

| Route: Santa Cruz – São Miguel | | | |
|--|--|---|--|
| | | | |
| | <p>3km before the center of São Miguel</p> | <p>Road in front of the plant site for the CAIS</p> | |
| | | | |
| | <p>Plant site for the CAIS</p> | <p>Replacement of Distribution Pipe Line</p> | |
| <p>General Description of Environmental Situation: The entire road is paved with stone. Few villages are situated along the route and some buildings are close to the road. No involuntary resettlement is supposed to occur under the current situation. Temporary discomfort during construction shall be mitigated, including the provision of home access to local people and easily accessible roads for traffic. A candidate new desalination plant site for the CAIS project was selected, but the project has been suspended since 2007; meanwhile, construction of a new hotel is proceeding near the site.</p> | | | |

| Route: Assomada – Tarrafal | | | |
|---|--|-------------------------------------|--|
| | | | |
| | <p>Exit of city center of Assomada</p> | <p>Serra Malagueta Natural Park</p> | |
| | | | |
| | <p>10km before Tarrafal</p> | <p>Ribeira da Prata</p> | |
| <p>General Description of Environmental Situation: The entire road is paved with stone. Few villages are situated along the route and some buildings are close to the road. The Serra Malagueta Natural Park is situated between Assomada and Tarrafal. No project has been executed along this route under the JICA Project. Some beaches near Tarrafal, e.g., Ribeira da Prata, shall be protected by the local municipality because they are the areas where sea turtles lay their eggs.</p> | | | |

| | | |
|-------------------------------------|--|---|
| Route: Assomada – São Miguel | | |
| | <p>Intersection of the road to São Miguel</p> | <p>8km from the city center of Assomada</p> |
| | <p>10km before São Miguel</p> | <p>Intersection of the road to Assomada</p> |
| | <p>General Description of Environmental Situation:</p> <p>The entire road was paved with asphalt at the end of 2009. Few villages are situated along the route and some buildings are close to the road.</p> <p>No involuntary resettlement is supposed to occur under the current situation.</p> <p>Temporary discomfort during construction shall be mitigated, including the provision of home access to local people and easily accessible roads for traffic.</p> | |

| | | |
|-------------------------------------|--|---|
| Route: São Miguel – Tarrafal | | |
| | <p>City center of Calheta</p> | <p>General landscape along the road</p> |
| | <p>General landscape along the road</p> | <p>20km before Tarrafal</p> |
| | <p>General Description of Environmental Situation:</p> <p>The entire road is paved with stone. Few villages are situated along the route and some buildings are close to the road.</p> <p>No involuntary resettlement is supposed to occur under the current situation.</p> <p>Temporary discomfort during construction shall be mitigated, including the provision of home access to local people and easily accessible roads for traffic.</p> | |

6.6 Environmental Impact

6.6.1 Positive Impact

Table 6.6-1 presents the potential positive environmental impact of the project and measures to improve the positive impact.

Table 6.6-1: Positive Impact

| Positive impact | Measures to improve positive impact |
|--|--|
| Improvement of quantity of water production (m ³ /day) | Awareness regarding water |
| Improvement of water quality | Awareness regarding environment and life quality |
| Improvement of accessibility of serviced water (Number of Persons) | Awareness regarding water |
| Improvement of serviced hours of water facilities (hours/day) | Awareness regarding environment and life quality |
| Improvement of collection of water tariff/Reduction of water loss (CVE/month, year) | Systematic leak detection campaigns and awareness regarding ways to save water |
| Reduction of medical bills for each household through decreasing waterborne diseases (CVE/month, year) | Awareness regarding public health |
| Reduction of labor costs for getting water to each household (CVE/month, year) | Increase awareness regarding employment for women |

Source: Study team

6.6.2 Negative Impact to Be Assessed

Although the project's activities are known to some extent, and the Detailed Design (D/D) has not yet been done, any negative impact of the project would be assessed in accordance with the "Environmental Checklist" of the JBIC Guidelines and relevant laws of the GoCV.

The environmental impact will be similar in each municipality and it is therefore not necessary to prepare separate environmental assessments for each. The following list presents the identified and expected impacts as a result of the activities of the project. Any impacts on the socio-economical situation and public health are also included.

(1) JBIC Environmental Checklist


General items to be considered are summarized in the following JBIC Environmental Checklist.

JBIC Environmental Checklist: Water Supply

| Category | Environmental Item | Main Check Items | Confirmation of Environmental Considerations |
|----------------------------|-----------------------------------|--|--|
| 1. Permits and Explanation | (1) EIA and Environmental Permits | ① Have EIA Reports been officially completed? ② Have EIA Reports been approved by the authorities of the host country's government? ③ Have EIA Reports been unconditionally approved? If conditions are imposed on the approval of EIA Reports, are the conditions satisfied? ④ In addition to the above approvals, have the other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government? | The GoCV shall be required to conduct EIA Study after the Survey based on the following articles of Annex-I of Decree-Law No.29/2006: 18 Collection, treatment and distribution of water - CAE - CV - Section E - Division 41 a) Canalization work and regulation of the water routes b) Installation of facilities for reservoirs and storage of water c) Collection, treatment and distribution of desalinated and non-desalinated water 20 Construction - CAE - CV - Section F - Division 45 d) Construction of base camp |
| | (2) Explanation to the Public | ① Are the contents of the project and the potential impact adequately explained to the public based on appropriate procedures, including information disclosure? Has understanding been obtained from the public? ② Are proper responses made to comments from the public and regulatory authorities? | The procedure of EIA and the necessary items to be studied is also provided in Decree-Law No.29/2006. |
| 2. Mitigation Measures | (1) Air Quality | ① Is there the possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Do chlorine concentrations within the working environment comply with the country's occupational health and safety standards? | No influence on the air quality. |
| | (2) Water Quality | ① Do pollutants, such as SS, BOD and COD, contained in effluents discharged by the facility comply with the country's effluent standards? | At existing desalination plants, RO Membranes are maintained by using liquid containing sodium hydroxide. Waste water after maintenance is discharged directly into the sea, but sodium hydroxide is a deleterious substance and if a large amount is used, the discharge must be controlled under proper management. |
| | (3) Wastes | ① Are wastes, such as sludge generated by the facility, properly treated and disposed of in accordance with the country's standards? | Deposition sites shall be identified before construction and waste must be protected against wind and water erosion by being covered. |
| | (4) Noise and Vibration | ① Do noise and vibrations generated from the facilities, such as pumping stations, comply with the country's standards? | The sites for desalination plants and pumping stations are carefully selected and constructed far from city centres and touristic zones. The influence of noise and vibration is relatively low. |
| | (5) Subsidence | ① In the case of the extraction of a large volume of groundwater, is there the possibility that the extraction of groundwater will cause subsidence? | No influence on ground water. |

| Category | Environmental Item | Main Check Items | Confirmation of Environmental Considerations |
|------------------------|---------------------|--|--|
| 3. Natural Environment | (1) Protected Areas | ① Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there the possibility that the project will affect the protected areas? | No influence on the national protected areas. |
| | (2) Ecosystem | ① Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? ② Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? ③ If significant ecological impact is anticipated, are adequate protection measures taken to reduce the impact on the ecosystem? ④ Is there the possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impact on aquatic environments, such as aquatic organisms? | The influence on marine diversity due to the discharged water after desalination is relatively low. If a large amount of sodium hydroxide is used as a detergent for RO Membranes, the discharge from the plant must be controlled under proper management. |
| 4. Social Environment | (1) Resettlement | ① Is involuntary resettlement caused by implementation of the project? If involuntary resettlement is caused, are efforts made to minimize the impact caused by the resettlement? ② Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? ③ Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? ④ Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, and people living below the poverty line, ethnic minorities, and indigenous people? ⑤ Are agreements with the affected persons obtained prior to resettlement? ⑥ Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? ⑦ Is a plan developed to monitor the impact of resettlement? | No involuntary resettlement will occur under the current situation. To prevent unplanned land use and occupation due to increased population density in the areas upgraded with public services, information regarding the project, including implementation schedule, project site, etc., should be clearly explained to the people and administrative control for land use shall be strengthened. |



| Category | Environmental Item | Main Check Items | Confirmation of Environmental Considerations |
|-----------|---|---|---|
| | (2) Living and Livelihood | ① Is there the possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impact, if necessary? ② Is there the possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses? | To prevent social impact due to price increases for new services, a government subsidy is required in a normal welfare program. |
| | (3) Heritage | ① Is there the possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws? | No influence on heritage. |
| | (4) Landscape | ① Is there the possibility that the project will adversely affect the local landscape? Are necessary measures taken? | The sites for desalination plants and pumping stations are carefully selected and constructed far from city centres and touristic zones. Influence on the landscape is relatively low. |
| | (5) Ethnic Minorities and Indigenous People | ① Does the project comply with the country's laws for rights of ethnic minorities and indigenous people? ② Are considerations given to reduce the impact on the culture and lifestyle of ethnic minorities and indigenous people? | The water tariff is settled taking into account affordability for poorer people. |
| 5. Others | (1) Impact during Construction | ① Are adequate measures considered to reduce the impact during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? ② If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce the impact? ③ If construction activities adversely affect the social environment, are adequate measures considered to reduce the impact? ④ If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers? | Temporary discomfort during construction shall be mitigated by the following measures: <ul style="list-style-type: none"> • Divulge routinely all information concerning construction procedures. • Enforce safety and protection measures established in the construction contract document. • Provide home access to local people and easy access to roads for traffic.  <p>Pollution of environment by temporary installations shall be mitigated by the following measures:</p> <ul style="list-style-type: none"> • Inappropriate deposition of excavated material and construction waste shall be avoided through the |

| Category | Environmental Item | Main Check Items | Confirmation of Environmental Considerations |
|----------|---------------------------------------|---|---|
| | | | <p>identification of deposition sites before construction and waste must be protected against wind and water erosion by being covered.</p> <p>Degradation of borrow pit area shall be mitigated by the following measures:</p> <ul style="list-style-type: none"> • Borrow pit areas must be approved by the local population as well as authorities • Include reclamation works, leveling of terrain, replanting of vegetation • Prevent erosion from heavy traffic on temporary gravel roads • Identify access roads before construction begins |
| | (2) Monitoring | <p>① Does the proponent develop and implement a monitoring program for the environmental items that are considered to have potential impact?</p> <p>② Are the items, methods and frequencies included in the monitoring program judged to be appropriate?</p> <p>③ Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)?</p> <p>④ Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?</p> | It is enacted that monitoring should be done under the charge of the project owner according to the conditions of EIA approval and Monitoring Reports should be submitted periodically to EIA Authority under the Decree-Law No.29/2006. |
| 6. Note | Note on Using Environmental Checklist | <p>① If necessary, the impact on trans boundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as trans boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).</p> | Not necessary. |

- 1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project environmental considerations are made, if necessary.
- 2) An environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which it is located.

(2) Construction Phase

1) Land Acquisition:

Land acquisition involves the purchase of land for construction of desalination plants, water reservoirs, pumping stations, and a pipeline network. Land acquisition may impact the environment and local wealth, especially when purchasing agricultural fields or land within areas of environmental interest such as forests. Touristic potential and tourism development may also be affected by land acquisition. Although this activity is not expected to be significant for the sub-projects examined, there may be a few occasions where some land may have to be acquired.

2) Resettlement:

Providing land acquisition has been done according to the above recommendations, any significant cases regarding resettlement shall be avoided. Moreover, during construction of pipelines, it will be necessary to secure Right of Way (RoW). In some cases, this RoW will pass near or even through residential buildings.

3) Procurement and Depositing of Surplus Earth:

This concerns the procurement of construction materials (e.g., gravel) or their depositing in the case of surplus earth from construction sites especially when burying pipelines. Inappropriate procurement of materials in an illegal manner or in protected areas may have a significant impact on the environment, tourism and the lives of people. At the same time as additional pollution issues, inappropriate depositing of surplus earth coming from construction sites may have a similar effect.

4) Earth Movements and Concrete Works:

This activity consists of the excavation of trenches and foundations and concrete works for reservoirs and large ponds for water facilities. The main environmental impact would relate to the possible contamination of local underground water by earth movements and construction activities like the pouring of concrete, and consequences related to the uncontrolled depositing of materials.

5) Material Transport:

This includes the transporting of all construction materials such as concrete, pipes or other material as well as the transport of equipment or machinery. Temporary environmental impact would be assumed including noise and dust pollution.

(3) Operation Phase

1) Common issues resulting from expanding of the water supply:

- The risk of occupational health accidents may increase, such as staff working at the water supply facilities may not be sufficiently trained in handling chlorine and other chemical materials and hazardous waste.
- The improvement of accessibility to water will often attract people from areas with less services. This can result in unplanned construction activities and overcrowding, causing social problems, pollution due to overloading of the sanitation systems and soil erosion.
- A changing economy can result in price increases as full-cost recovery is introduced by the commercial operator, and an increase in the cost of land/housing in areas with better services. These effects could prevent the poorest segment of the population having access to the improved services.

2) Desalination plants:

It includes repair and maintenance, dosing of chemicals, and discharge water. Possible impact includes:

➤ Pollution of discharged water

The discharged water of the desalination plant is highly concentrated with salts and minerals. If the desalination plant is not properly designed or operated, discharged water can become a cause of sea pollution.

➤ Chemicals and solid and liquid waste

The operation of desalination plants produces solid waste such as used RO membrane cartridges. However, these membranes are not made of toxic materials and do not contain toxic liquids. They should not constitute a heavy environmental threat especially when disposed of in properly managed deposit sites. Toxic liquids with high concentrations, such as chloride, may be used for the decontamination of drinking water, and may constitute an environmental threat when not handled properly. Herbicides and pesticides are not being used.

➤ Problems for neighborhoods

Noise from the desalination plant will occur as a normal part of operations and can affect the neighboring residential areas if they are not properly located and shielded by planting or other means.

6.7 Measures to be considered in Each Municipality

In target municipalities, site-specific impacts due to water production facilities and distribution systems shall be inspected and evaluated through the EIA Study conducted by GoCV. In the IEE stage, the general environmental impact was presumed according to dialogue with local stakeholders for environmental management through an “Inter-municipal Meeting Regarding Environmental Issues” conducted by the study team in May 2010 in Praia. The meeting included members from DGA, MTIE, SAAS and Camara Municipal. At the conclusion of the meeting, general measures for environmental management were summarized in each municipality’s Municipality Development Plan (PDM) and Municipality Environmental Plan and those measures should be considered at the stage of project formation, IEE and EIA, in order to harmonize the proposed water supply project and the environment.

6.7.1 Municipality Environmental Plan

General measures to be considered in each municipality described in their Municipality Development Plan (PDM) are as follows.

Table 6.7-1: Measures of Municipal Environmental Plan for Environmental Management

| Municipality | Measures to be considered |
|-----------------------|---|
| Tarrafal | <p>Document collected: “Plano de Actividades E Orcamento Pam Tarrafal De Santiago - 2010”: the Plan of Activities and Budget for Tarrafal de Santiago.</p> <p>The document does not include special measures to be considered regarding the environment.</p> <p>However, the beach of Tarrafal is a well-known place for sea turtles to lay their eggs and is thus a protected area. Thus, any project-related construction shall be avoided within the beach area on the west coast.</p> <p>The Municipality of Tarrafal also includes a part of the Natural Park of Serra Malagueta, which is also a National Park area.</p> |
| São Miguel | <p>Document collected: “Relatorio de Ordenamento/Volume III/ Plano Director Municipal de Sao Miguel”: Planning /Volume III/ Master Plan of Sao Miguel Municipality.</p> <p>There are several beaches along the littoral which are well-known place for sea turtles (Calheta) to lay their eggs. Thus, any construction shall be avoided within the beach areas.</p> <p>Furthermore, more than 50% of the area of the Serra Malagueta Natural Park is in the Municipality of Sao Miguel. This park is a major protected area and shall be avoided by this project.</p> |
| São Salvador do Mundo | <p>Document collected: “Plano Ambiental Municipal De Sao Salvador Do Mundo”: the Environmental Municipal Plan of Sao Salvador Do Mundo.</p> <p>Sao Salvador Do Mundo shelters the largest forest resources of Santiago and has undergone several reforestation plans since independence in 1975. The trees help to protect soils from erosion and water resources.</p> <p>It is thus recommended that the project avoids forest areas.</p> |

| | |
|----------------------------|--|
| Santa Cruz | No document has been made available to the Study Team. |
| São Domingos | Document collected: “Plano Ambiental Municipal De Sao Domingos - 2004” : the Environmental Municipal Plan of Sao Domingos. There is special biodiversity in the Forest Perimeter of Rui Vaz and Curralinho. This area shelters several endemic species of plants and small trees and the area shall be protected. |
| Praia | Document collected: “Plano Ambiental Municipal Da Praia - 2003” : the Environmental Municipal Plan of Praia. The coastal area of Praia includes several beaches where for sea turtles lay their eggs, e.g., San Francisco. The beach areas are also protected as ZDTI in order to promote tourism. For these reasons, any construction is to be avoided in these areas. |
| Ribeira Grande de Santiago | Document collected: “Plano Ambiental Municipal/RGS - Projectos, Actividades e Orcamento - 2010” : The Environmental Municipal Plan of Ribeira Grande de Santiago - Project, Activities and Budget. The document does not include special measures to be considered regarding the environment. On the other hand, the Municipality of Ribeira Grande comprises the Cidade Velha, which is a UNESCO World Heritage site. The site consists of a fortress, historical village, the cathedral, etc., and thus these areas shall be carefully considered in regards to any new construction. |
| São Lourenço dos Orgaos | Document collected: “Plano Ambiental Municipal - Sao Lourenco Dos Orgaos” : the Environmental Municipal Plan of Sao Lourenco Dos Orgaos. The Forest Perimeter of Pico de Antonia is considered to be a Natural Park and shelters the endemic plant named “Poilao”, and is the reproduction place for the endemic bird species named “Garca Vermelha de Santiago”. This Forest Perimeter of Pico de Antonia is thus to be avoided by the project. |
| Santa Catarina | Collected Document: “Santa Catarina, CAP.II Caracterizacao Geral Do Municipio” : Santa Catarina, Chapter II General Characteristics of Municipality. The Municipality of Santa Catarina, which includes the town of Assomada, shelters a part of the Natural Park of Serra Malagueta, which is a protected area. There are also forest resources in the Serra Malagueta that are essential to local fauna and flora as well as local cultures. These areas shall be avoided by the project. |

Source: Study team

6.8 Alternative Options and Mitigation Measures

6.8.1 Analysis of Alternatives

According to the potential environmental and social threats and impact described above, alternatives and mitigation measures have to be considered. Whenever it is possible, alternatives which avoid any impact should be considered before mitigation measures.

Considering the protected beach upon which sea turtles lay their eggs and the touristic potential of the surroundings of Tarrafal, it is proposed that land acquisition for the development of a potential desalination plant shall occur on the opposite site of the island (East Coast). In such an alternative, both the touristic potential of Tarrafal and the sea turtle beach are preserved by the

project.

In the framework of the desalination plant development project lead under CAIS, land has been reserved in the surroundings of Calheta de Sao Miguel. However, hotel development projects are being implemented very close to the land. If one of the new desalination plants of the Project is constructed on this land based on the agreement with GoCV, public consultation with the local authority and owner of the hotel should be conducted thorough the EIA to avoid any problems.

6.8.2 Analysis of Mitigation Measures

When alternatives are difficult to be found, mitigation measures shall be defined according to three (3) phases of design, construction and operation:

(1) Design Phase

For this phase, community involvement should be a part of the program for the implementation stage of the project and should include:

- i. Involving local communities, local leaders and NGOs in the process of making decisions on how to implement the project and how to make the Detailed Designs (D/D) through meetings with the local population
- ii. Setting up a communication system with local communities
- iii. Awareness campaigns on water that include the following topics:
 - Information about the proposed project
 - Water and hygiene
 - Connecting to and using the services
 - Save water
 - Environmental mitigation

(2) Construction Phase

For this phase, it is recommended that the implementation of mitigation measures should be included in the contract and bill of quantities for the construction work because of the following reasons:

- i. Mitigation measures shall be implemented as a part of construction supervision

- ii. Costs for implementation of mitigation measures are reflected in the prices quoted from the contractors
- iii. The major part of mitigation measures shall be implemented under the responsibility of the contractor

According to the potential threats seen above, the following ideas are proposed as mitigation measures:

1) Land Acquisition:

The candidate sites for construction of installations shall be selected preferably within the public domain. When private sites are the sole available solution for the candidate site, it shall be far from any household and shall avoid land used for agricultural purposes, so as to reduce as much as possible the impact regarding the lives of indigenous people and local wealth. In the best configuration, the pipelines shall follow actual road networks and be buried within actual Right of Ways so as to avoid the need for private land acquisition. Should there be the case where pipelines can not follow roads, then the mitigation measures for land selection shall be set as per above policy for construction of installations.

2) Resettlement:

Where buildings may be affected by pipeline disposal, it is important to ensure the necessary information shall be provided to local people, and they shall be involved in a timely manner. Where the RoW passes through or near environmentally fragile areas, it is important that the contractor is contractually obliged to take all appropriate measures to avoid any major impact on the local environment and to restore the environment as per the state before construction.

3) Procurement and Depositing of Construction Materials:

The Contractor shall be responsible for procurement of materials from registered suppliers. Any uncontrolled carrying shall be strictly forbidden. At the same time, depositing sites shall be legal deposit places, eventually registered with the competent authority. The carrying and depositing places shall be managed so as to reduce the impact on the local environment, and the Contractor shall be responsible to ensure that all mitigation measures are taken.

4) Earth Movement and Concrete Works:

The Contractor shall avoid contamination of local underground water when pouring concrete and when washing formworks or equipment with detergents by applying, if necessary, a protection layer and treating washing water in purpose-designed basins before releasing the water into the natural environment.

5) Material Transport:

So as to mitigate any potential impact, the candidate sites shall be considered so that large constructions avoid populated places, protected areas or areas with crops and agricultural activity. In any case, the contractor shall take all measures to avoid heavy dust and noise release by frequent checking of its transportation equipment and by scheduling transportation routes so as to avoid influencing populated places, schools, universities, etc. Furthermore, all commitments shall be taken and enforced, if necessary, by special training of truck and engines conductor so as to avoid any accidents and problems related to traffic safety.

(3) Operation Phase

For this phase, mitigation measures shall be ensured through:

- i. Inclusion in Detailed Designs (D/D)
- ii. Awareness campaigns for population and staff
- iii. Training and capacity development of responsible institutions¹

According to the potential threats seen above, the following ideas are proposed as a base for mitigation measures:

1) Common results of expanding of water supply:

- Appropriate staff training for desalination plants is required for the proper handling of toxic materials to avoid any accidents and for smooth operation of the facilities.
- The distribution modalities of water shall be thought to be fair and socially oriented so as to avoid discrepancies between areas and to avoid improper development processes.
- The pricing of the water supply shall be decided through a proper consultation process so that all the opinions of representatives of the population shall be considered, including poorer citizens.

2) Desalination plants:

- Pollution of discharged water

All salt and minerals in discharged water originally come from sea water which has been

¹ The development of the details of awareness campaigns, training programs and capacity building programs must be the subject of separate studies.

desalinated. When discharging the brine back into the sea, major environmental impact can be avoided providing that the discharging pipe is designed so that high-level dilution immediately occurs at the outlet of the pipe.

➤ Chemicals and solid and liquid waste

Solid waste generated at the various facilities can be disposed of into municipal landfill legally registered as appropriate deposit sites if the solid waste is not toxic and complies with deposit regulations. Should any toxic liquids or waste occur they should be properly handled and treated by a certified company or organization before deposit into appropriate deposit facilities. All of the waste products from all facilities should be properly collected and disposed of in appropriate deposit places.

➤ Problems for neighborhoods

The construction sites of the plants shall be selected so that they are far from households and human activity. Furthermore, when operating the facilities, appropriate measures should be taken to avoid excessive noise and disturbances to neighborhoods.

6.9 Monitoring Plan

A very important aspect of environmental management is environmental monitoring. Monitoring has two aspects. The first and simplest is monitoring of compliance, which basically ensures that mitigation measures are properly implemented. This is part of the supervisory activities discussed above and is generally the one that most monitoring programs focus on.

The second aspect of environmental monitoring is impact monitoring. The main objective of impact monitoring is to determine whether the environmental mitigation measures implemented prove to be effective in reducing anticipated impacts. This monitoring allows the mitigation measures to be modified if the original measures prove to be ineffective.

6.9.1 Monitoring Policy under the JBIC Guidelines

For category A and B projects, JICA will monitor certain parameters due to environmental and social impact during construction and operation in order to confirm whether the Project could be implemented under the JBIC Guidelines or not. The necessary information for monitoring shall be provided by the relevant parties, such as GoCV, executing agency, etc., to JICA by the appropriate means.

When third parties point out in concrete terms that environmental and social considerations are not being fully undertaken, if necessary, JICA will request the relevant parties to take appropriate

action or to conduct their own investigations to confirm the state of undertaking of environmental and social considerations. JICA may also conduct its own investigations if required.

The implementation of environmental monitoring should involve MTIE as the responsible agency of EIA study, ELECTRA, SAAS and new holding company of which establishment will be examined on a parallel with implementation of the Project as the operator, and INGRH, ARE, etc as the regulator. The operator needs to know that the services being delivered are in compliance with the procedures and regulations set out by the regulating institution. The operator will need to monitor their own production. The regulator on the other hand must be able to check that all procedures and regulations are adhered to. The regulator must be able to follow closely developments on a local as well as a national level and prepare new regulations if required.

6.9.2 Recommendation for Monitoring Plan

Monitoring of environmental impact caused by the Project should be undertaken as part of an overall environmental monitoring program by the Cape Verdean side. It is important to monitor not only the affected areas but also the non-affected areas in order to establish references for the various parameters.

Monitoring plans during construction and operation shall include the following items:

1) Environmental Considerations:

Monitoring of relevant biological, physicochemical parameters in seawater, groundwater and potable water at treatment plants, distribution points and consumers

2) Social Considerations:

Monitoring of social aspects of operating the water facilities includes:

- i. Number of connections to water supply systems
- ii. Water tariff for the consumers
- iii. Public health (Number of water diseases, diarrhea, etc.)

A recommended framework for monitoring plan is detailed in following table:

Table 6.8-1: Framework for Monitoring Plan (Recommendation)

1) Environmental Considerations

| Phase | Items to be monitored | Method / Frequency | Responsible Body |
|--------------------|---|--|---|
| Design Phase | Status of Detail Design in compliance with the condition of EIA approval and periodic submission of Monitoring Report | Monitoring Report (Periodically) | MTIE (S/V consultant), Auditor designated by DGA |
| | Status of Detail Design in compliance with protected areas (especially new reservoirs and pumping stations) | Supervision of Detail Design, Periodic Meeting | MTIE (S/V consultant) |
| Construction Phase | Construction method in compliance with the condition of EIA approval and periodic submission of Monitoring Report | Monitoring Report | MTIE (S/V consultant), Auditor designated by DGA |
| | Status of procurement and depositing of construction materials in compliance with relevant laws | Supervision of Construction, Periodic Meeting | MTIE (S/V consultant), Contractor |
| | Status of application of measures to prevent dusts, uncontrolled deposits of earth and wastewater treatments | Supervision of Construction, Periodic Meeting | MTIE (S/V consultant), Contractor, Camara Municipal |
| | Status of application of measures to prevent dusts and noises and to secure from accidents during material transportations (routes for transportation, operation schedule, etc) | Supervision of Construction, Periodic Meeting | MTIE (S/V consultant), Contractor, Camara Municipal, Local Police |
| Operation Phase | Compliance with the condition of EIA approval and periodic submission of Monitoring Report | Monitoring Report (Periodically) | MTIE Auditor designated by DGA |
| | Water quality of drinking water (in compliance with national standards to be determined) Parameters(sample): Ref. Table 2.5-5 | Monthly report / Every Month | New Holding Company, External Laboratory designated by Ministry of Health |
| | Water quality of ground water from well Parameters(sample): Ref. Table 2.5-7 | Monthly report / Every Month | INGRH, External Laboratory designated by Ministry of Health |
| | Water quality of discharge water from desalination plants (in compliance with discharge standards to be determined) Parameters(sample): Ref. Table 2.5-8 | Monthly report / Every Month | External Laboratory designatd by DGA |
| | Water quality of sea water near desalination plants (in compliance with environmental standards to be determined) Parameters(sample): Ref. Table 2.5-8 | Monthly report / Every Month | External Laboratory designated by DGA |
| | Management of solid and liquid waste | Monthly report / Every Month | New Holding Company, Camara Municipal |

Source: JICA Survey Team

2) Social Considerations

| Phase | Items to be monitored | Method / Frequency | Responsible Body |
|--------------------|--|--|--|
| Design Phase | Compliance with the condition of EIA approval and periodic submission of Monitoring Report | Monitoring Report (Periodically) | MTIE (S/V consultant), Auditor designated by DGA |
| | Situation of Public Consultation | Proper Timing | MTIE (S/V consultant) |
| | Status of Detail Design in compliance with the Right of Way (RoW) (especially alignment of pipe lines) | Supervision of Detail Design, Periodic Meeting | MTIE (S/V consultant) |
| | Status of application of measures to avoid involuntary resettlements and land acquisitions during Detail Design (especially new reservoirs and pumping stations) | Supervision of Detail Design, Periodic Meeting | MTIE (S/V consultant) |
| | Status of application of measures to prevent noises from desalination plants | Examination and Approval of Detail Design | MTIE (S/V consultant) |
| Construction Phase | Compliance with the condition of EIA approval and periodic submission of Monitoring Report | Monitoring Report (Periodically) | MTIE (S/V consultant), Auditor designated by DGA |
| | Status of construction works in compliance with the Right of Way (RoW) | Supervision of Construction, Periodic Meeting | MTIE (S/V consultant), Contractor |
| | Status of involuntary resettlements and land acquisitions (including progress of compensation process) | Every 6 months | MTIE (S/V consultant), Contractor |
| | Inspection of speculative trade of real estate | Proper Timing | Camara Municipal |
| Operation Phase | Compliance with the condition of EIA approval and periodic submission of Monitoring Report | Monitoring Report (Periodically) | MTIE Auditor designated by DGA |
| | Number of residents who connect to developed water supply system | Annual report / Every Year | New Holding Company |
| | Service hour of water supply / day | Monthly report / Every Month | New Holding Company |
| | Water consumption | Monthly report / Every Month | New Holding Company |
| | Number of patients due to water diseases | Annual data / Every Year | Ministry of Health |
| | Water Tariff (Affordability for poor) | At the timing when tariff will be revised | New Holding Company, ARE |
| | Increasing of land prices around project sites | Annual data / Every Year | Camara Municipal |

Source: JICA Survey Team

Chapter 7. Conclusion and Way forward

Chapter 7. Conclusion and Way Forward

7.1 Conclusion

This Final Report was prepared in cooperation with the Ministry of Tourism, Industry and Energy (MTIE), a former MEGC, of the Government of Cape Verde through office works in Japan and fieldworks in Cape Verde from October 2009 to December 2010.

This water supply project was concluded to be technically, environmentally and financially feasible. The economic analysis was conducted in consideration of the entire island benefit, and the EIRR was calculated to be 19.2%. This project was also concluded to be a beneficial project for the Santiago Island. The conclusion of the report is described in detail below.

(1) Growth of drinking water demand in 2020

In the Progress Report, the estimated population in 2020, the target year of the project, in Santiago Island will be about 370,566; however, this figure was re-estimated at 355,319 by the latest study by the Institute Nacional de Estatistics (INE). The ratio of urban area to rural area was also re-estimated at “60 to 40” instead of “66 to 34” on the island.

The water consumption rate was also re-estimated, and summarized as in Table 7.1-1:

Table 7.1-1: Water consumption rate

| | Urban (liter/day/person) | Rural (liter/day/person) |
|------------------------------------|-----------------------------|-----------------------------|
| With public pipeline connection | 150 | 80 |
| Without public pipeline connection | 50 | 50 |
| For hotel users (tourists) | 300 | 300 |

Source: Study team

Based on the population estimates for 2020, and the growth of water consumption per person in the year 2020, daily consumption of drinking water per resident in each municipality was estimated without considering seasonal variations of population. Water consumption by tourists from foreign countries with a 40% peak factor and some industrial usages are considered. Leakage, non payment water and administrative usage were also considered. Industrial usage was estimated based on interviews from each municipality.

As a result, the Daily Maximum Demand in the island was set to be 56,229m³/day for the water supply system development plan.

(2) F/S Project capacity for water production

For the decision regarding the F/S Project capacity, the following steps were considered and discussed:

- Whole drinking water demand in 2020 : 56,229 m³/day (round figure 55,000m³/day)
- Existing desalination capacity in 2010 : 5,000m³/day, in Praia
- Planned expansion plant : 5,000m³/day, by Spanish Government, in Praia
- Planned plant : 5,000m³/day, by World Bank, in Praia
- Additional capacity for total demand : 40,000m³/day
(= 55,000m³/day – 5,000m³/day/unit x 3 units)

Although some small desalination plants with a capacity of 500m³/day and 1,200m³/day are already in service, and some private desalination projects are planned, this total capacity was not counted due to uncertainty.

(3) Water quality analysis

Water quality analysis was conducted by the local laboratory Inpharma under instruction from the JICA study team. The following are samples of water resources and analysis of results, with additional comments:

- a) Desalinated water from existing desalination facilities in Praia and Santa Cruz
 - The quality of the water is generally within or close to the allowable level for drinking water
 - The chloride and boron content in Praia are slightly higher than WHO guidelines
- b) Beach well water for the existing desalination plants in Praia and Santa Cruz
 - No serious issues were found
- c) Ground water near the candidate sites for planned water distribution
 - The quality of the water is within the allowable level for drinking water
 - The nitrate level, total coliform and total hardness should be further investigated
- d) Sea water around the candidate sites for the planned and future desalination facilities
 - No serious issues regarding RO desalination application were found
 - Slightly higher salinity than general sea water was observed
 - Ordinary pre-treatment is required for RO desalination

- The analysis results were applied to the conceptual design of the planned desalination facilities

(4) Geotechnical Survey

The geotechnical survey was conducted by the Portuguese company Tecnasol under instruction from the JICA study team. The following are the results, briefly discussed, and additional comments:

- a) 3 vertical boreholes were drilled.

A hole was drilled in the area of ELECTRA Palmarejo, where the candidate site of the sea water desalination facility is planned.

Another two holes were drilled near Calheta city, one of two where the candidate site of the sea water desalination facility is planned.

- b) 20 trial pits were dug for assessing the geotechnical characteristics and collecting samples along the candidate water transmission lines.
- c) Dynamic tests were also carried out to determine the resistance of the ground to penetration.
- d) 4 trail pit samples were collected and analyzed on soil corrosivity, pH, bulk density and sulphides and moisture.

Comments

- 1) No serious issues regarding the selecting of ductile and HDPE for water transmission pipes were found.
- 2) The allowable ground bearing pressure was estimated as "high (good)" because of the rock or gravel composite condition.
- 3) A compression test for rock or gravel may be necessary for confirming the allowable ground bearing pressure for a detailed design.
- 4) For backfill compaction after laying the transmission pipe, some sand material will be necessary for protecting the piping surface.

(5) Drinking Water Quality in Product Water from the Desalination Facility

In Cape Verde, water quality standards are not yet regulated, though the Ministry of Health of Cape Verde is drafting standards. The drinking water quality supplied by the project basically follows WHO guidelines for Drinking Water, 3rd edition, 2008.

(6) Ground Water Utilization

Ground water utilization was studied and discussed from the viewpoints of cost reductions in investments in the project, boron content reduction and drinking water quality improvement. Because of the government policy that ground water will be utilized for irrigation purposes after completion of an adequate amount of the network for desalinated water, it was concluded that there would be no utilization of ground water for the study.

(7) Water Supply System Basic Planning

3 cases were developed in the Progress Report, and the additional case (Case 4), which was modified from cases 2 and 3, was developed from the main viewpoints of water supply service and operation and maintenance flexibility. Reference is made to Figure 7.1-1. Through careful discussions, GoCV and the JICA study team opted for Case 4 as the feasibility study target. The 3rd Steering Committee also confirmed this decision.

CABO VERDE - Water Supply System of Santiago Island



Altitude levels are indicative
Pumps location and reservoirs locations are indicative

Source: Study team

Figure 7.1-1: F/S Project Image (Case 4)

(8) Sea Water Desalination Facility

The conceptual design of two (2) sea water desalination facilities was undertaken.

The outcome of the design consists of System Description, Material Balance, Flow Sheet, Equipment list with short specifications, General Layout and Plot Plan of the RO System.

Based on the above outcome, the CAPEX and OPEX of the two facilities were estimated.

(9) Water Transmission Facility

A conceptual design of the water transmission facility was undertaken.

The design consists of a System Description, Water Transmission Pipe list with short specifications, Pumping Station list with short specifications and Water Reservoirs list with short specifications.

The following drawings are attached:

- Overall water transmission facility on a map of Santiago Island
- Typical reservoir
- Typical pumping station

Based on the above outcome, the CAPEX and OPEX of the facility were estimated.

(10) Economics Study

An economics study was conducted using the Financial Internal Rate of Return (FIRR) method with a drinking water tariff of US\$5/m³, and is summarized as in Table 7.1 -2:

Table 7.1-2: IRR at Base Case (FIRR, before tax)

| Project | S1 | S2 | N1 | N2 |
|---|--------|-------|--------|-------|
| Production capacity (m ³ /day) | 15,000 | 5,000 | 15,000 | 5,000 |
| Sales capacity (m ³ /day) | 13,500 | 3,000 | 13,000 | 5,000 |
| Total capital requirement (million US\$) | 72.0 | 26.0 | 77.6 | 32.7 |
| Plant construction cost (million US\$) | 68.0 | 25.0 | 74.0 | 31.0 |
| Others (million US\$) | 4.0 | 1.0 | 2.6 | 1.7 |
| Sales (million US\$/year) | 24.6 | 5.5 | 23.7 | 9.1 |
| Direct cost (note) (million US\$/year) | 11.5 | 3.7 | 13.6 | 3.6 |
| Gross profit (million US\$/year) | 13.1 | 1.8 | 10.1 | 5.5 |
| FIRR, before tax (%) | 16.2 | 2.9 | 10.9 | 14.7 |
| FIRR, after tax (%) | 13.6 | 2.5 | 9.2 | 12.4 |
| Benefit population* (thousand) | 67 | 29 | 116 | 53 |

(*) Total benefit population is 265 thousand.

Source: Study team

S1 shows the highest F-IRR value, and N2, N1 and S2 follow accordingly.

The economic analysis was conducted in consideration of the entire island benefit.

The following benefit was tentatively set:

- Release from water collection work, and increase the opportunity to join the other social job
- Use of underground water to agriculture
- Decrease of medical expenditure by improving sanitary conditions

The EIRR was calculated to be 19.2%. This project was also concluded to be a beneficial project for the Santiago Island.

(11) Implementation Planning

Construction planning and an implementation schedule were developed through and based on the system design and field work.

No critical issues regarding the construction of the system were found.

Due to the long transmission line construction period, multiple construction teams would be organized for effective and reasonable planning.

(12) Project Risk

No critical risk was found.

Water transmission construction, power supply, and beach well water are listed as medium technical risks.

Operation and maintenance are also listed as medium risks.

(13) Operation and Maintenance Planning

There is no organization which comprehensively manages and supervises waterworks and O&M at a whole island level.

Considering the current waterworks situation and the nature of the project, O&M systems in the transition period and in the future are recommended.

In the transition period, two water supply systems will be established in the south and the north of the island. The desalinated water produced by 2 desalination facilities in the southern and northern regions will be transmitted and distributed to target municipalities.

As a future scenario, an inter-municipal public holding company will be established to comprehensively manage and supervise the water supply system in southern and northern regions.

(14) Initial Environmental Examination

The Initial Environmental Examination (IEE) of the F/S Project took place from October 2009 to July 2010. The IEE has been carried out in accordance with the JBIC Guidelines dated April 2002 and relevant laws of the GoCV. In the IEE stage, general environmental impacts were presumed according to dialogues with local stakeholders for environmental management through an “Inter-municipal Meeting for Environmental Issues” conducted by the study team in May 2010 in Praia. In conclusion, the general measures for environmental management are summarized in each municipality’s Municipality Development Plan (PDM) and Municipality Environmental Plan and those measures should be considered at the stage of the F/S Project formation and IEE.

(15) Fund Plan

This survey report recommends making an application for Japan’s official development assistance (ODA) financing facilities, which are to support economic and social development in Cape Verde in line with the Japanese government’s medium- and long-term ODA policy.

From the viewpoint of this project’s characteristics, an application for Special Terms for Economic Partnership (STEP) might be expected.

7.2 Way forward

Major items as the way forward conducted by the GoCV are as follows:

- 1) to review this Final Report
- 2) to discuss the financing and funding in consideration of Japan’s ODA loan system
- 3) to initiate an Environmental Impact Assessment
- 4) to decide on the project’s priority in consideration of the GoCV policy and Japan’s ODA loan policy