

7 INITIAL ENVIRONMENTAL EXAMINATION (IEE)

7.1 Background

(1) Existing Environmental Situation

The Union of Myanmar is a land endowed with mostly semiarid monsoon forests and monsoon rainfall. However due to the cutting of trees for firewood, land development for agriculture, forest fire, etc., the forest land, which was originally two third of the total territory was considerably reduced. What has ever worsened the situation is that the insurgents recklessly cut the teak trees for money while the poor people enlarge the agricultural land for poppy growing. Moreover the reduction of forest area has led to soil erosion which in turn results in the reduction of natural recovery of soil fertility.

The wide variety of forest types including mangrove provide for a rich diversity of flora and fauna. As a result of its unusual ecological diversity, Myanmar is home to more than 300 known mammal species, 400 reptile species and 1000 bird species and a haven for about 7000 species of plants. It is however noticeable that the biological resources have deteriorated over the decades due to disturbances caused by humans and fragmentation of habitats.

Large number of wild elephants are captured annually under a Control Scheme administered under the Forest Department to replenish herds working in Timber industry. Despite protection measures by the Forest Department, elephant population is subject to illegal poaching for tusks in a number of areas.

The development works on water resources have been conducted by various departments of the Government of Union of Myanmar, but mostly without any environmental impact consideration. Most of the dams constructed so far have not had the reserved volume of storage water for the drinking water component. Moreover, also the laws and regulations on the environmental impact studies have not been enacted. Overall judgment based on the existing conditions reveals that there should be an authority or a coordinating committee that will regulate, monitor and coordinate the water resources development activities of the various Ministries, such as the Ministry of Progress of Border Areas and National Races and Development Affairs, Ministry of Agriculture and Irrigation, Ministry of Construction and Ministry of Energy, etc.

(2) Environmental Management Activities

Previously before 1992, environmental management pattern was directly administered by the respective ministries without a central coordinating environmental institution in Myanmar. But in 1992, an institution called the National Commission for Environmental Affairs (NCEA) was established under the Ministry of Foreign Affairs to manage and coordinate the environmental affairs of the Union of Myanmar as a separate entity. The NCEA has also been making sustained effort for enhancing public awareness and participation in environmental protection activities. Workshops, seminars and training courses have also been held with the aim of disseminating education and disseminating knowledge on environmental protection among the departments and the public.

The NCEA serves as the main contact point for external and internal environmental affairs. At present the Commission is preparing the Environmental Law and the Environmental Impact Assessment Law, it is learnt, the draft of which shall be thoroughly reviewed and finalized later.

With respect to the water quality standard, the WHO standard is used as a national standard without adopting Myanmar's.

NCEA has also formulated Myanmar Agenda 21 as an expression of the political commitment of the Government to sustainable development in line with the Historic Earth Summit in 1992.

These efforts and policies by NCEA are quite praise worthy, but it is to be pointed out here that actual practices are important as far as environmental affairs are concerned, such as monitoring the environmental conditions of big cities, rural areas, industries, rivers, lakes, forests and so on. Monitoring may require sophisticated instruments, but monitoring by eye, ear or nose is still sufficient for some cases in question.

The following materials were collected from the National Commission for Environmental Affairs on 10th September 2001.

- 1) National environment policy of Myanmar
- 2) Water and Air Pollution Control Plan (Standing Order No. 3/95) Ministry of Industry (1)
- 3) Myanmar Laws Relating to Environment
- 4) Brief Environmental Situation in Myanmar
- 5) International Environmental Conventions / Protocols Signed/ Ratified by Myanmar

Myanmar has the following environmental laws.

- ✧ The Protection of Wild Life and Wild Plants and Conservation of Natural Areas Law, 1994
- ✧ The Forest Law, 1992

The environmental conservation is controlled on the basis of these laws in Myanmar. Air quality protection law is not yet enacted.

In 1994, a very important environmental organization called the Dry Zone Greening Department was established under the Ministry of Forestry. The main objective of the Department is to save the dry zone from the deteriorating environmental situation, such as increasingly hot climate, decreasing rainfall, land erosion, stagnating agricultural production, shortage of domestic water, etc. The following maps and documents were able to be referred in the Dry Zone Greening Department.

- 1) Land Cover Maps of Dry Zone in Myanmar (13 Districts)
- 2) Current Land-use Status of Dry Zone
- 3) Environmental Situation in the Dry Zone
- 4) Characteristics of Dry Zone.

7.2 The Project

The environmental policy shall be to conduct the initial environmental examination in compliance with the environmental law and the environmental assessment law of the Union of Myanmar if they were in existence or enacted during the course of the study.

But these environmental laws were not established as yet. Since environmental guidelines were not yet established in the Union of Myanmar, the IEE shall be conducted in accordance with the environmental guidelines that are in particular formulated for groundwater development projects by JICA.

JICA's guidelines are based on the principles of promoting sustainable development while improving the living standard of the residents. The guidelines aim at harmonizing the development with a desirable environment.

By the study on initial environmental examination (IEE) or "Environmental Consideration", it shall be judged whether the project has significant impacts on the environment or not, to assess the impacts and to incorporate measures to prevent or alleviate their effects, if necessary. The IEE is a prerequisite (a standard practice) for the sustainability of the

development.

7.3 Scope of the Examination

The Initial Environmental Examination (hereinafter called “IEE”), a standard practice at the stage of master plan study, is carried out here to clarify the environmental impacts that may result from the implementation of this project on the basis of the existing information and data in a short period at a low cost. The present IEE is conducted with the following two objectives.

- 1) to evaluate whether Environmental Impact Assessment (hereinafter EIA) is necessary for the project at the project implementation stage and, if so, to define its contents and
- 2) to examine from an environmental point of view the measures for alleviating the effects of the project which require the environmental consideration, but not a full-scale EIA.

If IEE shows the serious impacts on the existing environment, EIA shall be conducted at the stage of Implementation Study.

7.4 Framework for Initial Environmental Examination (IEE)

The IEE shall be conducted in accordance with the process that consists of the following four activities:

- 1) basics to the process,
- 2) description of environmental setting,
- 3) impact prediction and assessment and
- 4) proposing remedial measures.

7.5 Basics to the Process

As stated above, the IEE shall be conducted on the basis of the standard of environmental assessment practice laid down by JICA.

7.6 Description of Environmental Setting

- (1) Purpose

- 1) To get the basic idea on the project for assessment of environmental impacts
 - 2) To provide sufficient information for the decision makers
- (2) The description of the environmental setting includes the following.
- 1) Project Description
For the project description, refer to Table 7.1. It includes background, objective, location, executing agency, beneficial population, features of the project, etc.
 - 2) Site description
For general features of the project site, refer to Table 7.2. It includes the environmental parameters, such as socio-economic environment (inhabitants, facilities pertinent to livelihood), natural environment (topography and geology, groundwater, lakes, rivers and meteorology, indigenous rare species of flora and fauna), environmental pollution (complaints and counter-measures) and others. For more details on the description of the environmental setting, refer to Table 7.6(1) to Table 7.6(2), which gives further information on the project site with photographs.

7.7 Impact Prediction and Assessment

Prediction and assessment of impacts from the project on the physical, chemical, biological, cultural, and socioeconomic environment (scoping) is carried out as a part of this initial environmental examination. The results from scoping are stated in Table 7.3.

Table 7.4 shows further studies conducted on the environmental parameters that are likely to be impacts from the project as derived from scoping.

7.8 Impacts from the Project and Counter-measures

In Table 7.5, the impacts from the projects are stated and remedial measures are proposed. However, no serious impacts are foreseen.

7.9 Conclusion

The present IEE shows that the project has no serious impacts on the existing environment. Hence it is concluded that the Environmental Impact Assessment (EIA) is not necessary to conduct at the stage of Implementation Study.

Table 7.1 Project Description
Water Supply Improvement Plan in Central Dry Zone

| Item | | Description |
|-----------------------------|---------------------------------|---|
| Study Name | | Water Supply Improvement Plan in Central Dry Zone |
| Background | | During the rainy season from May to October, people have to engage in farming with a scanty rainfall of 400 ~ 850 mm. The necessary water for living is obtained from ponds and shallow wells. Hand pumps are provided to the residents by UNDP and UNICEF for use with shallow wells. Most villages have shallow wells dug by hand. However, during the months of February ~ April, numerous ponds and wells are dried up. Thus the villagers have to travel several miles or tens of miles spending a whole day to get potable water from villages that have deep wells. For them it is a matter of life and death to secure water during summer. |
| Objective | | Hydro-geologic analysis will be conducted and tube well zoning maps required for the village water supply scheme will be made up. Then medium-term water supply schemes for the villages shall be envisaged. |
| Location | | Mandalay Division, the Union of Myanmar (Kyaukpadaung, Taungtha, Natogyi, Myingyan, Nyaung U, Pyawbwe,) and Magway Division, the Union of Myanmar (Chauk, Magway, Pakokku, Yezagyo, Myothit) |
| Executing Agency | | Department of Development Affairs, Ministry of Border Areas and National Races and Development Affairs |
| Beneficiaries | | 2.5 Million Population estimated as of July 2000 |
| Components of the project | Type of the project | New wells and extension of facilities |
| | Main features of the project | Drinking water |
| | Scale of Project /water quality | Depth to source: 100~300 m Water quality: Generally fair |
| | Major Structures | Tube wells Pumps shall be provided for pumping water into brick or concrete tanks. |
| | Reservoir facilities | Tank shall be installed near each tube well. |
| | Purification plant | Not required |
| | Appurtenant Facilities | No power line or facilities required. Pumps shall be driven by diesel engines. |
| Other items to be specified | | The tube-wells are originally dug for groundwater investigation. They shall be later used practically for water supply to villages. |

Table 7.2 Site Description
Water Supply Improvement Plan in Central Dry Zone

| Item | | Description |
|----------------------------|--|--|
| Study Name | | Water Supply Improvement Plan in Central Dry Zone |
| Socio-economic Environment | Inhabitants: (Residents/ Indigenous/ their views on the project, etc.) | Village tracts in Central Dry Zone, Union of Myanmar. The people are mostly of Myanmar tribe. Almost all of them are Buddhists. They depend on subsistence agriculture. Some are going out of their village to work as migrant workers. The people are very glad that this project gets started and they will be free of worries about the supply of drinking water. |
| | Public Facilities pertinent to livelihood (wells, reservoirs, water supply / electricity facilities) | Water supply facilities have been constructed, but these are still insufficient. During dry season, some villagers have to fetch drinking water from a several miles far-away village where good deep-well drinking water is available. Most villages are short of electricity. |
| | Public health and sanitation (illness, infectious diseases, hospitals, sanitary habits) | Some wells have a high salt content. The salt content is so high that the water is not good for drinking. These areas have very few reservoirs constructed for drinking water. Small village ponds are made up at lowland areas, but most of these ponds dry up in dry season. |
| Natural Environment | Topography and geology (steep slopes, soft grounds, wetlands / faults, etc.) | The geology is varied according to location in the central dry zone. Hard rock foundation exists in the area. The area is, with an exception of Mount Popa, mostly a flat plain stretching hundreds of kilometers from Mandalay to Magwe. Here Mount Popa is an extinct volcano. No major fault exists in the area. |
| | Ground water, lakes, rivers, climatology (water quality, quantity, rainfall, etc.) | In dry season, almost all the rivers and creeks dried up with sand river-beds exposed. The groundwater layers with a high content of salt exist in some places in Myingyan, Taungtha, Yezagyo and Pakokku townships. |
| | Indigenous rare species of flora and fauna, their habitats (National parks / habitats of rare species, etc.) | No species of flora and fauna are reported in the central dry zone. |
| Environmental Pollution | Complaints Pollution of the utmost concern | No complaint is reported as to pollution. |
| | Measures (Institutional measures / compensation, etc.) | National Commission for Environmental Affairs (NCEA) was established in 1992. |
| Others | Climate | The central dry zone is hot and dry in climate with day time temperature going up to 40 degree C in the month of April or May. Domestic water demand is rather high. Plenty of water is necessary for the livelihood of the people. |

For further details on the site description, refer to Table 7.6 (1) to Table 7.6 (4).

**Table 7.3 Results from Scoping
Water Supply Improvement Plan in Central Dry Zone**

| Environmental Item | | | Evaluation | Reason or Ground |
|--|----|---|------------|--|
| Socio-economic Environment | 1 | Resettlement of residents | D | As tube wells are of small size, their locations can be changed easily. No resettlement. |
| | 2 | Economic activities | D | No disturbance to peoples' economic activities. |
| | 3 | Transportation and public facilities | D | No disturbance to public facilities. |
| | 4 | Split of communities | D | No resettlement. Hence no split of communities. |
| | 5 | Historical relics and cultural heritage | D | No impacts on historical relics and cultural heritages |
| | 6 | Water right of users | C | Water rights are to be clarified with government authorities. |
| | 7 | Public health and sanitation | D | Shall be improved |
| | 8 | Waste | D | No waste generated |
| | 9 | Hazards (risk) | D | No occurrence |
| Natural Environment | 10 | Topography and geology | D | No major changes of topographic condition |
| | 11 | Soil Erosion | D | No major changes of soil or topography. |
| | 12 | Ground water | C | Possibility of ground water draw-down |
| | 13 | Lakes and river flow | D | No water intake at any river |
| | 14 | Coastal and coastal zone | D | No coastal area in the project |
| | 15 | Flora and fauna | D | The existence of rare species not identified. |
| | 16 | Meteorology | D | No facility shall change meteorological condition |
| | 17 | Aesthetic appearance | D | Small scale structures, No effect on the aesthetic appearance |
| Environmental Pollution | 18 | Air Pollution | D | No facility to pollute air |
| | 19 | Water pollution | D | Mud water shall be generated during drilling only |
| | 20 | Soil contamination | D | No big construction work to contaminate soil |
| | 21 | Noise and vibration | C | Noise to be clarified. |
| | 22 | Ground subsidence | C | Due to excessive withdrawal of groundwater, ground subsidence is to be clarified. |
| | 23 | Offensive odor | D | No facility to make bad smell |
| <p>Note;</p> <p>A : Great impact</p> <p>B : Some impact is expected</p> <p>C : Not clarified. (require further investigation in the initial environmental examination (IEE))</p> <p>E : Almost no impact, not to be included in IEE.</p> | | | | |

**Table 7.4 Impacts under Analysis for Initial Environmental Examination
Water Supply Improvement Plan in Central Dry Zone**

| No. | Environmental Impacts due to the Project | Analysis Conducted | Remarks And Expected Impacts |
|------------|---|---|---|
| 1 | Water rights | The groundwater development is carried out by the government which is the supreme owner of groundwater rights. | No impacts foreseen |
| 2 | Groundwater | Study on the groundwater potential reveals that the total quantity of potential groundwater far exceeds the quantity extracted by the newly dug wells. | The extracted volume is rather small (less than 1 m ³ /sec). Thus no impact is foreseen. |
| 3 | Ground subsidence | Study on geological condition of the ground, such as the thickness of clay layer, etc. reveals that ground subsidence is not likely to occur. Extracted amount is so small that the groundwater table shall not be altered. | No ground subsidence is expected. |
| 4 | Changes of flow in Lakes and Rivers | No major hydraulic structure is planned to construct on lakes or rivers. Hence no changes occur to the existing lakes and rivers. | No impacts on lakes and rivers. |
| 5 | Noise | Noise shall be generated during tube well drilling only. | No impact is foreseen. |

**Table 7.5 Environmental Impacts from the Proposed Project
Water Supply Improvement Plan in Central Dry Zone**

| Environmental Item | Environmental Impact | | Evaluation and Counter-measures |
|-----------------------|--|---|---|
| | Existing (2002) | Future (2004) | |
| Water rights | Existing tube wells are functioning properly except the shortage of fuel for pumps. No problem exists on groundwater right. | Newly dug tube wells shall not obstruct the function of existing groundwater facilities. | No problem with groundwater right |
| Noise from pumps | Pumping at the existing tube wells in the Central Dry Zone does not generate any significant noise. | New pump houses for newly dug tube wells will not be a source of noise. Noise may be a problem during the time of tube well digging only. | No significant impact is anticipated in future. |
| Wastewater generation | Generated wastewater from existing water supply system is rather small in quantity, the drainage channel and drainage facilities are sufficient. | New drinking water facilities will generate small amount of waste-water. | No problem with respect to waste water. |
| Ground subsidence | Extracted amount is rather small in quantity. No impact is reported as to ground subsidence. | The newly constructed wells are small in number (approximately 10 tube wells) for a township. No problem as to ground subsidence is foreseen. | No significant impact is anticipated. |
| Groundwater drawdown | No problem of groundwater drawdown is reported. | Approximately 10 tube wells for a township | No problem of groundwater drawdown is anticipated in any township |

Table 7.6 (1) DESCRIPTION OF ENVIRONMENTAL SETTING
Water Supply Improvement Plan in Central Dry Zone









| | |
|---|--|
| Environmental Parameter | Natural Environment: Groundwater, lakes and rivers |
| Sites under Study | Ayeyawaddy River, Mount Poppa, Welaung Village, Natogyi |
| Scope of Study | |
| Existing water environment of the Central Dry Zone | |
| Other Information | |
| <p>In most areas of Central Dry Zone, the groundwater is salty with an exception of those areas such as Mount Poppa, river belts of Ayeyarwaddy and big seasonal rivers like Sindewa, Pin, Yin, etc. including low land areas. The groundwater of shallow wells (less than 80 m depth) is generally of low quality. The groundwater quality is depending upon the type of subsurface soil. The people of almost all the inland areas away from Ayeyarwaddy have to rely on groundwater from tube wells or hand-dug wells for drinking and domestic use. In some parts of dry zone like Oppo village in Taungtha township, the groundwater is not only of inferior quality, but also the quantity is insufficient. Lakes are few in those areas except drinking water ponds near the villages. These ponds mostly dried up in dry season. Hence the people have to drink low-quality groundwater in dry season. Seasonal rivers are numerous on both south and north sides of Poppa in the Central Dry Zone. Some seasonal rivers have water flowing occasionally during monsoon season that lasts for nearly six months from June to November. The people along the big seasonal river “Sindewa” flowing on the northern region of Mount Poppa have to rely on Sindewa’s groundwater obtained from digging shallow wells (1 to 2 meter depth) in the riverbed for drinking. Although the water of the tributaries is salty, the water quality of Sindewa is surprisingly good for drinking.</p> | |
| Overall Judgment | |
| <p>The Central dry Zone’s water environment is bleak especially during four months of dry season from March to June and also especially for the areas which are far away from the Ayeyarwaddy river. But the water environment along the Sindewa seasonal river is quite satisfactory. The water environment of the area has been considerably improved as a result of construction of numerous storage dams across big seasonal rivers and their tributaries.</p> | |
| Photographs | |
|  |  |
| | |
|  |  |
| 1. Ayeyawarddy River at Pagan | 2. Hand-dug Tube Well at Yezagyo |
| 3. Sindewa Seasonal River upstream of Confluence with Ayeyarwaddy | 4. Village Drinking Water Pond at Kyaukpadaung |

Table 7.6 (2) DESCRIPTION OF ENVIRONMENTAL SETTING
Water Supply Improvement Plan in Central Dry Zone

| | |
|--|--|
| Environmental Parameter | Socio-economic Environment: Facilities pertinent to livelihood |
| Sites under Study | Cultural Properties, Wells, Reservoirs, Water Supply, Electricity in 11 townships |
| Scope of Study | |
| Water supply facilities and peoples' living condition | |
| Other Information | |
| <p>In the Central Dry Zone, some dams were constructed across seasonal streams to form reservoirs for irrigation of tropical crops such as maize, groundnut, sunflower, cotton, sesame, etc. But the irrigated area is small compared to the total area under cultivation. Hence, plantation has to rely on mostly natural rainfall. Crop failure is rampant due to the erratic nature of rainfall. The peoples are consequently living on the subsistence agriculture resulting in poor living standard. Some young men have to work a long way from home for additional income. These young migrant workers are not coming back to their home country. Thus the population of the rural area is not increasing as predicted. The cultural heritage at Pagan (the temples) attracts visitors from all over the world and it is transformed into a tourist industry that increased the foreign exchange earning of the country. Taung zin water supply project (pumping from Ayeyarwaddy) that has been recently carried out is supplying water to rural areas (100,000 population) in Nyaung U township and some areas far away from Ayeyarwaddy are getting drinking water from deep tube wells dug by JICA assistance. Kyaukpadaung is getting potable water from Mount Popa where spring water is available throughout the year.</p> | |
| Overall Judgment | |
| <p>The socio-economic environment is not favorable. This is due to the lack of a pleasant water environment. Good-quality water supply system shall enhance the improvement of socio-economic environment of the Central Dry zone.</p> | |
| Photographs | |
|  |  |
| (1) Cultural Heritage at Pagan | (2) Taungtha Dam for Irrigation |
|  |  |
| (3) New Tube Well at Tanaungwin, Nyaung U | (4) Spring Water Intake (Popa) for Kyaukpadaung |

Table 7.6 (3) DESCRIPTION OF ENVIRONMENTAL SETTING
Water Supply Improvement Plan in Central Dry Zone

| | |
|---|--|
| Environmental Parameter | Natural Environment: Topography and Geology |
| Sites under Study | 11 Townships in Central Dry Zone, 6 in Mandalay Division and 5 in Magway Division |
| Scope of Study | |
| Topography and geology of the area, living standard | |
| Other Information | |
| <p>The land in Central Dry Zone is quite flat with a slight difference of elevation. As the rainfall is scarce, upland crops such as maize, groundnut, sunflower, cotton, sesame, etc. are being planted. The Central Dry Zone is endowed with at some places fertile soil. The only mountain that can be found in this vast plain is Mt. Popa, which stands high in the sky towering to an altitude of 1518m. It is an extinct volcano. It has a high potential of groundwater (approximately 2 million gallons per day) out of which 0.8 million gal per day is being used for water supply to Kyaukpadaung, 13 km away from Mt. Popa, and also for near-by 16 villages. Chauk is an old oil field where oil yield is decreasing as the result of long-term extraction.</p> | |
| Overall Judgment | |
| <p>The natural environment is not favorable as the area is hot and dry with an annual rainfall of around 600 mm. Unless new oil fields are found in this area, the economic situation is bleak. Export quality dry-zone fruits should be planted for export to improve the general standard of living. Overall judgment reveals that good quality potable water supply is essential for improvement of socio-economic environment in Central Dry Zone.</p> | |
| Photographs | |
|  |  |
| 1. Natogyi area waste land | 2. Mount Popa (extinct volcano) |
|  |  |
| 3. Agricultural land (flat and good for upland crops) in Yezagyo Township | 4. Oil field at Chauk |

**Table 7.6 (4) DESCRIPTION OF ENVIRONMENTAL SETTING
Water Supply Improvement Plan in Central Dry Zone**

| | |
|--|--|
| Environmental Parameter | Socio-economic environment: Public Health and Sanitation, |
| Sites under Study | Water Supply facilities, Water Quality |
| Scope of Study | |
| Myingyan, Chauk and Magway water supply facilities | |
| Other Information | |
| <p>The people in the Central Dry Zone except those living near the Ayeyarwaddy River have to rely on groundwater for drinking and domestic purpose. The problem mostly encountered in using the groundwater is that potable groundwater is hardly available as it is of an inferior quality due to a high content of minerals and salts. This is true especially for Taungtha, Natogyi and Myingyan townships where groundwater is available in large quantity by digging anywhere at a depth of 20 m to 100 m, but potable water is quite scarce. This problem is solved in the case of Taungtha Township where people living in the northern side of Mt. Popa can get potable water from Sindewa big seasonal river. Numerous small seasonal rivers are flowing into Sindewa, but Sindewa water is potable as its discharge is too big to be diluted by small rivers with salty water. In fact, the water supply of Myingyan Township is being pumped out groundwater by submerged pumps near Ayeyarwaddy. Although the water is of low quality, people in Myingyan have to drink the groundwater as no other potable water is available. No water supply project was ever envisaged to make use of Ayeyarwaddy River which is flowing near Myingyan. A water supply scheme has been planed by WRUD for Myingyan and Taungtha to make use of Sindewa's groundwater (shallow wells in river bed). The plan is to pump the Sindewa's groundwater to Mt. Taungtha to achieve water supply by gravity flow. The scheme has not been materialized until the present time.</p> | |
| Overall Judgment | |
| The waters from some wells are being tested regularly. In water scarce areas such as the interior areas of Magway Division like Myothit, water is important even if it is of an inferior quality. | |
| Photographs | |
|  <p>1. Groundwater pump station in Myingyan</p> |  <p>2. 1-million gallon reservoir at Chauk</p> |
|  <p>3. JICA Assistance Tube-well at Magway</p> |  <p>4. Salty Water Hand dug well at Welaung, Taungtha Township</p> |

8. TECHNOLOGY TRANSFERRED IN THE STUDY

All the field works had been carried out in cooperation with the Study Team and engineering staff of DDA. The status of technology transfer in the Study were as follows:

(1) Test Well Drilling

Drilling of 23 test wells was conducted in cooperation with 4 drilling teams of DDA during eight months under supervision of two Japanese experts of the Study Team. A drilling team normally consists of one driller head and one assistant driller and three or four supporting staff. In each village about 10 unskilled workers were employed for assisting various drilling works such as fitting and detaching drilling bits, rods or accessories, collecting the cutting slimes, bentonite mixing and so on. The driller heads had about 20 year drilling experiences and showed a high applicable performance during the work. However, it was observed that they needed a basic drilling operational technology and also they had not adequate experiences of drilling tube wells of over 200 m depth. Therefore, Japanese expert gave OJT basis trainings about mud mixing, drilling speed control suitable to the ground conditions, well logging, recording of drilling column, etc. Through this training the drillers have mastered applicable technologies to be adopted in the fieldwork. The drillers have also understood difficulties of drilling in case depth of the tube well exceeding 200 m in the Study area.

(2) Hydrogeological Prospecting

DDA had owned electrical resistivity sounding equipment, which had been donated through Japanese grant aid projects in 1980s. The equipment, however, had deteriorated and been left in the case without repair for years. Although DDA has some talented geologists who have basic knowledge about the hydrogeological prospecting technology, they had no chance to apply their particular knowledge in the field after the equipment became out of order. Therefore, drilling work had been managed depending on the experiences of drillers or their intuition, so drilling ended in failure sometimes.

JICA provided a set of electrical resistivity sounding equipment and a set of electromagnetic sounding equipment to DDA through this Study. Electrical resistivity sounding technology was transferred through actual survey work, which had been conducted in the entire 110 target villages for four months under instruction of two Japanese experts in this Study. Electromagnetic sounding technology, which was new to DDA, was also transferred through one-month training consisting of lectures and OJT basis fieldwork. This survey was

conducted at 15 villages in four Townships, where the underground feature had not been traced so clearly by the electrical resistivity survey. The geologists have mastered how to operate the both equipment and to evaluate the survey results through the fieldwork. The results obtained through these surveys were referred for decision of drilling depth or aquifer positions. DDA is now capable to manage hydrogeological prospecting by its self. DDA has recognized the effectiveness of these hydrogeological prospecting technologies and made a plan to expand the survey area to Sagain Division in the Central Dry Zone.

(3) Formulation of Well Database

There are thousands of tube wells in the Central Dry Zone, however, data of these tube well had not only been stored properly but also the items of information of the tube wells had not been standardized. Therefore, it was very difficult to collect or compile relevant data and analysis hydrogeological conditions based on the existing tube well conditions.

A well database covering the 11 targeted Townships was formulated by the Study. A GIS software was introduce to formulate the database and various data processing works such as scanning topographic maps as base maps, coordinating latitude and longitude ranges, plotting and digitizing line and features of roads, rivers railways, etc., collecting well data, and imputing data were conducted in cooperation with several counterpart engineers.

In the Study, items of information were standardized and a data sheet for tube well conditions was prepared based on the standardized items. The data have been collected after the data sheet was filled out for each tube well. The data of each tube well was input and compiled for visualizing the location of tube well on a map and necessary information in various table. More than 1200 data of tube wells have been compiled in database through the Study. Data shall be updated and accumulated as new well data are collected or new tube wells are completed. On the occasion of completion of the database, DDA has organized a special section for dealing the database. There are several engineers and operators in a computer room equipped with about 10 computer sets in the Headquarter. Engineers in charge have mastered perfectly to operate and modified the database.

Through the experience of database formulation, DDA recognizes the advantage and began with expanding the covering area of database to manage the nationwide improvement of infrastructures. It is expected that the database will become the reliable data source by accumulating more data and DDA will use it efficiently for promoting the rural water supply development projects in near future.

9. PROJECT EVALUATIONS

9.1 Technological Evaluation

The Government of Myanmar is implementing “10 Year Project for Rural Water Supply from 2000 to 2010” in three Divisions located in the Central Dry Zone. The proposed project in this study aims at improving water supply conditions in rural area. And it consists of the part of procurement of necessary equipment and materials for well drilling of 120 deep tube wells in 110 of target villages and another part of construction to be managed by the Government of Myanmar within five years. The number of the targeted villages corresponds to about 12 % of the total number, 967, of villages where deep tube wells were planned to be drill in the “10 Year Project”. After completion of the proposed facilities, the drilling equipments are expected to utilize continuously to contribute greatly for groundwater development in Myanmar.

DDA, the implementing organization in Myanmar, has experiences to construct tube wells and the related facilities with equipment and materials provided by various ODA projects of Japan or other international aid organizations. DDA has a drilling section and there are some drilling staff and technicians. Among them there are some drillers who have more than 20 years career of drilling. Therefore DDA can manage construction of the proposed tube wells, reservoirs, pump houses, etc. by applying its experiences and abilities of implementation of the project, if adequate equipment and materials are provided. There are some difficulties for identifying a sufficient groundwater resources in the Central Dry Zone, because the targeted aquifer is almost fissure water exists in the ground around 100 to 300 m deep and the groundwater sometimes contain high salinity or minerals. Therefore it is recommended to construct tube wells carefully based on the data of hydrogeological prospecting and the well structure and logging of the existing tube wells located nearby, etc.

Village Committees have been organized in all the target villages to maintain water ponds, dug wells, or other related facilities and to manage activities on water utility or hygiene improvement programs. The water committee shall be formulated base on the present village committee for managing of the water supply facilities to be constructed by the proposed project. Villagers understand the basic roles and functions of the water committee because they are observing it through water fetching work from other villages. Therefore it is expected that each target village can operate and maintain adequately the proposed facilities, if the general training on the facilities is given to the key persons in the village. In case that large problems or damages happen on the pump equipment, DDA’s supports are indispensable because there is no mechanic and proper equipment in the village.

9.2 Socio-economic Evaluation

In the Central Dry Zone, in many villages people have spent a lot of times and cost for obtaining water for domestic use due to its hard natural conditions. Villagers normally use water ponds or dug wells. After those water sources dry out in the dry season, villagers have to fetch water by bullock cart with barrels on it from the tube wells in other villages several miles distant. Such villagers spend four or five hours a day for water fetching and have to pay about double the price for the own villagers. Therefore the target villages desire a tube well in their village so as to use it at their convenience. The proposed project aims at not only reduce or remove such heavy burdens from the villagers but also improving health and hygienic conditions by supplying safe and sufficient groundwater. Moreover, if villagers spend the time to be saved by reducing water fetching on wage-workings, economic conditions can also be activated in the villages. The beneficiaries of the proposed project are estimated at 137,000 live in 110 villages in 2010.

9.3 Environmental Evaluation

The project proposes to construct a set of tube well, ground reservoir, pump house, and pipes in a target village. Since the facilities are comparatively small and constructed in a center of the village, no remarkable environmental impact will be brought by the proposed project. From the geological point of view, ground subsidence is not likely to occur in the study area by the groundwater development. Therefore, it is judged that environmental impact by the proposed project is negligible.

9.4 Overall Evaluation

The proposed project is supported by desires of villagers to have their own tube wells. The villagers also hope to operate and maintain the facilities erected by the project on their own initiatives. At the initial stage of the operation, it is very important for enhancing the project viability to instruct how the water committee should manage not only for operation of the facilities but also for a basic maintenance, water tariff, etc.

The proposed project will cover a crucial portion of the “10 Year Project for Rural Water Supply in the Central Dry Zone” implemented by the Myanmar Government. By the completion of the proposed project, the burden of water fetching will be reduced and village economy and health and hygienic conditions will also be enhanced in the target villages.

Consequently, the proposed project is expected to contribute widely development of the Central Dry Zone where is recognized as the least developed area in Myanmar. Therefore it is judged that the proposed project will be given the highest priority to be implemented. Moreover, it can be justified from the viewpoint of Basic Human Needs that the proposed project will be implemented.

10. RECOMMENDATIONS

DDA, the implementing organization in Myanmar, has not adequate ability in finance and technology to carry out the proposed project by itself at present. Especially financial difficulties do not allowed it to procure equipment and materials to be imported to Myanmar. Therefore it is recommendable that these equipment and materials would be procured and provided to the Myanmar side on the basis of a subsidy. Since there are some experienced drilling technicians, it is judged that DDA can manage the construction of the proposed facilities by its own budgetary arrangement with the equipment and materials to be provided in the proposed project. However, DDA has to recruit more staffs and make them well trained as soon as possible for enhancing their groundwater development ability. For this purpose, it is recommended that an adequate OJT training will be provided to the drilling staff of DDA by the manufacturer on the occasion of delivery of the drilling equipment to be procured in the project.

At present, machine maintenance system of DDA is not sufficient for taking care of various equipment such as drilling rigs, supporting equipment, vehicles and so on. There are several large and middle scale workshops equipped with machinery and tools in the Central Dry Zone. Those workshops belong to other Ministries or Departments. Therefore it is highly recommended that the central government have to take an important role to coordinate between DDA and Ministries or Departments concerned so that DDA can utilize those workshops for maintenance or reform work during the construction period of the project.

In all the target villages, village committees for social welfares and public health are organized and making activities on water utility or hygiene improvement programs. Although they have no experience yet to operate and maintain the new water supply facilities and to collect water tariff from consumers, DDA's support is indispensable for encourage the target villages to manage the water supply activities. It is especially recommended for DDA to provide a basic training to the villagers, who operate and maintain the new facilities, on the initial stage of operation of the facilities. Moreover, as the target villages may have

difficulty for financing a replacement cost for the pump equipment in around the next fifteen years, it is strongly recommended that the central government work out the long-term financial strategy for supporting the village water supply project.

The water committee will be the implementing body at village level for managing the facilities to be constructed by the proposed project. Although the autonomy of water committee should be respected in financial and management of the facilities, taking weakness of financial and technological capacity of the villages into consideration, DDA's involvement in the water supply management will be positively appreciated for enhancing sustainability of the proposed project. Therefore, it is strongly recommended that DDA organize a new section specialized in rural water supply projects and appoint special staff and deployed to the Township offices. This section should monitor the conditions of facilities, activities of water committees, water qualities, etc. and perform repair work, train on operation and maintenance of facilities, and advise water committees properly. Allocation of the budget for such activities is also an indispensable responsibility by Township offices.

For securing sustainability of the project after completion of the construction of the facilities, it is also highly recommended that specialists working in the same area under various NGOs or international aid organizations cooperate with DDA and support the villages so that each village can be encouraged to improve their living conditions.