

GOVERNO DO ESTADO



CEARÁ
AVANÇANDO NAS MUDANÇAS

GOVERNO DO ESTADO DO CEARÁ
SECRETARIA DOS RECURSOS HÍDRICOS - SRH
SECRETARIA DE DESENVOLVIMENTO URBANO SDU
PROJETO DE DESENVOLVIMENTO, URBANO E GESTÃO DOS
RECURSOS HÍDRICOS PROURB CE
BANCO DO ESTADO DO CEARÁ BEC

AÇUDE PÚBLICO CASTRO

TOMO 3 ESTUDO DE IMPACTO AMBIENTAL

VOLUME III SÍNTESE EM INGLÊS

AGUASOLOS
CONSULTORIA DE ENGENHARIA LTDA

FORTALEZA- CE
OUTUBRO 1993



GOVERNO DO ESTADO DO CEARÁ
PROJETO DE DESENVOLVIMENTO URBANO
PRO-URB / CE

AÇUDE PÚBLICO CASTRO
TOMO 3: ESTUDO DE IMPACTO AMBIENTAL
SÍNTESE - INGLÊS



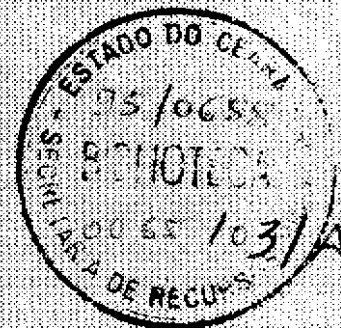
Lois. 00473 - Prep (X) Scan (X) Index ()
Projeto Nº 0065/03/A
Volume 1
Qtd. A4 19 folhas Qtd. A3 _____
Qtd. A2 _____ Qtd. A1 _____
Qtd. A0 _____ Outros _____

/03/A

SRH - SECRETARIA DE RECURSOS HÍDRICOS

AÇUDE PÚBLICO CASTRO

SÍNTESE INGLÉS



000003

CEARA

CEARA STATE GOVERNMENT

SECRETARIAT OF URBAN DEVELOPMENT AND ENVIRONMENT - SDU

SECRETARIAT WATER RESOURCES - SRH

CEARA STATE BANK - BEC

URBAN DEVELOPMENT AND WATER RESOURCES MANAGEMENT PROJECT

PROURB-CE

**CASTRO PUBLIC RESERVOIR
ENVIRONMENTAL IMPACT STUDY
SUMMARY**

DECEMBER 1993

000004

CONTENTS

| | |
|--|-----------|
| A. INTRODUCTION | 01 |
| B. PRESENTATION | 03 |
| C. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK | 03 |
| D. PROJECT DESCRIPTION AND MULTIPLE PURPOSES OF THE RESERVOIR | 05 |
| E. OFF-SITE INVESTMENTS | 06 |
| F. BASELINE DATA | 06 |
| G. ENVIRONMENTAL IMPACT | 09 |
| H. PROJECT ALTERNATIVES | 11 |
| I. MITIGATION PLANS | 11 |
| J. ENVIRONMENTAL MANAGEMENT, MONITORING AND TRAINING | 12 |
| K. CONCLUSIONS AND RECOMENDATIONS | 14 |

000005

A. INTRODUCTION

1. Following a brief overview of the environmental assessment procedures for the water resources component of Ceará Urban Development and Water Resource Management Project (PROURB-CE), this document summarizes the Environmental Impact Assessment (EIA) and associated Environmental Impact Report (RIMA) for Castro Public Reservoir. The EIA/RIMA analyzes the physical, biological and social impacts likely to result from the construction of the Castro Reservoir to be located on Castro River. The EIA/RIMA also identifies the necessary mitigation measures for the negative impacts of the Castro Project.

2. The water resources component will include the construction of approximately 40 (forty) new dams (barragens) and reservoir (açudes) and 47 (forty seven) aqueducts in sparsely settled rural areas in the semi-arid interior of the State of Ceará. The facilities are primarily designed to expand urban water supply, but will also regularize ("perenizar") water flow in rivers which are normally dry for 8-9 month of the year, thereby permitting downstream irrigation of lands situated on either side of the river, as well as floodplain (or "vazante") agriculture along the receding edges of the reservoir themselves. The reservoirs will also be used for fisheries development. Together, these improvements will help retain rural and urban population in the interior of the state, thus reducing migratory pressures on metropolitan Fortaleza and other large cities in Brazil, especially during periods of prolonged drought.

3. The reservoir to be created under the component will be distributed throughout the state in the areas of greatest water scarcity ("vazios hídricos"). Maximum storage capacity of the planned reservoir ranges from 4 to 100 million cubic meters (m³), with an average size of about 31 million m³. A total of 22,244.0 hectares is expected to be flooded as a result of the proposed dams, or an average of roughly 556 ha per reservoir. According to preliminary estimates, a total of 2,465.0 families will be resettled as a result of the component, of which more than half will be relocated elsewhere on their present landholdings. Most of the rest will be rehoused in close vicinity to their existing places of residence and provided access to irrigated land water made available through the project.

4. Due to the programmatic nature of the water resources component, an in-house environmental unit (IEU), consisting of specialists in the physical, biological and social (including resettlement) impacts of dams and reservoir in semi-arid regions will be created in the state Water Resources Management Company (COGERH), to be established in connection with the project. An advisory panel of independent, internationally recognized, environmental and resettlement specialists will also be appointed to provide guidance to the IEU with respect to inter alia: (i) the findings of the initial environmental reconnaissance and Term of Reference (TOR) for each proposed reservoir to be prepared jointly by the IEU and the State Environmental Agency (SEMACE), which will also be strengthened under

the project; (ii) the findings and recommendations of the environmental assessments; (iii) environmental plans, procedures, and budgets throughout the life of the water resources component; and (iv) the specific functions and staffing, training, and other needs of the IEU. The IEU, in turn, will ensure that the initial project-specific environmental assessments and subsequent monitoring and valuation will adequately anticipate environmental impacts. Together with SEMACE, it will also ensure that all recommended mitigatory measures are implemented.

5. Both, the IEU and the advisory panel will function throughout the implementation of the water resources component and for at least two years after project completion in order to continue to monitor and evaluate the environmental and social impacts of the project investments. SEMACE, with the assistance of the Ceará Foundation for Meteorology and Water Resources (FUNCEME), will monitor water quality and control pollution in the reservoirs to be installed under the component, as well as in the 80 existing large reservoirs in the state. SEMACE will likewise carry out environmental education programs with the rural populations situated in the immediate areas of influence of each reservoir to reduce the risk of contamination from nearby (generally small-scale) agriculture and grazing activities.

6. In accordance with Brazilian law and consistent with World Bank guidelines, environmental assessment of specific reservoir projects will be carried out as follows. Upon submission of basic project documentation by the proponent, in this case the Secretariat of Water Resources (SRH), a multi-disciplinary team from SEMACE, together with the IEU, undertakes an initial environmental reconnaissance of the site of proposed investment, including consultation with local population, to establish the basic guidelines and define the TOR for the environmental impact assessment (EIA) and the associated RIMA, which are the responsibility of the proponent and normally carried out by private consultants under the supervision of the IEU. Upon receipt of the draft EIA and RIMA, SEMACE assesses their coverage and quality in relation to the TOR, reviews their findings and recommendations, and prepares a technical memorandum ("parecer técnico") containing its own conclusions and recommendations and indicating any additional studies that may be required prior to granting a license to proceed with the civil works for the project.

7. When requested, SEMACE holds public hearings to discuss the environmental impacts and proposed mitigation (and, where applicable, resettlement) measures in connection with a particular project. The EIA, RIMA, and SEMACE's technical memorandum may also be reviewed by State Environmental Council (COEMA), which meets bi-weekly, at the latter's request. In any case, COEMA is informed of all pending requests for licensing which require the completion of environmental assessments. Once the EIA and RIMA are approved, SEMACE again visits the project area and consults with local populations prior to formally issuing a license for the initiation of project works.

8. The English language summary of the EIA/RIMA for the Castro Public Reservoir Project is presented in the remainder of this document. The environmental assessment of the Castro project was reviewed in detail by SEMACE prior to the Bank appraisal of the project and found acceptable. In addition to the individual project environmental assessments, a two-phase sectoral environmental assessment study covering the program as a whole will be prepared based on Terms of Reference to be prior to loan negotiations. The results of Phase I of this study, covering state wide information, will be presented as a condition of Bank loan effectiveness, while the results of Phase II, involving more project-specific information for the full set of investments to be financed under the water resources component of the project, will be presented within twelve month of the loan effectiveness date.

B. PRESENTATION

9. The summary of the Environmental Impact Study here presented, analyses the physical, biological and social impacts likely to result from the construction of the Castro Public Reservoir, in Castro River, which is part of the Choró's River Hydrographic Basin, State of Ceará, Brazil. It also identifies the mitigation measures of the negative impacts. The construction of the Castro Public Reservoir is an implementation of the State Water Resources Agency and was foreseen into the Ceará State Urban Development Project (PROURB/CE) as a political commitment of the State Government with the semi-arid hinterland cities of Ceará State.

C. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

10. The dam constructions and subsequent reservoir formations are particularly necessary for most of the cities of the State of Ceará, which are essentially agricultural cities, concerning that their socio-economic situation lean upon highly unfavorable environmental conditions. The irregular distribution of the pluviometric precipitation combined with the inadequate characteristics of local soils that, even being fertile, are shallow, present low permeability, are badly drained and cover a rocky substract, result in a dull and randomic regional development. The existence of water reservoirs may minimize such problematic situation. In addition, the dam construction will create the possibility of implementing its most importante social use, the domestic water supply. However, concerning the legal requirements, the construction of dams and subsequent formation of reservoirs can not be carried through without the elaboration of an Environmental Impact Study (EIS), according to the number 001 Resolution of CONAMA - Enviromental Federal Bureau, created by National Environmental Policy in 1981. The EIS should consider the positive and negative effects of the proposed project within the physical, biological and social environments, as well as the mitigation measures to prevent or compensate the negative impacts. The EIS executers must yet, present a simplified environmental report, to be made available, if necessary, to the affected population through a Public Assemble.

11. Still concerning the National Environmental Policy, some of the attributions of the Brazilian Environmental and Natural Resources Institute - IBAMA, are the establishment of environmental quality standards and land uses distribution, the requirement of environmental assessments for the liberation of deforestation licenses or for other potentially pollutant activities, and the creation of environmental protection areas, among others. The third article of the 044/85 Resolution of CONAMA, defines as environmental protection areas, the lands and forests along the water courses, around the reservoirs and near the rivers' sources. Being that so, in the region of the Castro Public Reservoir, the areas to be legally considered under protection are: the lands along Castro River for a 50 meters wide strip, those along the regions' streams for a 30 meters wide strip, and the lands around the reservoir for a 100 meters wide strip. Other laws concerning environmental issues are (i) Law nº 5197 deliberates about wildlife protection; (ii) Law nº 7802 deliberates about the use of agriculture chemical residuals; (iii) Law nº 3824 deliberates about deforestation of reservoirs sites. In this case, the projects' mentor, Water Resources State Agency will be responsible for the Deforestation Decree, once with the possession of the license allowing that agency for this activity, liberated by IBAMA.

12. In the State of Ceará, the Environmental State Agency in charge is SEMACE. Its attributions are to require, to analyse and to give the approval of the EIS, frequently elaborated by consultant private agencies. It also is responsible by writing the Operative Guidelines for the elaboration of the EIS which requires a detailed characterization of the projects' steps and from the area of implementation concerning the most significant impacts and possibilities of its mitigation. In case of the none approval of the EIS by SEMACE, the project will not be carried through. The State Law nº 11.996, (07/ 24/1992), deliberates about Water Resources State Policy and created the Councils and the State Committees for Water Resources Environmental Issues, which is composed by federal, state, districtal levels representative, as well as NGOs and peoples' representatives. The State Plan of Water Resources Uses brings some articulation mechanisms to reach the necessary integration and compatibilization of actions between the several government levels, including the district level, for the decision making as well as for the implementing of many activities made necessary for the project's feasibility. The Water Resources State Agency has its own attributions in the environmental sector like the supervision of documents which deal with environmental issues, including the EIS and the simplified report of the EIS, the promotion of meetings between the affected community, the local NGOs, and the State agency, the coordination of activities required by the mitigation plans and the environmental fiscalization work made necessary into the just created protection areas.

13. In the districtal level, the laws will regard the superior level ones. The cities counties must be involved by environmental issues as the deforestation process, the respect for the protection areas, the environmental education proceedings and, mainly, the control of the reservoir's watershed uses.

Considering that the determination of land uses for a watershed basin is responsibility of the districtal agencies of the government, the cities of the influence area of the Castro Reservoir, as part of Choró River's watershed basin, should adequate their environmental legislation to the programme of land uses already implemented by that main watershed plan for uses. The Choró River's Watershed Plan has the following goals: take advantage on the basin's regularized discharges; improve the regional agricultural activities; encrease the "per capita" income of the area by implementing irrigation plans; regional food supplying and supplying of raw material for the local transformation industries. The State Government's goals aren't others but the socio-economic viabilization of some cities placed in the semi-arid hinterland and the promotion of rational uses for the natural resources of the area, mainly soil and water.

D. PROJECT DESCRIPTION AND MULTIPLE PURPOSES OF THE RESERVOIR

14. The Castro Public Reservoir is designed for water supply, irrigation and fishery activities. The dam site is located 1km distante from Itapiúna city, heading upstream Castro River. The watershed of Castro's Reservoir is part of the main watershed basin of Choró's River and is located in the south-west part of it. The access to the dam site can be made through the State highway CE-021, heading south to Itapiúna City for about 120km from Fortaleza. Once in Itapiúna City, right over Castro River, one should turn right to reach a secondary road and ride on it for about 1km until reaching the dam site. The project's quantitatives are summarized as follows:

Site of the reservoir: Itapiúna City, State of Ceará, Brazil;

Dammed River: Castro;

Project Mentor: Water Resources State Agency;

Expropriated Area: 1,000ha;

Population for water supplying: 27.022 inhabitants (year of 2013);

Acumulation capacity: $63,9 \times 10^6 \text{ m}^3$;

Reservoir area: 753ha;

Watershed basin: 35,983ha;

Mean annual precipitation: 832mm;

Type of the dam: plain earth;

Maximum height of the dam: 25,9m;

Level of the top: 154,7 meters above the sea level;

Spillway level: 151,5m;

Maximum discharge (for 1000 years risk): $264,04 \text{ m}^3 / \text{s}$;

Regularized discharge: $0,55 \text{ m}^3 / \text{s}$;

Borrowed material area: 64,85ha;

Legal environmental protection area: 250,0ha.

000010

E. OFF-SITE INVESTMENTS

15. **Municipal water supply:** The domestic supply is considered the most important use in the Castro Project and will attend the urban population of the cities of Itapiuna, Capistrano, Chorozinho, Ocara and the districts of Ideal, Capivara and Caio Prado. All this population was estimated to be 27,022.0 inhabitants for the year os 2013. The daily mean demand, considering a dally "per capita" consumption of water of 150 l/s is 4,053,300.00 liters. That means a 35.02 l/s flow for Itapiúna, Caio Prado and Capistrano, 11.1 l/s for Ideal, Capivara and Ocara and 10.16 l/s for the city of Chorozinho. The Castro Reservoir will be supplying the Castro and Choro's Rivers sorrouding population, estimated in 3,000.0 persons. The necessary flow for this purpose is 3.4 l/s considering the "per capita" consumption of water, 100 l/day/enhabitant. The regularized discharge projected for Castro River is 550 l/s. Therefore, considering the water supply for the five cities and ditritcs through the pipelines as 56.66 l/s and the river sorroufins pputation as 3,4 l/s and 10% of losses, it would still present 484 l/s which would permit the irrigation of 484 ha. The potentially irrigable area downstream of the reservoir is 3,854.58 ha of aluvionar soils, but the use of the river plains for irrigation will be limited to 378 ha plus 30 ha around the reservoir and 150 upstream where 70 ha of agriculture resttlement spots are included.

16. The project includes there pipelines for water supply which will be made in cast iron with 250 mm diameter and 1.38 km length and a 35.02 l/s flow. It will be constructed along Castro River begining in the power house built on the river bank. The pipelines will accompany the river untill it reaches Itapiúna city and than it will head to a high point of the city to be distributed from there by a cast iron treated water pipeline. The supply for the cities of Itapiúna, Capistrano and Caio Prado will be implemented as a singue system whitin a floating captation containing four pumps with a 31.59 m³/h flow and manometric heigth of 22 m; a non treated water pipeline, as said above and a elevatory treatment station with two (2) filters, six (6) pumps, four of wich with unitary discharge of 14.33 m³/h, will supply Capistrano City, one with 14.33 m³/h will supply Capistrano City, one with 14.33 m³/h will supply Caio Prado and the last one, with a 16.74 m³/h discharge, will supply Itapiuna City, and a treated water made out of cast iron will be built with the folloing caracters: Capistrano Aqueducts - Q = 19.9 l/s, length = 12 km and diameter = 200 mm. Caio Prado - Q = 4,66 l/s, length = 13,5 km and diameter = 100 mm. The city of Ocara and the districts of Ideal and Capivara will be supplied starting from the right margin of Choro River, approximately 48 km downstream from the dam, where two pumps will be installed with a 21.10 m³/h discharge and manometric height of 18 m. The whole system will present: a cast iron non treated water pipeline with diameter = 150 mm, lenght = 0.80 km and discharge = 11.1 l/s; a elevatory treatment station sited at Ideal City composed of one filter and three pumps, one of wich a 9.36 m³/h for Ideal supplying and the other two with a unitary discharge of 15.30 m³/h will supply Capivara and Ocara; a treated water pipeline conducting water untill Capivara and Ocara the project includes also an irrigation area downstream of the dam.

17. **Irrigation:** The irrigation area downstream the Castro Reservoir has the extension of 483 ha, and will use 483 l/s. This irrigation project will be implemented by the Support Programme of Irrigated Agriculture (PROIR - Brazilian Northeastern Bank - BNB/ Constitutional Fund for Northeastern Finances - FNE), whose main purpose is to fix families in the country.

18. **Seasonal Agriculture:** Considering the legal natural area to be established around the reservoir, there will not be seasonal agriculture practices inside the green belt. The agriculture activities will take place only in the very end of the river's plan, located upstream, where the water reaches beyond the legally protected area. This use will be managed by SRH through "Projeto Beira D'água" using a 3ha diesel kit. This programme can also be credited to PROIR - BNB/FNE. Other alternative will be Programme for the Modernization of Not Irrigated Agriculture (PROAGRI - BNB/FNE).

19. **Fishery Activities:** This is one of the most important activities assumed by DNOCS. This use is detailed in the Fishery Plan to be presented following in this document.

F. BASELINE DATA

20. **Characterization of the Affect Area:** The hydrographic basin of the Castro Reservoir is part of the direct influence area of the project. The population resettlement will be undertaken inside this area. The city of Itapiúna will be the nearest urban population group connected with the project. The indirect influence area is the Choró River hydrographic basin, which has the area of 5,100.0 square kilometers. Therefore, the operation of the Castro Reservoir has to be made in agreement with the Choró River basin management.

21. **Social Environment:** According to the demographic sense of 1991, the populations of Itapiúna City is 12,417.0 inhabitants. The demographic densities are over 22 inhabitants per square kilometer. 70% of that population are economically active, 30% of which with unofficial jobs (pay no taxes); 30% depend on one or both of those groups (over 60 years old inhabitants and children). 60% of the whole population work on agriculture activities. Although the agricultural activities represent the main potentiality of the regional lands, the natural pastures represent the most intensive use of those lands.

22. **Population of the Impoundment Area:** The water will reach, totally or partially, 83 properties. 68 families will be resettled but only 10 will live in the rural dwelling nucleus project, to be undertaken by the State Water Resources Agency (SRH); 03 families will be sent to Itapiúna city as they preferred. The resettlement site will have all necessary basic infrastructure equipment.

000012

23. **Basic Infrastructure:** Sanitation: Itapiúna has 524 connections supplying 1,798.0 persons; Electric energy: serve the whole city of Itapiúna (Source: Ceará's State Electricity Company, 1990); Transport Infra-structure Features: there is only one main road between Itapiúna and Fortaleza; Housing: there are enough houses for the cities inhabitants; Actual Land Distribution: Most of the properties in the area are considered medium sized ones. It has 408 properties below 10ha occupying 2.300ha, 500 properties between 10 and 100ha occupying 15.697ha, 95 properties between 100 and 1,000ha occupying 23.714ha and 7 properties between 1,000 and 10,000ha occupying 10.823ha.

24. **Physical Environment:** The geological unit that characterizes the area is called Northeastern Complex and it is composed mostly by "gnaisses". According to the project, there will not be any difficulty concerning the substratum, in terms of the dam construction. The projects' area geomorphologic unit is called "Sertaneja Surface" and is formed by "sedimental hills". The regional soils present low permeability, shallowness and high susceptibility to erosion process, although they present high levels of decomposable minerals which makes them reasonably fertile. The vegetation covering of the area is mostly composed with opened bush-sized "caatinga" forests. For intensive agriculture uses, the soils need some conservation techniques. The most important climatologic component of the area is the bad distribution of the rainfall during the year. The area can be dry for about nine months, in a one year period.

25. **Biologic Environment:** The vegetation covering of the projects' area is mostly composed with opened bush-sized "caatinga" forests. The species considered more resistant to the environmental adversities of the area are: *Mimosa acutistipula* (jurema preta); *Jatropha mollissima* (pinhão); *Solanum sp* (jurubeba); *Cereus gounelli* (xique-xique); *Pilosocereus sp* (facheiro); *Cereus Jamacaru* (mandacará); *Croton sp* (marmeleiro), *Copernicia prunifera* (carnaúba); *Licania rigida* (oiticica); *Ipomea pes-caprae* (salsa); *Cyperus sp* (tiritica); among others. The wildlife is composed mainly by birds: *Rallideos* (frango-d'água); *Jacamnideos* (jaçanã); *Psitacideos* (papacu); *Picideos* (pica-pau); *Alcedinideos* (martim-pescador); *Tyrannideos* (vovô, lavandeira); *Fumarideos* (crispim); *Icterideos* (papa-arroz); *Fringilideos* (gola, papa-capim); *Thravpideos* (vem-ven). Some of the reptiles of the area are *Prynops sp* (cágado); *Helicops sp* (cobra d'água); *Waglerophis sp* (cobra).

000013

ENVIRONMENTAL IMPACT

The environmental impacts identified in the EIS were based in the Checklist for Addressing the Environmental Impacts of Dam and Reservoir Projets from Social Comission for Asia and Pacific, 1990, and are as follows:

CHECKLIST OF ENVIRONMENTAL PARAMETERS FOR JERIMUM DAM CONSTRUCTION, WATER SUPPLY AND IRRIGATION

| ACTIONS AFFECTING ENVIRONMENTAL RESOURCES AND VALUES | DAMAGES TO ENVIRONMENTAL | NATURE OF THE ENVIRONMENTAL IMPACT | RECOMMENDED FEASIBLE PROTECTION MEASURES |
|--|--|--|--|
| a - Social problems i - Population resettlement ii - Payment to the landlords iii- Employment places offer | <ul style="list-style-type: none"> - Families have to be resettled in a new place - Owners have to be paid according to the Brazilian Constitution (1988) - Construction and operation of the reservoir | LS,ST,B,Rm,IP,DI,Is LS,ST,B,Rm,IP,DI,Is Re, LT, SB, Is | Resettlement planning Payment in time according to the law |
| b - Problems related with technical alternative selection iv - Earth movements | <ul style="list-style-type: none"> - Erosion risks - Non utilized material disposition - Not renewable natural resources (earth and rock for dam construction) - Risks connected to the employees insurance - Risks connected to the employees sanitary conditions - A esthetic hazards (noise, vibration, etc) | LS,ST,A,IP,DI,Im LS,LT,A,R,Rm,II,Is LS,LT,A,I,DI,Im LS,ST,A,Rm,IP,DI,Is LS,ST,A,R,Rm,IA,II,Is LS,ST,A,I,IP,II,Is | Use the minimum of opened erosion area and the minimum possible time; plant temporary crops or covering with disposable materials for stabilization; build drainage channels, levels, or absorption areas; observe insurance standard methods; control sanitary conditions in the work area; getting awaring the population about every kind of hazards. |
| c - Rational reservoir deforestation | <ul style="list-style-type: none"> - New places of employment are produced - Wood for construction and energy are produced - Erosion is increased - Loss of forest resources | LS,ST,B,DI LS,ST,SA,I,Rm,IP,DI,Is LS,ST,A,DI,Is LS,ST,SB,Rm,IP,DI,Is | Rational deforestation plan for reservoir area |
| d - Reservoir filling v - Land submercion vi - River channel submercion vii - Lake formation | <ul style="list-style-type: none"> - Loss of native areas and natural habitats of the local vegetation and wild life - Loss of wood - formation of habitats which favor life and breeding of disease vectors - Encrease of ground water around the reservoir - Rittle micro-climate modification - Formation of habitats for fighes and aquatic birds - Oportunity for water uses and transportation - Reservoir silting | LS,ST,A,R,Rm,IA,DI,Is LS,ST,A,I,Rm,IP,DI,Is LS,ST,A,Rm,IA,II,Is LS,ST,B,Rm,Is LS,ST,B,I,IA,II,Is LS,ST,B,Rm,II,Is LS,ST,B,I,Rm,II,Is LS,LT,A,I,Rm,DI,Is | Wild life scape planning Program of planting native species Control the regional sanitary conditions Promote sanitary education of the population Use the possibility of drill wells Erosion control |

CHECKLIST OF ENVIRONMENTAL PARAMETERS FOR JERIMUM DAM CONSTRUCTION, WATER SUPPLY AND IRRIGATION

| ACTIONS AFFECTING ENVIRONMENTAL RESOURCES AND VALUES | DAMAGES TO ENVIRONMENTAL | NATURE OF THE ENVIRONMENTAL IMPACT | RECOMMENDED FEASIBLE PROTECTION MEASURES |
|--|---|---|--|
| viii - Downstream changes in the river channel and near bank areas | <ul style="list-style-type: none"> - River become perennial - Flood peak reduction - Dilution increasing - Possibility of irrigated lands - Wild life - Modification of the process erosion-deposition of sediment - Ground water recharge increasing - Continuous flow during the year | LS,Re,LT,SB,Is LS,LT,B,Is LS,LT,B,Is LS,LT,SB,Is LS,LT,B,Is LS,LT,A,I,Is LS,LT,B,DI,Is Re,LT,SB,Is | Environmental Protection Laws State Water Resources Plan |
| ix - The Jerimum reservoir itself | <ul style="list-style-type: none"> - Fixing the man in the hinterland - Water supply - Sanitary control necessity - Land ownership modification - Land price modification - Multiple use conflict - Water tax collection problem - Recreational possibilities - New roads - New agri-industries - More employment places - Better agriculture - Fishery implementation | Re,Na,SB,DI,Is LS,LT,SB,Is LS,LT,A,Rm,DI,Is LS,LT,B,Rm,DI,Is LS,LT,B,Rm,II,Is LS,LT,A,Rm,Is LS,LT,A,Rm,Is LS,ST,A,Rm,Is LS,LT,B,Rm,Is LS,ST,B,Rm,Is LS,ST,B,Rm,Is Na,Re,LT,SB,DI,Is Re,SB,DI,Is | Water supply treatment State Sewage system Accomplishing the goals of the State Water Resources Plan Accomplishing the goals of the Environmental Protection Laws |
| e - Irrigation problems x - Flow regularization | <ul style="list-style-type: none"> - Possibility of irrigation | LS,Re,Na,LT,SB,Is | |
| xi- Water logging xii- Utilization of chemicals xiii- Utilization of water from channel as drinking or cooking water | <ul style="list-style-type: none"> - Soil and water salination - Water contamination - Disease risk | LS,SA,Rm,DI,Is Re,SA,Rm,DI,Is LS,A,Rm,II,Is | Drainage Control chemical utilization Prohibition of the use of irrigation waters as human water supply |
| f - Water supply pipeline xiv - Regularization of the water supply system xv- Pipeline stripe area for operation and maintenance | <ul style="list-style-type: none"> - Public health emprovement - Expropriation problems | Re,SB,DI,Is LS,A,Rm,DI,Is | Legal actions |

LS - Local and Specific
 Re - Regional
 Na - National
 GI - Global
 ST - Short Term
 LT - Long Term
 SB - Significant and Beneficial
 SA - Significant and Adverse

B - Beneficial
 A - Adverse
 O - None Impact
 R/I - Naturally reversible/unreversible
 Rm - Restorable by mitigation or management
 IA/IP - Accidental Impact/Planned Impact
 DI/II - Direct Impact/Indirect Impact
 Iu/Is - Unic Impact/Sinergic or cumulative Impact

H. PROJECT ALTERNATIVES

26. Four location alternatives were studied: The studies demonstrated that the best option is located 1km far from Itapiúna City, upstream the river because it presents a lower cost along with a higher regularized volume. The living components (wildlife, native vegetation and human population) of the environmental of the four sites are similar. All of them will be able to live using less energy once having accumulated water in their region. The choice of the cross section is connected with the availability of construction material. The earth type was chosen concerning the lower costs and good effectiveness, as well as the favorable landscape component it brings for the region. The hydrological and geological studies were responsible for the choice of the spillway level and its width. The non construction alternative will result in the maintenance of the intermittence of Castro River, which presents no flow at all during drought periods that can reach 7 month in a year. Only sites 2 and 3 were worth being studied by a more technical point of view. After these, site 2 was the chosen alternative.

| Alternative | Annual Inflow Volume (hm ³) | Regularized Discharge (m ³ /s) |
|-------------|--|--|
| Site 2 | 25,20 | 0,55 |
| Site 3 | 15,50 | 0,18 |

I. MITIGATION PLANS

27. **Resettlement Plan:** The State Water Resources Agency promoted a meeting with the affected population and the local NGO for the decision making about the payment of the lost material in the impoundment area, the construction of the houses, the infrastructure to be installed in the area to be occupied by the resettled families, and other resettlement issues, as well as the sharing of responsibilities upon the environmental measures to be undertaken in the area. In this process the State Agency indicated a representative to answer to any resettlement questioning. The documentation of this first meeting is included in the EIS. Once over the negotiations and the decision making process, the State Agency will start the delivery of the construction material. The State Agency will, also, develop an educational plan on sanitation issues and will install sanitation equipment in the houses sited around the lake. The resettlement process can be done in 8 month and should be concluded before the reservoir filling.

28. **Racional Deforesting of the Castro's Reservoir Impoundment Area:** All lands below the level 150,5m, which means, 753ha, will be impounded. This area should be deforested before the filling of the reservoir. The implementing agency must deforest only the strictly necessary area. The

agency should allow the population to take advantage on the existent timber of the area. The detailed deforestation process is included in the EIS. This process should last 4 month, the most. Only the last two month of the deforestation process can coincide with the with the reservoir filling process. Considering the efficiency of the mecanic method, detaild in EIS, it will take 94 days, 8 hours a day of work to conclude the stump take-off. Considering the manual method, 40 men working 8 hours a day will do the stump take-off, in 90 days.

29. Wildlife Protection Plan: The wildlife rescue process should be undertaken before and during the deforestation process. Specifically, the rescue operations should start 1 month before the beguining of the deforestation process and from this point on, the two processes can continue parallely. If properly equipped with the rescue material, 20 men, working 8 hours, can prepair 10ha in one day. For each 8 hours of work it will be needed a 12 hours range of no interventions in the prepaired area, so that the animals can be rescued. The wildlife protection plan can, therefore, be concluded in 75 working days.

30. Fishery Plan: The fishery plan can be started as soon as the lake is totally filled. According to the plan description indicated in EIS, it will take four years to reach its most productive stage. The State Water Resources Agency will be responsible for the installation of the fishery infrastructure in the sorroundings of the lake. The State Agency should estimulate the population to create an institution which would obtain funds for the formation of a small fishery industry, regulate and control the activities in the reservoir sorroundings for the protection of fish population, promote training courses for fishermen and educational programmes estimulating proper uses for the reservoir.

31. Degraded Areas Recuperation Plans: Specific provisions must be made to eliminate or mitigate environmental damage in the impoundment area during and after construction. Some of the procedures are the responsibility of the contractor and others, basically the fiscalization work, are the responsibility of the State Water Resouces Agency among with the State Environmental Agency. Provisions should be incorporated into construction related impacts. Adequate location of borrow areas should be made; air and water pollution from construction equipment, earth movement and living quarters, avoided; screening of laborers for imported water-related diseases; solid waste disposal; siting of contractor facilities and other infrastructure to minimize destruction of natural landscape, and noise pollution. Some corrective procedures like the reforestation of the area are better detaild in the EIS.

J. ENVIRONMENTAL MANAGEMENT, MONITORING AND TRAINING

32. The State Water Resources Agency is mainly responsible for the management, monitoring and training processes to be undertaken for the implementation of Castro Public Reservoir and its

Mitigation Plans. SRH State Agency will promote a training course for environmental monitors, which characterization is as follows:

**TRAINING COURSE FOR ENVIRONMENTAL MONITORING AND EMPLEMAN TATION
OF MITIGATION PLANS OF CASTRO PUBLIC PROJ ETC**

| | |
|--|---|
| NOME DO F COURSE | I COURSE FOR RESERVOIR MANAGEMENT |
| PROMOTION OF SRH (State Water Resources Agency) | |
| INTERESTED POPULATION | Fishery, Forestation, Agriculture and Operative Engineers as well as technicians from Federal Technical School or Engineers from SRH. |
| NUMBER OF VACANCIES | 20 |
| DURATION: 200 hours, 45 days | |
| SCHOLARSHIP GRANT | US\$ 5,00/student/day |
| COSTS | . US\$ 5.000,00 for professor's payment . US\$ 1.000,00 for management, instalations, material and equipment expenses . US\$ 4.500,00 for scholarship grants . Total: US\$ 10.500,00 |
| NATURE OF THE SELECTION | Entervlew with a representative of SRH |

33. The range of implementation of the Mitigation Plans as well as its costs are shown in the following Figure. The implementation costs of the Mitigation Plans are detailed in the EIS. A General Diagram of the undertaking is shown annexed in the EIS. Although, this responsibility can be shared with other governmental agencies like the Electricity State Agency, the Waste Water State Agency, the Environmental State Agency, and some municipal agencies in charge in the direct influence area. The educational programmes about environmental issues should be very frequent in all the implementation process. Some of the procedures to be carried on in the watershed basin are: the farming activities should allways use racional techniques, sanitary control of critical areas; observation of actual environmental laws and rules: Law nº 7.803 of 07/18/1989, about the 100m protection strip around the reservoir; 50m protection strip along the streams; adequacy of wastewater equipment installed around the lake; strict observation of upstream land use rules, concerning soil exploration, liquid and solid discharges, prohibition of forest burning for agricultural uses, observation of hunting and fishing rules, etc.

000018

K. CONCLUSIONS AND RECOMENDATIONS

34. The implementation of Castro Public Reservoir in Choró River's Watershed Basin was analysed under two points of view. The first one assesses the need of accumulating water for several uses in that hinterland region of Ceará State. The second one analyses the environmental impacts likely to result from the construction of the dam and subsequent formation of the lake. Regarding the first feature, it would be enough to affirm that it is not possible to reserve water in the underground aquifers of the region because the soils are highly impermeable and the substratum is mostly rocky, which means that there is no other way of accumulating and using the badly distributed rainfall of the area, but by forming artificial lakes. Regarding the second feature, a potential environmental impacts checklist was elaborated, strictly searching for negative impacts so that their respective mitigation measures could be indicated. Once analysed the checklist, it can be concluded that, although there are several negative impacts, they all can be minimized through mitigating measures. The Environmental Impact Study does not have any objections concerning the alternatives for site and design technologies chosen for the dam and reservoir, understanding that they will not result in such negative impacts upon the natural or social resources of the area, that justify not constructing the dam. The recommendations are related to three ranges: before the construction of the dam, during and after the filling of the reservoir:

Before and during the construction of the dam:

1. Promotion of meetings between the implementing agency and the affected population;
2. Develop plans to employ manpower from the expropriated areas;
3. Develop land use projects for resettlement and downstream population;
4. Development of environmental education programmes linked with preserved ecological and cultural areas;
5. The owners of the expropriated lands should be paid before the beginning of the proposed project, in market prices and in cash. The affected population have to receive from SRH at least, all that was lost with the implementation of the project.

During and after the filling of the reservoir:

1. Sow grass on bare of reservoir banks to prevent soil erosion and afforestation of slopes with fast growing trees to rehabilitate deforestation areas;
2. Health education for local population;
3. Water quality monitoring coordinated by the State Environmental Agency - SEMACE;
4. Social assistance for resettled and the population of the rivers' surroundings.

A TÉCNICA QUE CONDUZ AO FUTURO



Projeto Curu - Paraipaba



Praia de Iracema



Projeto Curu - Paraipaba



000020

Quando uma empresa acompanha a evolução de seu tempo utilizando inovadoras e avançadas técnicas para a execução de seus serviços com eficiência e responsabilidade, cumpre o seu papel perante o futuro, contribuindo, desta forma, para o progresso do homem.



FAZ PARTE DA EVOLUÇÃO