

Chapter 7 Project Evaluation

7.1 Economic Evaluation

7.1.1 Economic Benefits

(1) General

There are two major benefits deriving from the implementation of the Project.

One is the time benefit. Under the present circumstances people in the eleven centers more or less go to the far-away springs/rivers and/or public fountains every day to fetch water. The time spent in such a way comes to an enormous amount when it is aggregated as an annual total for the whole town.

If the Project is implemented, less people will go to the above-mentioned water sources as more people will use house connections or yard connections. That is to say, the time for water fetching will be greatly reduced.

The JICA Study Team calculated the time to be reduced annually for the whole town in the future years under the "with project" conditions.

Eventually, the team converted the time into financial terms. This is the time benefit.

Another is the reduction of water-borne diseases. When the Project is implemented, more people will have an access to clean piped water. It will reduce the opportunities for them to get in touch with contaminated water and contract such diseases as diarrhea, dysentery, typhoid and scabies.

However, how many such cases will be reduced is very hard to estimate. Therefore, the team just wants to remind people that such an important benefit will be realized in the "with project" case.

(2) Calculation of Economic Benefits

How the above-mentioned time benefit was calculated is summarized below:

As a result of the socio-economic questionnaire survey conducted by JICA, the following information was collected:

Users	Time spent at a time (min.)	Daily frequency (times)	No. of persons at a time
Public fountains	36	2.3	1.1
Springs/rivers	158	1.5	1.2

If the number of households using public fountains and the number of households using springs/rivers is estimated in both the "without project" and "with project" cases in the

target years, one can work out the total time spent fetching water every year in both cases by utilizing the above tabulated information.

The respective number of households using the above two water sources in the "with project" case was estimated based on the service population projection in the other chapter. The respective number of such households in the "without project" case was calculated on the assumption that piped water users will increase by 2% every year.

Then, the difference in the aggregated annual water-fetching time between the two cases was calculated for each year.

Finally, such a time was converted into financial terms by using the following information:

Monthly household income (birr)	Family size (persons)	Waking hours in a day	Time value per hour (birr)
A	B	C	$D=A/30/B/C$
334	4.5	16	0.1546

The results are shown in Table 7.1.1.

7.1.2 Cost

The cost can be divided into capital cost and operation and maintenance (O & M) cost.

Capital cost is huge compared to the economic benefits resulting from the reduction of water fetching time. If one could quantitatively incorporate the subdual of water-borne diseases, benefit related to WID and multiplier economic effect into benefits, then one could consider the total cost including capital cost. But, the reality is such that one considers O & M cost - actually, a part of it - only for the sake of convenience.

O & M cost consists of electric cost, fuel cost, disinfection cost, personnel cost, installation cost of connections, purchase cost of water meters and other cost. (For more details refer to 4.5.) It was estimated as an annual recurrent cost for future years.

It turned out that the whole O & M cost is too large in comparison with the above benefits. Eventually, personnel cost was picked up, representing O & M cost.

The personnel cost used here is the incremental one, that is to say, the difference between the personnel cost in the "with project" case and the personnel cost in the "without project" case.

7.1.3 Economic Evaluation

Based on the data calculated in the above-mentioned way, cost benefit streams were prepared as shown in Table 7.1.2.

As it shows, the cumulative cost and benefits for 30 years come to 6,993 thousand birr and 15,569 thousand birr respectively. It means benefits are 223% of cost at the discount rate of zero.

That is to say, the cumulative benefits of the reduction of water fetching time for 30 years are more than 2 times as great as the cumulative personnel cost of WSS at 0 opportunity cost.

It is to be noted that time benefit resulting from project implementation is quite marked for the town.

Table 7.1.2 Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
 CF=Cash Flow (=BF - CS)

Table 7.1.1 Saved Time and Benefit

Year	Saved Time (hours)	Benefit (birr)	NO.	YEAR	CC	OM	CS	BF	CF
1996	0	0	1	1996	0	0	0	0	0
1997	0	0	2	1997	0	0	0	0	0
1998	0	0	3	1998	0	0	0	0	0
1999	549,295	84,937	4	1999	0	138	138	85	-54
2000	1,002,079	154,951	5	2000	0	162	162	155	-7
2001	1,286,165	198,879	6	2001	0	175	175	199	24
2002	1,578,098	244,021	7	2002	0	187	187	244	57
2003	1,878,246	290,432	8	2003	0	199	199	290	91
2004	2,186,989	338,173	9	2004	0	212	212	338	126
2005	2,504,631	387,290	10	2005	0	224	224	387	163
2006	2,929,664	453,013	11	2006	0	238	238	453	215
2007	3,362,369	519,922	12	2007	0	251	251	520	269
2008	3,803,063	588,066	13	2008	0	265	265	588	323
2009	4,252,075	657,497	14	2009	0	278	278	657	379
2010	4,709,751	728,267	15	2010	0	291	291	728	437
2011	4,709,751	728,267	16	2011	0	291	291	728	437
2012	4,709,751	728,267	17	2012	0	291	291	728	437
2013	4,709,751	728,267	18	2013	0	291	291	728	437
2014	4,709,751	728,267	19	2014	0	291	291	728	437
2015	4,709,751	728,267	20	2015	0	291	291	728	437
2016	4,709,751	728,267	21	2016	0	291	291	728	437
2017	4,709,751	728,267	22	2017	0	291	291	728	437
2018	4,709,751	728,267	23	2018	0	291	291	728	437
2019	4,709,751	728,267	24	2019	0	291	291	728	437
2020	4,709,751	728,267	25	2020	0	291	291	728	437
2021	4,709,751	728,267	26	2021	0	291	291	728	437
2022	4,709,751	728,267	27	2022	0	291	291	728	437
2023	4,709,751	728,267	28	2023	0	291	291	728	437
2024	4,709,751	728,267	29	2024	0	291	291	728	437
2025	4,709,751	728,267	30	2025	0	291	291	728	437

7.2 Financial Evaluation

7.2.1 Calculation of FIRR

Regarding detailed information on revenues and cost, refer to Section 4.5.

(1) Initial Trial

Initially it was assumed that the central government would provide subsidy to the Dupli WSS amounting to 80% of initial cost.

It is to be noted that the cost related to the construction of accommodation facilities as well as WSSD's management is not included in the above initial cost.

Based on the revenues and cost estimated in Section 4.5 under such an assumption, cost benefit streams were prepared for the 30 years starting in 1996.

Using them, financial internal rate of return (FIRR) was calculated. As a result, it worked out to 8.3%.

The value was judged to be too high in consideration of the nature and objective of the Project.

Besides, it is important for the central government to be paid back initial cost as much as possible, thus lessening its budgetary burden.

After repeated simulations, it was finally decided that the subsidy ratio of initial cost would be 50%.

(2) Final Results

Under the above-mentioned subsidy conditions, cost benefit streams were prepared as shown in Table 7.2.1.

Using the streams, FIRR was calculated. As a result, the value of 3.8% was obtained.

The value exceeds 1%, which is the assumed interest rate of external loan by 2.8%. It is judged to be sufficiently and reasonably high considering the nature and objective of the Project.

7.2.2 Sensitivity Analysis

To see how the value will be affected under different circumstances, sensitivity analysis was conducted. The conditions and results are shown below:

Item	Conditions	Results	Difference from Base Case
1. Case 1	Benefits : -10%	FIRR: 2.6%	-1.2%
2. Case 2	Initial Cost : +10%	FIRR: 3.1%	-0.7%
3. Case 3	Progress of : 1997=70% Construction 1998=30%	FIRR: 3.9%	+0.1%
4. Case 4	Progress of : 1998=70% Construction 1999=30%	FIRR: 3.0%	-0.8%

In Cases 3 and 4 detail design will be done in 1996 and 1997 respectively.

As the table shows, the value of FIRR is robust enough by maintaining the level of substantially more than 1% under adverse circumstances conceivable.

Case wise, the shortage of revenues will deal the strongest negative impact on the financial feasibility of the Project, followed by the delayed progress of works and, then, cost overrun, while earlier progress and completion of works will raise the feasibility by a little margin.

Table 7.2.1 Cost Benefit Streams

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit: thousand birr)

NO.	YEAR	CC	OM	CS	BF	CF
1	1996	797	61	859	52	-807
2	1997	5191	63	5253	53	-5200
3	1998	5191	64	5255	54	-5200
4	1999	0	266	266	297	32
5	2000	0	295	295	481	186
6	2001	0	417	417	606	188
7	2002	0	435	435	706	271
8	2003	0	453	453	806	353
9	2004	0	471	471	907	435
10	2005	0	490	490	1007	518
11	2006	0	666	666	1231	565
12	2007	531	689	1219	1419	200
13	2008	2655	711	3366	1607	-1759
14	2009	2655	734	3389	1795	-1594
15	2010	0	757	757	1982	1226
16	2011	0	421	421	1903	1482
17	2012	13	421	434	1903	1469
18	2013	13	421	434	1903	1469
19	2014	0	421	421	1903	1482
20	2015	0	421	421	1903	1482
21	2016	0	421	421	1903	1482
22	2017	0	421	421	1903	1482
23	2018	0	421	421	1903	1482
24	2019	0	421	421	1903	1482
25	2020	0	421	421	1903	1482
26	2021	0	421	421	1903	1482
27	2022	0	421	421	1903	1482
28	2023	0	421	421	1903	1482
29	2024	0	421	421	1903	1482
30	2025	0	421	421	1903	1482

7.3 Organizational Evaluation

The existing organizational situation related to water supply and sanitation in Dupli can be summed up as follows:

- Dupli is a satellite town of Asayta so far as water supply is concerned. The status will soon become detrimental for Dupli to manage financially by itself with a growing population and increasingly more water production.
- The satellite WSS of Dupli is financially in the red. Although Asayta headquarter will take care of the situation, the best thing is for the satellite WSS to financially stand on its own feet. But, it is not given the power commensurate with expected financial independence.
- The satellite WSS of Dupli has run into financial difficulties. It is not encouraging for the existing state, where workers are under-paid, they have little supplies and equipment for operation and maintenance and there is a shortage of skilled manpower.
- Sanitation functions in the satellite WSS of Dupli have been totally neglected. But, the sanitary situation in the town is such that organizational/institutional countermeasures are urgently required.
- A key for a successful implementation of water supply/sanitation projects lies in community involvement. It seems that the authorities have not given proper consideration in this regard.
- Another key for a successful implementation of water supply/sanitation projects lies in female participation. It appears that the authorities have not been properly aware of it.

To rectify the above situation, the following organizational/institutional measures have been proposed.

- It is recommended that the satellite status of Dupli WSS be elevated to the independent WSS after the Phase I Project is completed in 1988 so that water supply activities of Dupli may be commensurate with the extent of water production and the size of population.
- Autonomy is a trump for a financially good performance. The satellite WSS of Dupli should have a say regarding water tariff, personnel management and purchase of equipment and materials subject to the approval of Asayta.
- In the event the independent WSS of Dupli is started, it is essential for the WSS to be institutionally given its own decision-making power regarding the revision of water tariff, hiring and firing of staff, remuneration, execution of small-scale rehabilitation or new works, purchasing of supplies and equipment, etc. Approval

will be given by the regional organization, and it will be reported to the central organization.

- The fundamental conditions for any WSS to have a successful financial performance are to have a sufficient supply of water on one hand and to have a reasonable level of water price on the other. Both conditions are hopefully expected to be satisfied through the Project. If the WSS of Dupli has a successful financial performance, then the accompanying difficulties such as the shortage of skilled manpower and little availability of equipment and supplies will be eventually overcome.
- The organization related to sanitation will be newly established in the organizational set-up of WSS after the Phase 1 Project is completed in 1998. It will perform loan service and promotion activities regarding the installation of sanitation facilities.
- Sanitary/Health Committee will be organized in the town. The members will be composed of representatives from schools, hospitals, Weroda council, municipality, the bank, central and regional water supply organizations, WSS and community. The major objective of the committee is coordinating and unifying the related activities so that sanitary awareness of the townspeople and the installation of sanitation facilities will be effectively promoted.
- Public fountains to be newly constructed in future will be managed by the community if people are overwhelmingly in favor of it. According to the socio-economic questionnaire survey conducted by JICA, they strongly side with it. People will be freed from the frustrations and constraints they experience every day today in connection with the opening hours, breakdowns and repairs, water tariff, etc. The community will have decision-making power in financial, personnel and technical terms subject to WSS's approval. The community is expected to financially stand on its own feet.
- Construction of community toilets will be promoted. Financial resources may come from the community itself or other sources. Sanitary/Health Committee and WSS will assist in the acquisition of funds. A strict financial management of the toilet will be required. The maintenance and operation, payment and collection of the user charge, the decision on user charge, etc. will be totally in the hand of the community. Sanitary/Health Committee and WSS will be always ready for helping the community in this regard.
- It is also proposed that the female participation ratio in the workforce of WSS, the community managed public fountain and the community toilet be more than 50%.

7.4 Technological Evaluation

The proposed water supply system is composed of relatively simple facilities, those of which are not quite different from existing ones. Although new material made of fiberglass reinforced plastic is to be introduced into such work as well casing, the light

material could facilitate the construction work very smoothly. The material is also expected to be long life-span comparing to other conventional material, thus maintenance and renewal cost could be reduced in the long run.

In the Project, two number of boreholes are newly required and those including existing ones are located with certain distance from each other. Therefore, mobilization is due required for the daily operation of those boreholes. In this regard, transportation must be strengthened by means of vehicle or motorbike, otherwise well attendant is additionally required in the number.

In this center, water in shallow aquifer will be adopted as a water source in order to meet the water demand in future and judging from the water quality of deep groundwater. In this case, water quality analysis shall be employed, composed of mainly turbidity and biological aspects.

Also, WSS office shall be set-up in this center to maintain and operate the facilities as planned.

7.5 Environmental Impact Assessment (EIA)

Currently, there are not Ethiopian laws or regulations which stipulate that development activities represented as a project require an EIA prior to the approval of the project. However, the procedure to establish the EIA is going on within the relevant authority as of 1995.

In this Study, initial environmental examination (IEE) firstly had been carried out throughout Phase I study and supplemented during the field survey of Phase II, based on the "Guideline of Environmental Consideration for Groundwater Development" prepared by JICA. IEE conducts preliminary assessment in terms of social environment, natural environment and public nuisance, as summarized on the formats in relevant appendix "Result of Initial Environmental Examination". The formats of project and site descriptions brief the content of the Project and the site, thus facilitate the relating person/organization to understand the outline of the Project at the early stage. The scoping format categorizes the environmental component with a classification mentioned below by screening the each component.

- A; Advance impact is expected by the Project,
- B; Negligible impact is expected by the Project,
- C; The impact is Unknown at present, and
- D; Enhancement is expected by the Project.

No advance impact classified "A" above is shown on the format, and most components are expected to undertake negligible impact from the Project. Also enhancement is expected in some components such as economic activities, public health and hygienic condition.

The components classified as "C" are identified as the ones to be considered for EIA. The result of EIA is described below, and no negative environmental impact is expected.

7.5.1 Vested Rights

Although the facilities planned are small in the scale, a part of dwelling and commercial areas, and such properties as houses and trees might be affected, to which compensation shall be made in accordance with government regulation. With consideration above, facilities have been so planned that such circumstance be avoided as much as possible in the design stage. With reference to the outcome of GEP survey, probable water sources had been planned away from dwelling areas, and new reservoir sites planned nearby existing ones or away from dwelling areas, from which little effect is expected. Also, main distribution lines had been designed alongside existing roads to avoid any considerable resettlement.

Afar people customarily states their own land right despite the fact that the land is officially owned by the state. In Mille and Dupti, conveyance pipeline from the source to reservoir could be expected to cross the Afar areas, which are located mainly at outskirts of Dupti. Although it is very difficult to identify the Afar area because of their nomadism, due consultation shall be made prior to the commencement of the construction work. Since the effect is expected only during pipeline installation, any conflict could be avoided by the prior consultation.

Considerable number of water vendors, who fetch water from Awash river and sell to the town dwellers, were observed during the field survey. The income of those vendors relies on mostly vending the water, therefore they would lose their income by the Project. However, the loss of income could be covered if they altered the way of fetching water from Awash river to public fountains, which are to be increased in number, and vending the water.

As mentioned above, any vested right in terms of properties, land right and vending water could not be seriously affected by the Project.

7.5.2 Public Health and Hygienic Condition

The improved water supply will increase the quantity of waste water. If the drainage system was not accompanied, it could lead to unhygienic condition and leave people vulnerable to water-borne diseases.

In this Study, sewerage is regarded as a component of the Project and not as a mitigative measure. During field survey, the areas had been delineated, which were suffering from poor drainage condition at present and also toilet condition had been investigated. Based on those assessment, the improvement of drainage and toilet had been proposed in this Study. Disposal of spillage water at public fountains has also been designed in such manner of soakaway pit or connecting to an existing drainage.

With the implementation above, public health and hygienic condition could be enhanced rather than negative impact by the Project.

7.5.3 Accidental Damages to Existing Facilities

Although construction of pipeline network and reservoir may be expected to give damages accidentally to the dwellers and existing facilities, such cases have not been reported based on the previous construction experiences. Under proper supervision of the construction, such damages can be avoided or reduced to negligible level even if any.

7.5.4 Soil Erosion

Judging from the construction scale, little soil erosion is expected both during and after the construction. Although minor soil erosion may be expected in case of sandy and silty formation of the ground, such erosion has not been reported in noticeable level based on previous construction experience. It is also recommended that construction work be carried out during dry season not only to facilitate the construction work but also to reduce the soil erosion as much as possible.

7.5.5 Groundwater Quality and Quantity

The current water source of Dupli is groundwater, and there may be a possibility that the existing sources could be affected due to over-exploitation of groundwater by this Project. However, with reference to the scheme mentioned below, employed in the design of this Project, it is expected that any noticeable effect in terms of quantity to the existing sources could not be arisen.

The location of new boreholes has been designed with a distance from the existing sources enough to avoid any influence to the water table for the existing ones.

The maximum of groundwater extraction in this Project has been designed to be within the great amount of recharge by Awash river. This concept enables the new well designed in this Project to avoid noticeable over extraction of groundwater, leaving the sources unaffected.

However, Groundwater in Dupli has already shown such problems as sodium, iron, chloride, fluoride, nitrate and sulfate. Among those, chloride and fluoride are the serious ones with the fact that between 40 and 50 % of children had shown mottling of their teeth and a number of patients claiming kidney problem was ranked at 6th in Tendaho hospital during the field survey in February 1995.

Although the groundwater in Dupli has great potential in terms of quantity, the water supply system which utilizes existing deep groundwater could increase the problem mentioned above. Therefore, utilization of shallow aquifer, recharged by Awash river, was introduced in this Study, contributing to the mitigation of existing problem. It is recommended that the water quality of the shallow groundwater be checked and monitored.

7.5.6 Land Subsidence

Dupty's foundation is composed of sediment. Although no perceptible land subsidence has been reported until now, minor land subsidence might be caused by excessive pumping if the foundation contains thick clay strata. According to the lithology of two (2) boreholes drilled in Dupty, the strata between ground-level and 20-30 m below the ground-level are mainly composed of clay layers, then the strata become gravel layers as the depth increases (see below).

Borehole Wollo I		Wollo II	
Depth (m)	GL	GL	
	5 Silty clay	5	Silty clay
	10	10	
	15 River deposit	15	Gray colored clay
	20 (clay)	20	_____
	25 Silty clay	25	
	30 _____	30	Clayey sand
	35 Clayey gravel	35	and gravel
	40 Basaltic gravel	40	
	45	45	Clay with
	50 Sandy gravel	50	volcanic
	55 with clay	55	aggregate
	60	60	
	65 Coarse sand	65	Silty clay & sand

Note: The boreholes above were drilled in 1976.

Based on the lithological information above, no noticeable subsidence is expected as long as the groundwater is exploited over about 30 m depth below the ground-level. Also, the shallow wells introduced in this Study are located away from residential area, thus leaving the area unaffected.

7.5.7 Traffic Nuisance

Some water distribution pipelines had to be designed to cross a road, and the installation work may interrupt traffic and cause nuisances. Based on the site investigation, two (2) installation methods were identified; namely to install the pipe through existing drainage under across the road, and to install half of the pipe first and then the remainder by shift. The shifting installation method usually requires one (1) day work. Therefore, any traffic nuisance to be caused by the installation of pipeline could be avoided, because the nuisance could be acceptable judging from the installation term of just one (1) day even in the case that the sifting installation method is employed.

7.6 Indirect Benefit Evaluation

7.6.1 Subdual of Excreta and Water Borne Diseases

Excreta and contaminated water are the major sources of diseases in Dupli. From the field survey that has been carried out by the Project, the incidence of diseases as reported by Dupli Hospital in December 1994 shows the following as the top ten diseases.

<u>Diseases</u>	<u>Number of Cases</u>
1. Malaria	68
2. Urinary tract Inflammations	50
3. Bronchitis	47
4. Unspecified fever	38
5. Tuberculosis (TB)	34
6. Pneumonia	33
7. Glandular TB	27
8. Diarrhea	27
9. Gastritis and dyspepsia	22
10. Sexually transmitted diseases	19
Total Number of Cases	<u>365</u>

The estimated number of cases per year as a percentage of population comes to about 30.4%. These cases are very high. The excreta and water borne diseases among above could be subdued on condition that the followings are made in line with improvement of water supply.

- Provision of toilets that will eliminate the use of open-field for excreta disposal.
- Undertaking regular and timely operation and maintenance of the toilet facilities.
- Providing effective user's education to properly use the toilets and care for them.
- Identification and elimination of faecally contaminated sites that breed insects.
- Treatment of sewage and sullage, if possible, prior to discharge.
- Improvements of domestic water supply of Bati to reduce the effect of contaminated water to health.
- Undertaking sustained and effective sanitary education programme to improve environmental, domestic and personal hygiene.
- Making the communities in Dupli to participate in the planning, choice and constructing toilet facilities; and to take over the operation, maintenance and management of these facilities.

7.6.2 Benefit Related to WID

The benefits related to WID are as follows:

By improving the piped water supply in Dupli, the intended benefits will include the significant reduction of time and energy spent in the collection of water, for men, women, boys and to a lesser extent for girls. This will allow almost everyone in Dupli to have more time for other activities including relaxation or income generation activities and improved sanitary behaviors. It will allow boys in particular to have more time for studying. If the project succeeds in maintaining the role that men and boys play in the collection and carrying of water, the benefits of extra time for studying will also be passed onto girls.

The project should improve the quality of life for all social groups, making Dupli a more pleasant place to live and improving the health and well-being of the community as a whole. It will also reduce the amount of time that men and women spend in taking care of the sick.

By providing additional latrine facilities, women and girls living on the outer edges of the town will enjoy more privacy than they have had in the past for urination, defecation and menstruation. Improved latrine facilities in the rest of the town will benefit all users, but particularly benefit females who have suffered particularly from the inconvenience of smell.

The project will allow the community to determine the positioning and style of water and sanitation facilities in Dupli, increasing their sense of power over their environment. In addition, the project will give employment opportunities, some of which are likely to be long term.

7.6.3 Economic Activities

There are prerequisites for a town to grow economically. Physically, it must have a sufficient level of basic infrastructure such as, road, electricity and water. Socially, it must have, above all, a sufficient educational and medical level.

Road is essential for exchange of materials, finished goods and persons with outside areas. Both electricity and water constitute indispensable components for manufacturing industry. Also, they are a necessity for commercial activities.

A sufficient level of education begets an enlightened type of people with a desire and will for better life. A sufficient medical level makes a healthy people and a healthy people can easily turn a hard working people.

If these five factors are satisfactorily combined, a town is ready for an economic growth.

Dupli has a certain level of road, education and medical facilities. Regarding electricity, the geo-thermal project is now underway. If it turns out to be successful, it will have a

substantial impact on the center's economy. Water is now an acute problem. But, it is going to be resolved through this Project.

The center has a capacity and prospect for future economic growth.

Water has especially strong impacts on manufacturing industry such as food & beverages, chemicals, mineral products, iron & steel and machinery & equipment, hotels, restaurants & bars, and hospitals. In an event water is sufficiently supplied through this Project, Dupti's economic activities may be stepped up centering on them.

7.6.4 Benefit Related to Others (i.e. religion and tribe)

The level of access to water and sanitation facilities currently existing for Muslims and Christians is almost the same. The level of income for these two religious groups is also very similar. The level of ethnic variation in Dupti is moderate, but lower than expected, with a particularly low level of Afar represented. As a result it is difficult to determine the relative levels of service enjoyed by the different ethnic groups. The benefits of the project are likely to permeate to all religions and tribes to a similar degree. These will be the benefits of time savings allowing people to do other activities in that time, an improved level of health and well-being and increased feelings of power over their lives. These benefits should be carefully monitored by segregating data collected during the implementation and operation and maintenance phases to ensure that the benefits are being accrued equitably.

Chapter 8 Conclusion and Recommendation

8.1 Conclusion

Study on Water Supply and Sanitation Improvement has been carried out in Dupli along with other 10 centers. The center is suffering from acute water shortage and deteriorating sanitary condition.

Water service coverage in Dupli is currently 45 % only, and water consumption per capita per day is extremely low with the amount of 17.4 lpcd in average. Water quality of the sources is above WHO drinking water guideline values in terms of fluoride, sulfate, nitrate and chloride, and also many faecal coliforms have been detected in samples collected from connections and household containers. This means the contamination is expected in such ways of through cross-connections, leaking and back-siphonage associated with aged facilities.

Sanitation condition prevailing in Dupli stays at low level. Although population in the centers shows relatively high awareness for sanitation, as exemplified for the knowledge of Diarrhea cause and preparation of oral rehydration solution, the majority of the people dispose off their body wastes in open fields and in traditional pit latrines. Although toilet coverage is 97 % which is very high, those are mostly ill-maintained and poorly designed/constructed in terms of emptying and ventilation. Emptying toilet usually has to wait for long time due to unavailability of vacuum truck, and also there is no dumping site prepared for the emptied disposal near the center. Drainage facilities are not well equipped except ones along the main road, constructed by road authority. However the existing drainages are not well maintained and often blocked with garbage and refuse, creating stagnation of water.

Taking above situation into consideration, water supply has been planned in terms of both rehabilitation and new-construction with the target years of 2005 and 2010. In this Study, water coverage in year 2010 is targeted to be 100 %. Water demand is to be realized after completion of the Project with the volume estimated on the basis of 15 lpcd for public fountain, 35 lpcd for yard connection and 60 lpcd for household connection respectively.

For sanitary improvement, some types of toilet such as individual, community and public have been designed, those of which can be easily copied to facilitate the diffusion of such toilets. Typical sections of drainages are also shown in this Study, and those can be constructed by community level. Also, sullage disposal pit was shown, contributing to the disposal of household waste water. Sanitary education video and education manual will greatly contribute to the diffusion of sanitary education program, getting community involved, participated and motivated.

With reference to above, this Project shall be put high priority in the water supply sector for rural towns and be commenced immediately to mitigate the deteriorating condition. With completion of this Project, the followings are to be realized:

- Improvement of current deteriorating water supply

- Improvement of poor sanitary condition prevailing centers
- With both above completed, subdual of water/excreta born diseases, enhancement/strengthening of community, motivation of community, reduction of overburden incurred by fetching water for specially women and girls, and enhancement of economic activities, thus achieving the sound life in Dupli.

8.2 Recommendation

As mentioned above, this Project was concluded to be carried out immediately taking into consideration both current deteriorating condition and the effect to be born by the Project. Followings are recommendations to be undertaken during construction work as well as after completion of the Project:

- Coordination among related departments located under Ministry of Water resources (central government) shall be made with Water Supply and Sewerage Service Department being the pivot, and coordination among the central, the regional and the center shall also be effectively made. For this purpose, the Project Manager shall be appointed and a committee composed of above three level is required under the manager in order to coordinate and facilitate the implementation. Also, WSS office should be established in this center.
- Although hydroelectricity is scheduled to come by the time of first target year of 2005 to this center, the supply shall be made in keeping pace with the completion of this Project since operation cost of hydroelectricity could be about 60% of that of diesel generator (Financial analysis for Dupli was made on condition that hydroelectricity was available).
- In line with the implementation of water supply project, progressive water tariff structure and double entry accounting system should be introduced. The former scheme can raise the average water tariff without affecting low-income households. The latter can draw real picture incorporating depreciation and interest payment so that WSS can have not only enough operation and maintenance cost but also fund to expand the water supply system by themselves.
- The related organizations, specially WSS, should be strengthened as programmed in order to manage the enhanced water supply and sanitation facilities effectively. WSS will have authority to revise water tariff, dismiss or employ its staff and launch on new investment subject to regional office, so that WSS will have self-independent sense and can stand on their own feet.
- A committee, composed of health/sanitary relating organizations, shall be established in the center in order to improve sanitary and health condition. This committee can also coordinate communities in preparing sanitary facilities such as toilet, sullage disposal site, drainage and etc. WSS should facilitate the coordination of the committee.

- Since detailed topographic map is not available for Dupli, topographic survey shall be carried out along planned rising and distribution pipelines, at well sites and reservoir sites. Land acquisition, where required in such works of rising main, reservoir and well, shall be made in time before the commencement of the construction.
- To get the community motivated and empowered, it is very efficient if the management and operation of facilities are made by the community itself. In this regard, " Community Management of Public Fountain " and " Community Management of Community Toilet " are recommended. According to the household survey, the majority of people are in favor of the public fountain managed by the community.
- Community, particularly women and girls, must be involved in confirmation of the water supply and sanitation facilities design, system and devices at the commencement of the implementation stage. This is made specially for finalization of public fountains' design and location, design of toilet facilities, and management scheme of those facilities. Exercises of involving the community are extremely motivating factor. It provides them with a feeling of involvement and thus provides empowerment.
- Community participation promoter should be assigned in line with the implementation of the Project, who will be responsible for coordinating instructions for the community members on the design, construction and operation and maintenance of the water and sanitation facilities as part of the long term sustainability. Also, a CPP supervisor shall be dispatched from WSSD on occasional basis to facilitate the CPP's work.
- Sanitary education manual and video titled "Simple Steps...for Better Health" should be fully utilized for the purpose of diffusion of sanitary education program as well as motivating the population for better sanitary activities. The sanitary education manual will be modified, if necessary, according to the response of the attendants, since the manual has not been tested.
- Results of the analysis for access and control suggest that they share resources with men equally within the home but that female headed households tend to be poorer than their male counterparts. Female headed households are particularly vulnerable and special attention must be paid to them during implementation to make sure that they are benefiting adequately from the Project, and this should be monitored.
- Monitoring should be made in line with the project cycle to confirm and measure the benefits to be born by this Project, those of which are increase of water coverage and water amount, subdual of water/excreta borne diseases, motivating community, reduction of time for fetching water and activating economy.

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