION TERMS OF REFERENCE

TERMS OF REFERENCE FOR THE TERMINAL EVALUATION OF THE SAO FRANCISCO (GF/1100-99-14)

1. Background

In accordance with UNEP/GEF policy, either mid way through the execution of the project or upon completion and before requesting any further GEF assistance, all GEF projects are subject to a terminal evaluation by external evaluator(s) contracted by UNEP. Accordingly, the Sao Francisco (GF/1100-99-14) is subject to a terminal evaluation.

Sao Francisco

In 1996, the Secretariat of Water Resources under the Ministry of Environment of Brazil, requested the United Nations Environment Programme (UNEP) for GEF (Global Environment Facility) assistance in the preparation of a water resources management programme for the Sao Francisco Basin. Initial funds provided by GEF through a PDF Block B Grant (US\$ 341,000 – October 1997 – June 1998) helped prepare a project proposal for improving water resources management of the Sao Francisco Basin. In July 1999, the GEF approved grant funds to the value of US\$4,771,000 for enhancing and restoring the environmental functioning of the Sao Francisco Basin and its Coastal zone (GF/1100-99-14). This project has been under execution since September 1999 and should terminate in December 2004. The Organization of American States has been designated as the agency for the coordination of the execution of the project. Since its formation in December 2000, ANA (the Brazilian Water Agency under the Ministry of Environment) has been taking over, from the Secretariat of Water Resources, the responsibility for the national coordination of the execution of the project. Further, the Sao Francisco project has been subject to a mid-term evaluation in 2002/2003.

2. Legislative Mandate

This project meets the objectives of the GEF Operational Program #10 International Waters Land-based Activities Demonstration Project component (paragraph 10.13). The project actions are consistent with the GEF principle of linking project elements with major cross-cutting issues such as land degradation, and with the UNEP Environmentally Sound Management of Inland Waters (EMINWA) integrated watershed management planning process and related, regional seas programme. The proposed actions are also consistent with UNEP's role under the GPA. More specifically since its inception the project has been supporting UNEP's programme of work and its subprogramme of work related to the sustainable management and use of natural resources caring for freshwater, coastal and marine resources.

3. Objective and Scope of the Evaluation

The terminal evaluations will specifically look at main findings, key lessons and best practices to be used for future projects in the country, in the region and for the UNEP, OAS and the GEF.

The scope of this evaluation will cover all key activities undertaken in the framework of the project. The evaluator will compare planned outputs of the project to actual outputs and assess the actual results to determine their contribution to the attainment of the project objectives. The Evaluation will diagnose problems if any and suggest necessary corrections and adjustments. It will evaluate the efficiency of the project management, including delivery of outputs and activities in terms of quality, quantity, timeliness and cost efficiency. The evaluation will also determine the likely impact of the projects.

The Evaluation will highlight lessons learned and best practices thus far from the implementation of the project that would improve the future work in the basin and assess the appropriateness of these projects in meeting the long-term objectives of the GEF.

In this regard, the Evaluation should assess the extent to which (1) sources of environmental stress in the basin have been adequately addressed through project activities, (2) mechanisms for joint management of the basin have been put in place or strengthened through execution of the project, and (3) there has been a change in environmental state as a consequence of the projects intervention.

4. Terms of reference

In particular but not restricted to, the evaluator shall;

1. Assess the overall relevance and appropriateness of the project objectives in relation with UNEP's mandate, and its programme of work objectives. In case the projects objectives have been modified, assess appropriateness of such modifications;
2. Evaluate how, and to what extent, the stated project objectives and global environmental objectives have been met so far; taking into account achievement indicators;
3. Assess the scope, quality and significance of the project outputs produced so far in relation to its expected results. In case the project outputs have been modified, assess appropriateness of such modifications;
4. Ascertain to what extent the project implementation benefited from relevant ongoing and past research and operational activities of the country, the scientific community, the GEF, UNEP and the OAS, and indicate how such potential synergies may have been realized defining the extent to which lessons learned, best practices and experiences from these activities have been cross-pollinating the Sao Francisco project;
5. Determine the extent of collaboration of the project with other relevant initiatives in the region;
6. Determine the usefulness of the project outputs for follow-up in terms of national level of action and determine the level of sustainability;
7. Determine how this project has helped and will continue to help improve planning within the basin and riparian countries and the extent to which said improvements are sustainable;
8. Delineate the project's actual and potential contributions to strengthening national and regional policy frameworks and action plans;
9. Assess how the governments are utilizing experience and information gained through this project;

10. Ascertain the nature and significance of the contribution, both potential and actual, of the project outcomes to the wider portfolio of GEF International Waters Projects;
11. Assess the extent to which the project has met the GEF criteria relating to (1) value as a demonstration project; (2) the extent to which results could be transferred outside the environmental, social and economic context of the Basins; (3) stakeholder participation in execution of project activities in determining the level of stakeholder involvement and participation in project activities; (4) dissemination of information to the wider public in the riparian countries, and (5) degree of country ownership/drivenness;
12. Assess the project adaptability to political and institutional changes as appropriate;
13. Evaluate project management with a view to deriving lessons learned for the benefit of future GEF projects. The evaluation should make specific reference to:
 - The effectiveness of institutional arrangements in project management and execution between the various agencies and institutions (UNEP, OAS, local executing agencies, Government and non Government institutions);
 - Evaluate the effectiveness of project management in terms of assignment and execution of project activities by the staff paid through the GEF contribution;
 - The effectiveness of the monitoring mechanisms employed throughout the project's lifetime;
 - Identify administrative, operational and/or technical problems and constraints that influenced the effective implementation of the project and present recommendations for operational changes;
 - Evaluate, in broad terms, the financial management of the project, including efficiency of disbursements, expenditures on administrative and overhead charges as distinguished from that on substantive outputs, and;
 - Assess the level of co-financing realized so far, both cash and in-kind, evaluate the actual co-financing level against the originally envisaged level, and evaluate the need to acquire more co-financing funds.
14. Provide recommendations to UNEP and ascertain the need for further GEF support and assess the sustainability arrangements of the project as appropriate.

5. Evaluation methodology

The evaluation will be conducted by using a participatory approach where by the Task Manager and other relevant staff is kept informed and regularly consulted throughout the evaluation.

The following are the main approaches for collecting and analyzing data:

- a) Desk review of project documents, outputs, monitoring reports and relevant correspondence;
- b) Specific review of (1) TDAs & SAPs, (2) Basin Institutional arrangements/tools with a view to identify best experiences and practices to be replicated elsewhere.
- c) Interviews with project Stakeholders (Technical Units, UNEP-OAS, main representative of the local executing bodies, local government entities, NGOs, academia...) as appropriate.

6. Evaluation Reporting Format

The overall evaluation report will not exceed 35 pages without annexes. The report together with annexes will be written in English and be presented in electronic form in MS word format.

The report outline will be composed of;

- (1) a concise executive summary, not exceeding five pages,
- (2) introduction and background,
- (3) scope, objective and methodology of evaluation,
- (4) findings and conclusions,
- (5) lessons learned ^a, &
- (6) recommendations.

As per the GEF Secretariat guidelines and to allow consistency across all IAs, evaluations will include ratings on the following aspects:

1. Timeliness: how the project met the schedule and implementation timetable cited in the project document and later revisions thereof.
2. Achievement of results/objectives (the extent to which the project's environmental and development objectives were achieved)
3. Attainment of outputs
4. Completion of activities
5. Project executed within budget
6. Impact created by the project
7. Sustainability
8. Stakeholder participation/Public Involvement
9. Monitoring & Evaluation

^a The lessons learned and best practices reported by the evaluator will subsequently be fed into UNEP/GEF Best Practices Database

Each of the items should be rated separately. The following rating system is to be applied:

1=Excellent	(90% - 100% achievement)
2=Very Good	(75%-89%)
3=Good	(60%-74%)
4=Satisfactory	(50%-59%)
5=Unsatisfactory	(49% and below)

The rating will be converted in a separate annex to the GEF rating system of: Highly satisfactory (80%-100%), Satisfactory (65%-79%), Marginally Satisfactory (50%-64%), Unsatisfactory (49% and below), N/A.

The ratings will be substantiated providing ample justification.

7. Outputs of the evaluation

The outputs of the evaluation will be an evaluation report to UNEP. This report will discuss best practices and lessons learned and will feed into the UNEP-GEF best practice database.

Although an electronic version of the final evaluation report will reach UNEP no later than 31 January 2005, Mr Tucci will send his final Sao Francisco report to the Team Leader and UNEP by 31 December 2004 as per the below detailed schedules in Annex I, II and II, with copies as follows to:

Mr. Norgbey Segbedzi
Chief, Evaluation and Oversight
UNEP
P.O. Box 30552
Nairobi
Email: segbedzi.norgbey@unep.org

With a copy to

Ms Anna Karen Regenass.
Monitoring and Evaluation Officer
Division of GEF Coordination
UNEP
P.O. Box 30552
Nairobi
Fax: 254 2 623162
Email: anna-karen.regenass@unep.org

And

To Isabelle Vanderbeck
Task Manager
UNEP
P.O. Box 30552
Nairobi
Fax: 254 2 622798
Email:isabelle.vanderbeck@unep.org

8. Schedule of Evaluation

Under the overall supervision of the Evaluation and Oversight Unit (EOU); the overall guidance of the Monitoring & Evaluation Officer of the GEF Division and direct supervision of the GEF IW LAC Projects Task Manager within UNEP, the evaluator shall undertake, in close consultation and cooperation with the Team Leader of the said Evaluation, the terminal

evaluation of the project GF/1100-99-14 (Sao Francisco) during the period October 2004 to December 2004 (*one month spread over 3 months*).

The evaluation should commence on 04 October 2004. The evaluators shall meet in Brasilia on 04-05 October 2004 for a kick-off meeting between the team leader, the evaluators, UNEP (Task Manager) and OAS. Thereafter, the evaluators will travel to their respective project locations and interview the project stakeholders. Details of the evaluation schedules are appended in Annex I. The contract of the evaluator will be for one month spread over three months and the evaluation will be completed by 31 December 2004. A draft of the report should be sent to UNEP, addressed to Mr Norgbey with a copy to Ms Regenass & Ms Vanderbeck, by 15 November 2004. Comments on the draft report will be provided to the evaluators within 10 days prior to final submission of the report.

10. Schedule of payment

Due to the travel involved, the evaluator will receive an initial payment of equivalent to the lumpsum travel upon signature of the contract. Upon submission of the first draft report 50 % of the fee will be paid with the final payment made upon satisfactory completion of work. The fee is payable under the individual SSAs of the evaluators and is inclusive of all expenses such as travel, accommodation and incidental expenses.

The evaluators will make their own travel and insurance (medical, travel, baggage, etc.) arrangements according to the work schedule and travel itinerary provided in Annex I.

In case, the evaluator cannot provide the products in accordance with the TORs, the timeframe agreed, or his products are sub-standard, the payment to the evaluator could be withheld, until such a time the products are modified to meet UNEP's standard. In case, the evaluator fails to submit a satisfactory final product to UNEP, the product prepared by the evaluator may not constitute the evaluation report.