

CHAPTER 2 MASTER PLAN FORMULATION

2.1 Rural Water Supply Plan

The rural water supply plan in this master plan will cover 20 of the communes in the 5 northern provinces of Vietnam. The implementation will be in accordance with the framework of the current rural water supply system detailed in *Chapter 6 of Part 1*.

2.1.1 Outline of the Plan

- (1) Target year: 2010
- (2) Service commune: 20 communes in the 5 northern provinces of Vietnam
- (3) System: Household connections (Level III)
- (4) Target service population, design water supply amount and service coverage rate

Year	Service Population	Supply Amount	Service Coverage Rate (%)
2002	74,800	9,170m ³ /day (123 l/c/d)	50
2005	124,000	16,350m ³ /day (132 l/c/d)	80
2010	149,700	23,030m ³ /day (154l/c/d)	90

Note: l/c/d = amount of water supplied in liter per capita per day

2.1.2 Target Operation

This plan will be implemented by CERWASS. The central and regional CERWASS offices will generally supervise the planning, implementation design, construction and supervision of the works. The communes, which become the owners of the facilities, will be responsible for the operation, maintenance and management of the facilities after completion and the turn over.

The planning, design, and construction of many of the existing water supply facilities in Vietnam were carried out mainly with emphasis on the demands of the party providing the services. Many aspects of the system were seen not to reflect the opinions of the beneficiaries. The consensus supposedly of the commune with regard to operation and maintenance is also deemed unsatisfactory.

The key to the success of the master plan is measured by the sustainability of the water supply facilities to be constructed, which is reliant on the commune resident's understanding and acceptance of issues related to facility O&M and payment of the costs. Prior to the construction of the facilities, CERWASS, the province and relevant district agencies should, therefore, hold discussions with the communes to gain understanding through acceptance and public commitment.

While the CPC tends to focus on the policy making aspect regarding the construction and operation of the water supply facilities, the beneficiaries or the residents tend to focus on the financial aspect, e.g. ability to pay the water charge. It is very important, therefore, to gain the residents' complete understanding regarding their financial obligations in facility O&M, as well as the convenience of receiving clean water and how this would improve health and sanitary conditions.

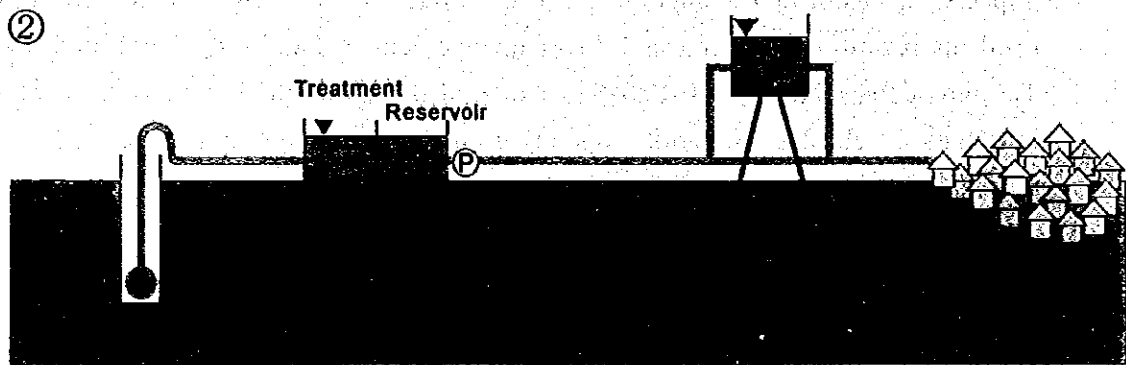
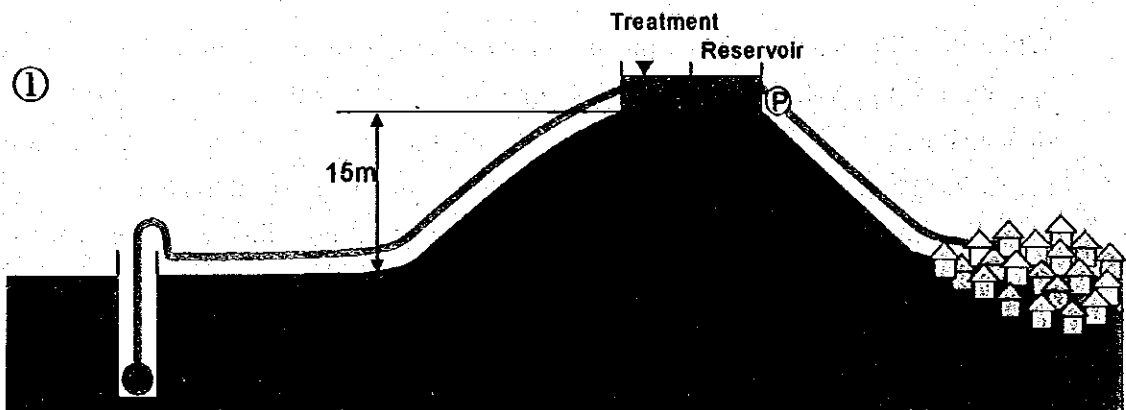
With these considerations, the study will promote from the planning stage close cooperation between the service providers and the beneficiaries, and establish mutual understanding between the two parties. Accordingly, the CPC should make the following fully known to the residents: the objectives and contents of the plan, the facilities to be constructed, funding required, operation, maintenance and management methods, water charge, and the positive impacts on health and sanitation. The committee should also gain the consensus of the residents regarding their full and direct involvement in facility operation and maintenance. The providers, including CERWASS, should also provide the required technical assistance, information relevant to facility operation, maintenance and management, hold training programs, and supervise administrative activities.

2.1.3 Facility Plan

The water supply system will be made up of the following facilities in accordance with the facility design standards mentioned in the preceding chapter.

- | | |
|-----------------------------|---|
| (1) Source facilities: | deep well (15 communes except for 4 in Ha Tinh, and Nong Cong Town in Thanh Hoa) river water intake facilities (5 communes: 4 in Ha Tinh and Nong Cong Town in Thanh Hoa) |
| (2) Purifying facilities | filter, sedimentation basin |
| (3) Distribution facilities | service reservoir, elevated tank, distribution pump, distribution pipeline, water service pipeline |

The system flow chart is as shown below.



2.1.4 Funding & Construction Schedule

The investment amount required to implement the master plan is estimated at US\$ 16.2 million (VND 225.3 billion). The water supply facilities will be constructed within a period of 1.5 years in Ha Noi, Ninh Binh, Thai Nguyen, Thanh Hoa, and Ha Tinh simultaneously. The Figure 2.1 below shows the construction schedule and the financial investment plan.

2.2 Organizational Plan

2.2.1 Outline of the Implementation System

This master plan will be implemented mainly by the Project Management Unit (PMU) under the central CERWASS office. Aside from CERWASS, a National Program Steering Committee (NPSC) will be also established to take charge of establishing relationships with other relevant projects and monitor the progress of the master plan which will be a model for rural water supply projects nationwide. Therefore, the following organizations will be formed, including the aforementioned two, for the implementation of the master plan.

- | | |
|--|---|
| (1) Project Management Unit (PMU): | detailed planning, administration and operation, establish cooperation with international organizations, offer assistance to implementing agencies, monitoring of the project, evaluation of the project's progress, reporting to the NPSC. |
| (2) National Program Steering Committee: | establish cooperation with national projects, monitoring. |
| (3) National Training Team (NTT): | organizational reinforcement and assistance |
| (4) Provincial Program
Coordination Committee (PPCC): | planning and coordination in project operations
(set up by province) |
| (5) Provincial Program Coordinator (PPC): | |
| (6) Provincial Training Team (PTT): | assistance and reinforcement at the commune level. |

The figure below shows the relationship of the above organizations.

Figure 2.1 Proposed Implementation Schedule

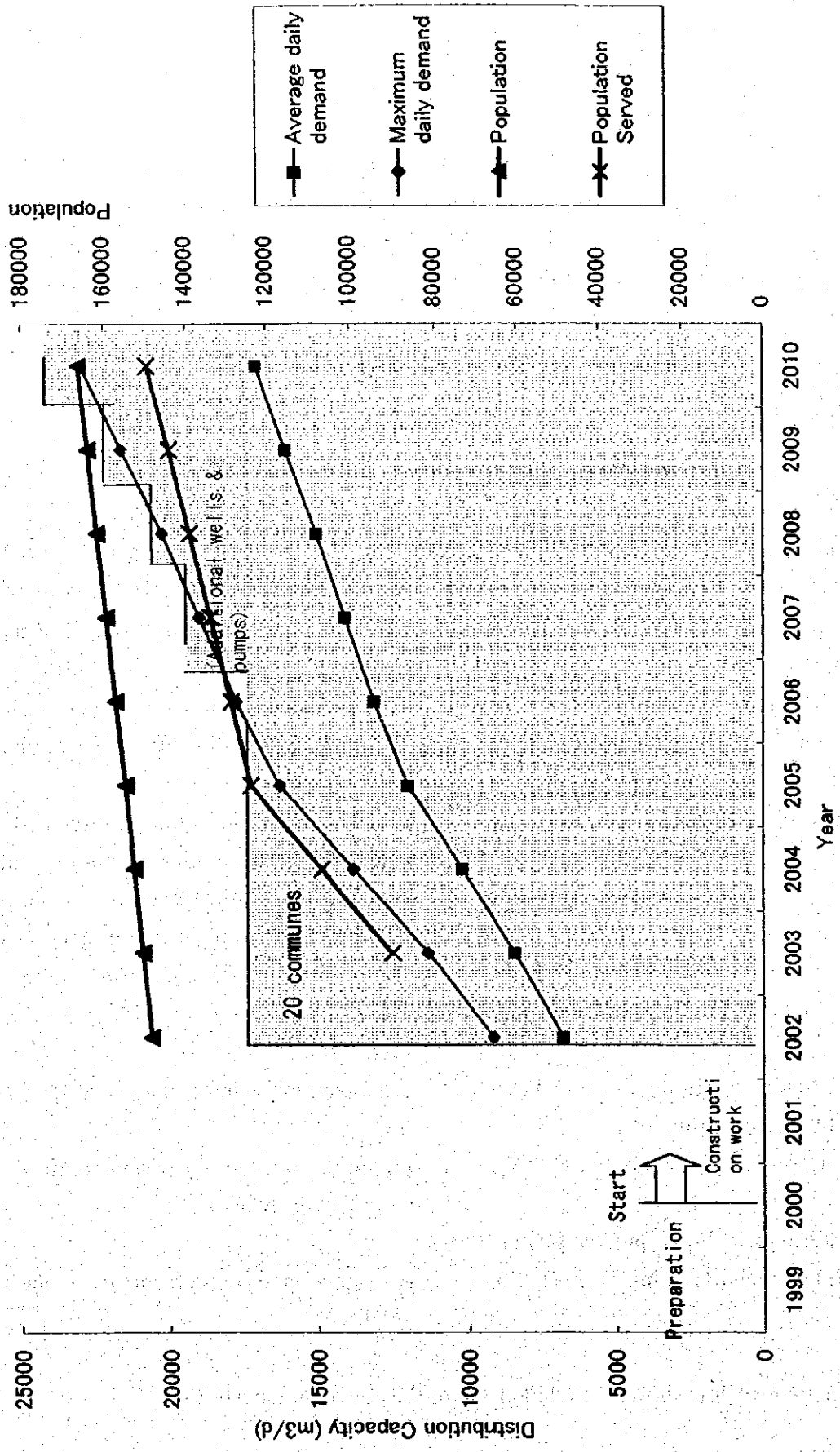
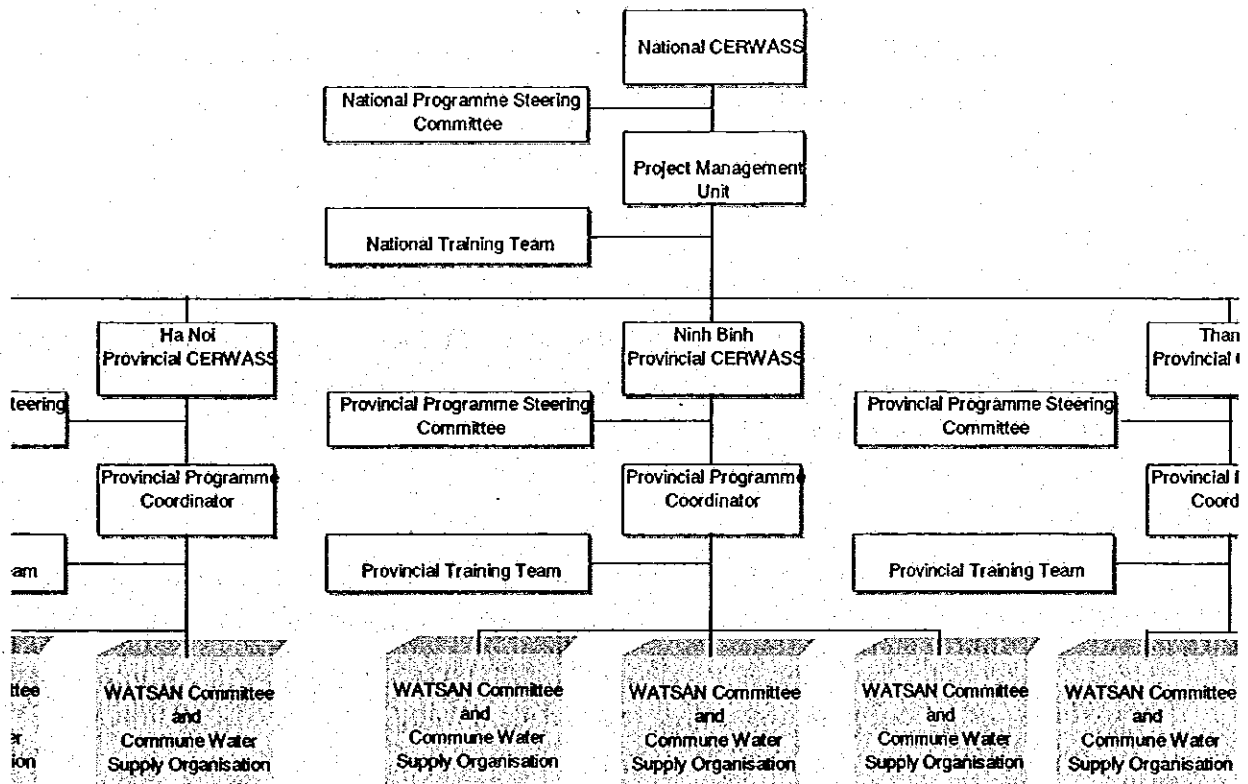


Figure 2.2 Proposed Organizational Diagram in the Master Plan



2.2.2 Central & Regional Organizations

(1) PMU

PMU will be organized under the central CERWASS office. NPSC will be made up of representatives of the following organizations: MARD, MOH, Vietnamese Women's Union (VMU), central CERWASS. PMU will regularly report to NPSC on the progress of the project and request the latter's cooperation when necessary.

(2) NTT

NTT will be organized under PMU and will be responsible for detailed planning and organizational reinforcement. NTT will also hold a Trainer's Training (TRT) program for PTT to enable them to efficiently carry out organizational assistance and reinforcement at the commune level.

(3) PPCC

PPCC will be established in every province and will be in charge of coordinating with relevant agencies to facilitate the progress of the project, and project monitoring. This organization will be made up of the PPC and representatives of the following: Provincial Peoples Committee (PPC), regional CERWASS, Provincial Department of Health (PDH), District Health Center, VMU.

(4) PPC & PTT

PPC will lead PTT to mobilize the commune residents organizations and assist in the forming of the WATSAN and Commune Water Supply Organization (CWSO) in every commune. PTT will consist of regional CERWASS staff experienced in the supervision of water supply facility construction work and O&M training, and VMU members experienced in resident mobilization and the conduct of health and sanitation education programs.

2.2.3 Organizations at the Commune Level

(1) CPC

Prior to the construction of the facilities, every CPC should hold discussions with the regional CERWASS, the implementing agency, and PTT, receive their assistance, and select the members of the Village Mobilizer (VM) among the commune residents. The VM will be the core organization in charge of information dissemination, educational programs, and establishing communication (IEC) in the commune.

(2) WATSAN Committee

Based on the results of the activities of the VM, CPC will establish a WATSAN committee in the commune. This committee will fall directly under CPC and act as an advisory committee. The committee will represent the water users and residents, guide the CWSO in accordance with the new management guidelines, to ensure the sustainable acquisition of sufficient water supply and good drinking water quality. The committee will also hold a health and sanitary improvement campaign in relation to the use of safe and clean water. Through the WATSAN committee, the residents and water users can convey their opinions regarding water supply services, technology and operation involved. WATSAN committee will consist of representatives from every public organization, and the elected users and residents.

(3) CWSO

CWSO will be established under CPC and will be responsible for the daily operation, maintenance and management of the water supply facilities. This organization will consist of an administrator, waterworks meter reader and water charge collector, treasurer, operation and management staff. The waterworks administrator is fully responsible for the operation and maintenance of the facilities. These positions will be filled by the WATSAN committee.

2.3 Financial Plan

2.3.1 Capital Investment & Household Connections

The investment for the master plan will be covered by the budget to be decided between the central and regional governments. The expenses incurred by the installation of household connections should be shouldered by the users. Based on past data, this would cost about half (VND 300,000 to 1,000,000) of a household's monthly income.

Majority of the residents are mostly dissatisfied with the existing water resources. Therefore, it is assumed that the residents would switch to the use of the new waterworks system if this means acquiring water of good quality at a reasonable price. The expenses in the installation of household connections and water charge will be discussed between the users, residents, and decided by the WATSAN committee.

For the impoverished class who are considered to have difficulty in paying the expenses incurred by the installation of household connections, the following should be considered.

- Grant a subsidy in accordance with household income
- Provide job openings in the distribution pipeline installation
- Installation of public taps

Regarding the installation of public taps, the idea was opposed by many based on the results of various interviews in the site and during the PCM workshop. The user's, however, should hold discussions in view of the use and maintenance of this facility.

In principle, a water fee should include the depreciation costs to cover the renewal of the facilities in the future. This could be difficult to realize in view of the income of the households, except in the two communes in Ha Noi where the income level is high.

2.3.2 Water Charge

(1) Standard Water Charge

The water charge that the residents is assumed capable of paying was estimated based on the electric bill as shown in the table below.

Table 2.3.1 Maximum Amount Target Households are Able to Pay (Monthly Basis)

Province	Income (VND)	Electric Bill (VND)	Ratio to Income (%)	Maximum Amount Able to Pay (VND/m ³)
	(a)	(b)	(c) = (b) / (a)	(d) = (b) / 11*
Ha Noi	800,000	50,000	6%	4,500
4 Target Provinces	600,000	20,000	3%	1,800

* Assuming a monthly water consumption of 11m³/household.

The factors that would determine residents' willingness to pay are: quality and price of substitute source, water charge in other areas, desired service level, distance to public taps. The residents are also aware of the standard water charge imposed in urban areas (VND 1,500 to 2,000 per m³). In order for the residents to accept the water charge that was decided, the price of safe water should be emphasized in the campaign.

(2) Setting up the Water Charge

The sustainable O&M of the facilities is significantly influenced by revenues from the collection of water charges. With the assistance of CERWASS and PTT, the target

communes should fully discuss the following issues prior to facility construction.

- Explain the details of the O&M costs (breakdown) and the amount the users need to shoulder, and clarify the relevant details.
- Study how much of the O&M cost the users can pay, meter rate system, depreciation cost.
- Collection method and management of records, auditing by the WATSAN committee

2.4 Organizational Reinforcement

The capabilities of the organization will be reinforced in order to ensure the sustainable operation and maintenance of the water supply facilities. This would entail the training of the members of the organization in required skills and to impart the necessary knowledge and mental attitude suited to the realization of their respective responsibilities. This master plan intends to carry out research and training at the national, regional and commune level.

2.4.1 National & Provincial Level

Being central to the promotion of the plan, CERWASS carries out programs for the reinforcement of organizations, with the assistance of international cooperation agencies, e.g. UNICEF. The staff of the planning division attended the training program on participatory planning method during the PCM workshop held as a part of this development study. CERWASS needs to further promote the development of the capabilities of these organizations through the projects of international cooperation agencies and donors. For now, however, members of the central CERWASS office who have relevant experience should make up the NTT team.

PPCC is responsible for the coordination and monitoring of water supply related services in the provinces. To smoothly conduct these responsibilities, a workshop should be carried out to improve PPCC's skills.

In view of the type and extent of technology PTT needs to acquire, holding a seminar or workshop alone would not suffice. A basic training course, such as the TRT should be held with NTT in charge. It is also worth trying to conduct actual training on the processes involved in the construction of pilot facilities.

2.4.2 Organizational Reinforcement at the Commune Level

(1) Training of CPC

PTT will hold a workshop and gain CPC's understanding on the importance of the following:

- Mobilization of the residents and significance of public participation
- Educating the residents on health and sanitary issues
- Financial management and establishment of a water charge
- Monitoring & assessment of water supply facility O&M
- Solving of conflicts

(2) Training of VM

With the assistance of NTT, PTT will train the VM on a phase-wise basis on the details of IEC. VM in turn will fully inform the residents about the details of the plan through meetings and house visits.

(3) Training of WATSAN Committee

PTT will educate the WATSAN committee on the following issues:

- Responsibilities of the committee
- Water borne diseases and sanitation
- Water prices
- Participatory operation
- Gender issues
- Solving of strife and problems
- Articles and regulations of an association for O&M
- Protection of water resources

PTT will also train the committee on the following activities relevant to O&M:

- Management and operation methods
- Financial management
- Establishment of water charges
- Principles of auditing
- Fee collection system
- Recording and preservation of records

- Consumer services
- Official duties of O&M staff
- Water supply facility monitoring

(4) Training of Commune Water Supply Organization

Together with the members of the WATSAN committee, the water supply administrators will also undergo the training aforementioned. They should, however, undergo further special administrative training afterwards. The water meter reader and fee collector should be given training using the actual device. As for the operation, maintenance and administration of the water treatment facilities, pump, and distribution system, the following will be carried out for every commune personnel prior to the construction work:

- Collective training
- On-the-job training during the construction period
- Periodical research and training during the operation and maintenance phase

2.5 Water & Sanitary Campaign

The water and sanitary campaign intends to fully convey to the residents how the use of clean and safe water can improve health and the sanitary environment, through the IEC activities. In the M/P target communes, a PCM workshop was carried out and the objectives for health and sanitary improvement were analyzed. The results were used as a basis to prepare the Project Design Matrix proposed in this study and shown in Table 2.5.1.

2.5.1 Objectives & goal of the campaign

Campaign objectives:	To grant 10 % of the total target household by 2000 a certificate that proves their being a " <i>Sanitary Family</i> " (a family that actively participated in sanitary activities and conducts sanitary practices).
Campaign goal:	To reduce the prevalence of water borne diseases in the target communes to 10 % by 2000.

2.5.2 Results, Activities, & Monitoring

The results are mainly in the form of the educational texts on sanitation to be produced, technology to be introduced for the improvement of living conditions, and participation in sanitary activities. Through the VM, the WATSAN committee will carry out the campaign and monitor the results.

2.5.3 Investment, Others

Investment will be mainly in the form of human resources and educational materials. As much as possible, modern educational texts will be used during the campaign. The input of human resources from outside into the communes refers to the assistance to be extended by the PTT to public organizations such as the VWU in the mobilization of the residents.

Table 2.5.1 Model of Project Design Matrix of Water and Sanitation Campaign

Title: Water and Sanitation Campaign			
Target group: Habitants of the Commune			
Duration: from January 2000 to December 2000		Project area: (Name of the commune)	
Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
Overall Goal Decline of water related diseases	10 % of decrease of water related diseases in habitants of the commune by the end of 2000.	Record in Community Health Station (RP: CHS director and Water and Sanitation Committee)	Government continues policies for health improvement
Project Purpose Achieving high awareness of hygiene	Until the end of 2000, 10 % of households have received certification of healthy family by active participation for health activities and hygienic behaviour.	Record of certification determined by PC and director of CHS	Water supply project continues to work well. No big natural disaster which influence human health
Outputs 1. IEC enhancement (RP: CHS director) 2. Quality of life improvement (RP: Women Union, Farmer's Union and Youth Union) 3. Community participation promotion (RP: member in charge of PC)	1.a Until the year 2001, 10 educational materials of various media are prepared. 2.a 10 alternative / improved technologies are presented to the habitants every year. 2.b Until the year 2001, 20 % of habitants bigger than 15 years old, continue to use at least 1 alternative / improved technologies 3.a Until the year of 2001, 30 % of habitants bigger than 15 years old participate in the health programme minimum 5 times/ year.	1.a Number of material 2.a Number of introduced technologies 2.b Direct observation by Women's Union and Youth Union in each Hamlet 3.a List of participants (RP: member in charge of PC and Water and Sanitation Committee)	Economic condition of the commune does not deteriorate drastically.

Activities	Inputs	
<p>1.1 Improvement of material for hygiene education (RP: CHS and teachers)</p> <p>1.2 Improvement of health broadcast (RP: CHS and PC)</p> <p>1.3 Training of promoters (RP: CERWASS, PC)</p> <p>1.4 Hygienic education by promoters by class and home visit (RP: CHS and teachers)</p> <p>2.1 Introduction of alternative/ improved technologies (RP: Farmer's Union, Women's Union and Youth Union)</p> <p>2.2 Vocational training for poverty alleviation (RP: Farmer's Union, Women's Union and Youth Union)</p> <p>3.1 Setting special time for community participation (RP: PC, CHS)</p> <p>3.2 Health education for father/mother (RP: PC, CHS)</p> <p>3.3 Promotion of use of safe water (RP: PC, Water and Sanitation Committee)</p>	<p>Human resources: (by commune)</p> <ul style="list-style-type: none"> • Water and sanitation committee; • Members of Women's Union, Youth Union and Farmers' Union and other Unions; • Announcer; • Nursery staff for children; <p>(from outside)</p> <ul style="list-style-type: none"> • District Officer of PC; • Provincial CERWASS; • Expert of social mobilisation from NGOs or other external expert (RP for coordination is Commune PC); • Expert of training NGOs or other external expert (RP for coordination is Commune PC); • Environmental sanitation engineers; • Medical specialist such as dentists and ophthalmologists; <p>Equipment (by commune)</p> <ul style="list-style-type: none"> • Teaching material; • Stationary; • Loud-speaker for announcement <p>(from outside)</p> <ul style="list-style-type: none"> • Equipment for improved technologies such as bio-gas system for wastewater; • Equipment for vocational training; • Documents of references; • Simple audio-visual equipment; • Copy machine / printer; <p>Facilities (by commune)</p> <ul style="list-style-type: none"> • Meeting place • Storing place of compost <p>Cost (by commune)</p> <ul style="list-style-type: none"> • (Running cost should be estimated when the project starts.) 	<p>The majority of commune people continue to dwell in the commune.</p> <hr/> <p>Preconditions Support from upper authority</p>

Notes: RP stands for responsible person.

CHAPTER 3 SELECTION OF A PRIORITY PROJECT

3.1 Selection Criteria

The target communes were evaluated for the selection of a priority project based on the following criteria.

Table 3.1 Evaluation Factors & Ranking

Evaluation Factors/Ranking	A	B	C
(1) Groundwater Yield	> 1,000 m ³ /day	200-1,000 m ³ /day	< 200 m ³ /day
(2) Groundwater Quality	good	Fe, Mn > WHO standards	salty
(3) Importance & Urgency			
- Existing source	Rivers, ponds, etc.	Public wells	only shallow wells
- Environmental problems	critical	well known	not known
- National plan to eradicate poverty	included	not included	
(4) Ability to pay Water Charge	Income of over VND 10 million	Income of around VND 5-10 million	Income of less than VND 5 million
(5) Organization & Management			
- Willingness to pay	high	average	low
- Willingness to form WATSAN	high	average	low
- Government assistance	possible	not clear	not possible

3.2 Priority Project

3.2.1 Selection Method

From the scoring of the overall evaluation results, communes in Ha Noi and Thanh Hoa scored high, and Ha Tinh scored the lowest among the 5 provinces. Some communes in Ninh Binh and Thai Nguyen also scored low. These strongly reflect the results of studies on groundwater yield and quality. The scores of other factors in the evaluation implied no significant differences in the conditions in the communes (see Table 3.2).

The main premise of this master plan is to develop groundwater through the construction of water supply facilities. The selection of the priority project therefore puts emphasis on groundwater yield and quality. Given this prerequisite, the priority project will be

implemented in a total of 15 communes, that is excluding the 4 communes in Ha Tinh and Nong Cong Town in Thanh Hoa where development is assessed to be difficult. Except for commune 1, most of the selected communes were evaluated and given a score of over 9.5. The score given to the 5 excluded communes was less than 9.

3.2.2 Reasons for Exclusion

(1) Ha Tinh (4 communes)

The results of the boring and pumping tests done in Trung Le and Duc Yen indicated the salty quality of groundwater and small groundwater yield. The 4 communes in Ha Tinh are located at the alluvial plain of the Ca River basin. Assessed to have similar hydro-geological conditions, the development of groundwater in these communes is concluded to be difficult.

(2) Thanh Hoa (Nong Cong Town)

Boring and pumping tests were not carried out in this commune. However, based on the results of the boring tests in the Van Thanh Commune upstream, groundwater in this commune is considered to be high in salinity. The impermeability of the outcropping basement rock in the area is also another factor considered as to why groundwater development would be difficult in the area.

3.2.3 Reasons for Inclusion

The results of boring and pumping tests confirmed the salty quality of groundwater in Yen Thanh in Ninh Binh and Van Thanh in Thanh Hoa. But due to the following reasons these two communes will be covered by the priority project:

(1) Yen Thanh

The boring test done in the central plain area of the commune indicated extremely high salinity levels, which makes groundwater development difficult to carry out in this area. However, in view of the favorable groundwater yield in an existing well in the hilly area southeast of the commune, the commune is assessed to have groundwater development potential.

(2) Van Thanh

Boring and pumping tests indicate salinity in the groundwater, but because the level (about 400 mg/l) is lower than the standard (500 mg/l) established by Vietnam for salinity, the commune is assessed to have groundwater development potential.

3.3 Recommendations for Excluded Communes

The 4 communes in Ha Tinh are all in the district of Duc Tho. In Duc Tho Town, the provincial capital, a waterworks development project is currently underway with funding from OECF. The project overall cost is VND 79 billion and is at its first phase, which is scheduled until 2002. With the La River as a source, the project aims to construct water supply facilities that would produce 1,500 m³/day.

Duc Yen, one of the target communes, may benefit from the expansion of this project as it is only separated by a railway from Duc Tho Town. Three other communes should also be covered by the waterworks expansion project in the whole of Duc Tho Province which basically uses the La River as a source.

The formulation of a waterworks development project with river water as a source would require the conduct of preliminary surveys on river flow, water quality, water use conditions (irrigation, industrial, domestic), industrial effluent and wastewater, river flow and salinity backwash, that would provide the basic information required for further studies. The conduct of the same surveys should also be carried out for Nong Cong Town in Thanh Hoa, to determine the feasibility of a water supply development based on river water use.

PART IV

PRIORITY PROJECT

PART IV PRIORITY PROJECT

CHAPTER 1 BASIC CONDITIONS OF THE PROJECT

1.1 Target Area & Policy

1.1.1 Target Area

The existing water sources in the 15 communes for the priority project consist of shallow wells, tube wells, river water, and rainwater. These sources are quite close to the residence and the water consumption amount per household ranges from 400 to 500 liters. Most of these water sources, however, are contaminated with coliform bacilli. In addition, water in the shallow wells is rich in iron, resulting in frequent complaints from the residents regarding the color, smell and taste of the water. The amount of water produced by these sources is also not stable, resulting in water shortage problems in the dry season.

Table 1.1 List of the Priority Communes

NO.	Province	District	Commune	Population (thousand)
1	Hanoi	Tu Liem	Xuan Dinh	15.77
2			Dong Ngac	6.90
3	Ninh Binh	Tam Diep Town	Quang Son	7.50
4		Yen Mo	Yen Thang	8.53
5		Nho Quan	Dong Phong	10.00
6	Thanh Hoa	Nong Cong	Van Thang	6.66
7			Thieu Hoa	Thie Hung
8		Yen Dinh	Thieu Do	7.01
9			Dinh Tuong	6.52
10			Vin Loc Town	5.08
11	Vin Loc	Vinh Thanh	5.98	
12	Thai Nguyen	Dong Hy	Dong Bam	5.28
13			Hoa Thuong	12.80
14		Pho Yen	Nam Tien	6.27
15		Thai Nguyen Town	Thinh Duc	6.24

1.1.2 Water Supply Facility Planning Policy

The water supply facilities will be constructed based on the following policies:

- (1) Each commune will be constructed with its own water supply facility. The use of one water source for Vin Loc Town and Vinh Thanh is considered possible as these communes are adjacent to each other. Therefore, the water supply facility to be constructed in this area will be shared by these two communes.
- (2) The water supply system will provide services through household connections (service level III). A 90 % service coverage rate is targeted by 2010.
- (3) Water supply facility O&M will be independently carried out by each commune. A biological filter for water treatment will be planned, therefore, as it is easy and inexpensive to operate and maintain.

1.2 Water Demand Forecast & Design Water Amount

The water demand estimated in the master plan for 2010 will be adopted as the forecast water demand. The water demand for domestic and non-domestic use will also be adopted from the values established in the master plan. Table 1.1 shows the population in and design water amount for each commune.

1.3 Groundwater Resource

The number of deep wells every commune would need was determined based on the optimal pumpage estimated from the results of the boring and pumping test results (see *Part 2, 6.2*).

CHAPTER 2 PRELIMINARY DESIGN

2.1 Facility Plan

The water supply facility standards of the Ministry of Construction of Vietnam will be adopted as the design standards for facility planning. For any facility not covered by these standards, the design standards of the Japan Waterworks Association were adopted.

2.1.1 Water Source Facilities

The water source facilities in the study area consist of production wells, pump house, and transmission pipelines. Aside from the conversion of the test wells into production wells, new production wells will also be constructed.

2.1.2 Water Treatment Facilities

The water treatment facilities in the study area consist of a receiving well, biological filtration basin, backwash tank, drainage basin, and sludge drying bed.

The treatment facilities are used to remove iron bacteria and manganese ions. According to the water quality analysis results, iron and manganese levels in the ground water in the communes are high. The biological filtration method will be adopted therefore. However, a simple filtering facility will be adopted for communes where the ion levels are lower than the water quality standard established in Vietnam.

Boring tests were not carried out in the two communes in Ha Noi, but in view of the quality of the water produced by the wells of the Ha Noi waterworks system, groundwater in these areas are presumed to contain high manganese levels. The biological filtration method will be adopted therefore. As alternative treatment methods, the adoption of an aeration tower and a contact basin/sedimentation basin will also be considered.

2.1.3 Distribution Facilities

The distribution facilities to be constructed under this project consist of a distribution pond, pumps, elevated tanks, and distribution pipelines. The distribution pond capacity will correspond to 7 to 8 hours worth of the design maximum daily supply; this will include the capacity of the elevated tank.

The elevated tank will be planned for communes in flat areas. Since the two communes in Ha Noi, Thieu Hung and Thieu Do in Thanh Hoa have soft grounds, studies should be carried out on their topographic locations for the formulation of the future expansion plan.

Table 2.2 shows the capacity of the facilities by commune. Figure 2.1 shows the outline of the facilities.

2.2 Project Cost

Project cost covers the construction cost, design management cost, and contingency costs. The total project cost, calculated with due consideration of price increase, is VND 191,000 (US\$ 13.7 million). Table 2.3 shows the breakdown of the project cost.

2.3 Proposed Construction Schedule

Figure 2.2 shows the proposed construction schedule.

Table 2.2 Facility Capacity

Supply Area		Capacity of Facilities of each Commune-2				Filtration Basin (Excluding stand-by Basins)				Distribution Reservoir		
Province	Commune	Water Quantity Max. Daily Supply (m ³ /day)	Aeration Tower Aeration Area 30m ³ /m ² /h (m ³ /m ² /h) 30.0 (m ²)	Contact & Sedimentation Basin Capacity of Basin 1hour (m ³) 1.00	Necessary Filtration Area (m ²)	Dimensions of Filtration Basin			Capacity of 1basin (m ³ /day)	Distribution Facility		
						Number of Basins	Dimension (m) B L	Min. L		8 hours /7hours (m ³)	Elevated Tank	
Thai Nguyen	Hoa Thuong	1,630		(NO)	23.3	2	3.0	3.9	815	8hours	NO	
	Dong Bam	880		(NO)	12.6	2	2.0	3.1	440		NO	
	Thinh Duc	700		NO				NO			NO	
	Nam Tien	1,010		NO				NO			NO	
	Total	4,220			36.9					1,407		
Ha Noi	Dong Ngac	1,200	1.7	50.0	17.1	3	2.0	2.9	400		350 *	
	Xuan Dinh	2,710	3.8	112.9	38.7	3	3.0	4.3	903		903 *	
	Total	3,910	Alternative	162.9	55.9					1,253 *	179	
Ninh Binh	Dong Phong	1,610		NO				NO			537	
	Quang Son	1,230		(NO)	17.6	2	2.5	3.5	615		410	
	Yen Thang	1,380		(NO)	19.7	2	3.0	3.3	690		460	
Thuan Hoa	Total	4,220			37.3						1,407	
	Vinh Thanh Vinh Loc	1,010		(NO)	14.4	2	2.0	3.6	505		337	
		1,030		(NO)	14.7	2	2.0	3.7	515		343	
Thuan Hoa		2,040		(NO)	29.1	3	3.0	4.9	1,020		680	
	Dinh Tuong	1,090		NO				NO			360	
	Thieu Hung	1,130		(NO)	16.1	2	2.5	3.2	565		377 *	
	Thieu Do	1,170		NO	16.7			NO			390 *	
	Van Thang	1,110		(NO)	15.9	2	2.5	3.2	555		370	
Total		6,530			77.9						2,177 *	
		18,880	5.4	162.9	206.9	m ²					6,243 m ³	
					Treated water						Total in 2010 *	
					14,480	m ³	70	m/day				691
												* Alternative/2010
												Constructed in next expansion stage

Table 2-3 Total Project Cost

Province	Commune	A		B		C		D		E		F		G		H		FINANCING REQUIRED (G+H)			
		FACILITY (WATER SOURCE & TREATMENT PLANT)		TRANSMISSION DISTRIBUTION PIPELINE & HOUSE CONNECTION		LAND COST		ENGINEERING		BASE COST (A+B+C+D)		PHYSICAL CONTINGENCY		PROJECT COST (E+F)		PRICE CONTINGENCY					
		(MIL VD)	(MIL US\$)	(MIL VD)	(MIL US\$)	(MIL VD)	(MIL US\$)	(MIL VD)	(MIL US\$)	(MIL VD)	(MIL US\$)	(MIL VD)	(MIL US\$)	(MIL VD)	(MIL US\$)	(MIL VD)	(MIL US\$)				
Thai	Hoa Throng	3,500	10,200	0	780	980	830	1,130	15,760	1,130	0,090	1,221	3,400	0,244	17,020	1,221	3,400	0,244	20,400	1,463	
	Dong Bam	3,000	4,900	0	440	350	890	0,638	8,890	0,638	0,051	9,600	1,920	0,138	9,600	0,689	1,920	0,138	11,500	0,825	
	Thinh Duc	3,000	6,400	0	520	660	10,580	0,759	10,580	0,759	0,061	11,400	2,280	0,164	11,400	0,818	2,280	0,164	13,700	0,983	
	Nam Tien	2,900	6,100	0	500	630	10,130	0,727	10,130	0,727	0,058	10,940	0,785	0,157	10,940	0,785	2,190	0,157	13,100	0,940	
	Sub total	12,700	27,600	0	2,240	2,820	45,360	3,250	45,360	3,250	0,260	48,990	3,514	9,800	0,703	48,990	3,514	9,800	0,703	58,800	4,21
Ha Noi	Dong Ngac	3,300	4,100	0	410	520	8,330	0,598	8,330	0,598	0,048	9,000	0,646	1,800	0,129	9,000	0,646	1,800	0,129	10,800	0,775
	Xuan Dinh	7,600	7,100	0	820	1,030	16,550	1,187	16,550	1,187	0,095	17,870	1,282	3,570	0,256	17,870	1,282	3,570	0,256	21,400	1,535
	Sub total	10,900	11,200	0	1,230	1,550	24,880	1,785	24,880	1,785	0,143	26,870	1,927	5,370	0,385	26,870	1,927	5,370	0,385	32,200	2,31
Ninh Binh	Dong Phong	3,200	6,000	0	510	640	10,350	0,742	10,350	0,742	0,060	11,180	0,802	2,240	0,161	11,180	0,802	2,240	0,161	13,400	0,961
	Guang Son	4,700	5,500	0	570	710	11,480	0,823	11,480	0,823	0,066	12,400	0,889	2,480	0,178	12,400	0,889	2,480	0,178	14,900	1,069
	Yen Thang	3,800	5,600	0	520	660	10,580	0,759	10,580	0,759	0,061	11,430	0,820	2,290	0,164	11,430	0,820	2,290	0,164	13,700	0,983
Sub total	11,700	17,100	0	1,600	2,010	32,410	2,324	32,410	2,324	0,186	35,000	2,511	7,000	0,502	35,000	2,511	7,000	0,502	42,000	3,01	
Thuan Hoa	Vin Loc Town																				
	Vinh Thanh	4,200	5,900	0	560	710	11,370	0,816	11,370	0,816	0,065	12,280	0,881	2,460	0,176	12,280	0,881	2,460	0,176	14,700	1,054
	Dinh Tuong	2,700	4,600	0	410	510	8,220	0,590	8,220	0,590	0,047	8,880	0,637	1,780	0,128	8,880	0,637	1,780	0,128	10,700	0,768
	The Hung	2,800	3,900	0	370	470	7,540	0,541	7,540	0,541	0,043	8,140	0,584	1,630	0,117	8,140	0,584	1,630	0,117	9,800	0,703
	Theu Do	2,200	3,900	0	340	430	6,870	0,493	6,870	0,493	0,039	7,420	0,532	1,480	0,106	7,420	0,532	1,480	0,106	8,900	0,638
Sub total	Van Thang	3,800	5,600	0	520	660	10,580	0,759	10,580	0,759	0,061	11,430	0,820	2,290	0,164	11,430	0,820	2,290	0,164	13,700	0,983
	Sub total	15,700	23,900	0	2,200	2,780	44,580	3,199	44,580	3,199	0,256	43,150	3,454	9,630	0,691	43,150	3,454	9,630	0,691	57,800	4,15
Sub total		51,000	79,800	0	7,270	9,160	147,230	10,558	147,230	10,558	0,845	159,010	11,406	31,800	2,281	159,010	11,406	31,800	2,281	191,000	13,7

Note: Cost 1999 year level
Exchange rate US\$ 1.00=13,941VD(Vietnam Dong)

Fig 2.1 Flow Diagram

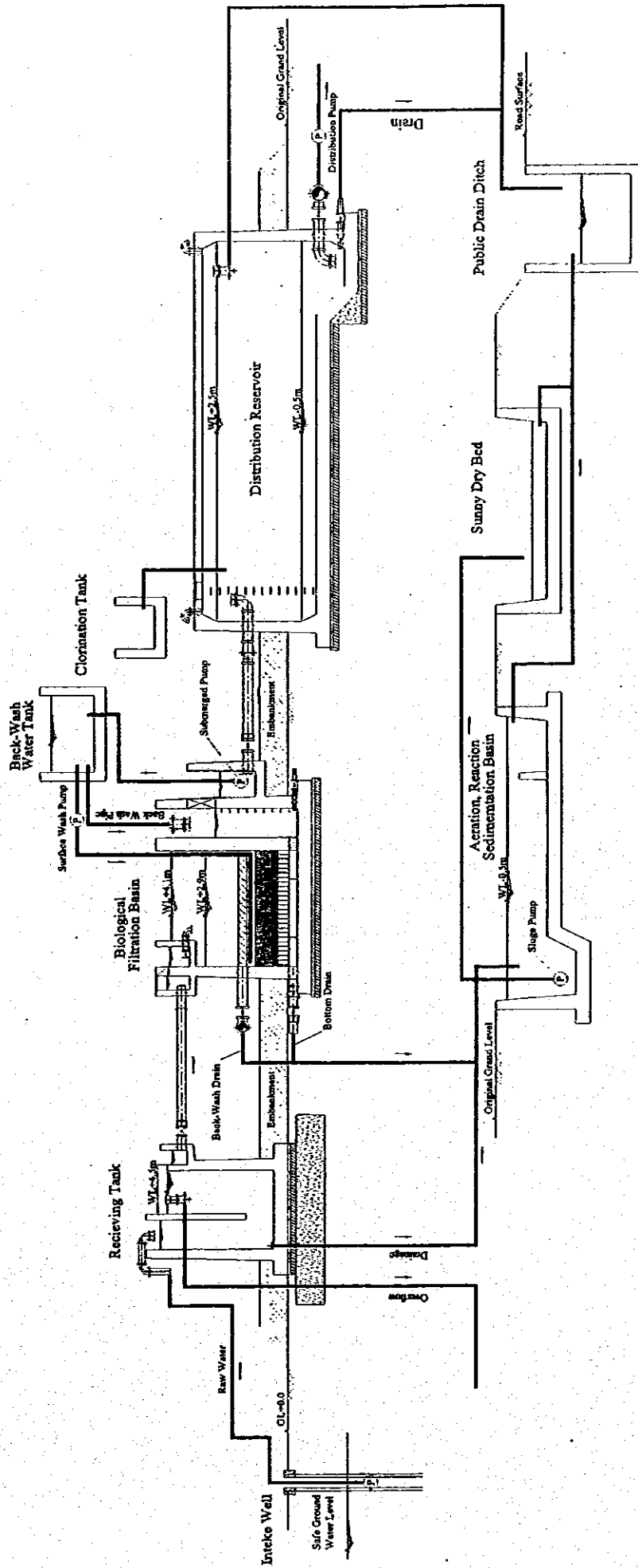


Fig 2.2 Proposed Construction Schedule

Item/Province/Commune		2000	2001	2002	2003	2004
Approval by the Government		End of 1999				
Detailed Design		▬				
Land Acquisition		▬				
Bidding			▬			
Preparation Work and Procurement			▬			
Technical Guidance and Filter Ripening				▬		
Main Work and Operation Guidance						
Thai Nguyen	Hoa Thuong		▬			
	Dong Bam		▬			
	Thinh Duc		▬			
	Nam Tien		▬			
Ha Noi	Dong Ngac		▬			
	Xuan Dinh		▬			
Ninh Binh	Dong Phong		▬			
	Quang Son		▬			
	Yen Thang		▬			
Thanh Hoa	Vinh Loc Town, Vinh Thanh		▬			
	Dinh Tuong		▬			
	Thieu Hung		▬			
	Thieu Do		▬			
	Van Thang		▬			

CHAPTER 3 O&M AND FINANCIAL ANALYSIS

3.1 O&M Organization

3.1.1 Outline of the Organization

For facility operation and maintenance, the CPC will organize a CWSO under the WATSAN committee. The organizational structure is shown in the following figure.

The O&M organization will consist of the WATSAN committee and the CWSO. This organization will be formed under the CPC and will operate under the supervision of CPC. To ensure clarity in its activities, the organization will be granted the same administrative powers as the CPC, and will fulfill its responsibilities with the help of the latter.

3.1.2 Responsibilities & Functions

(1) WATSAN Committee

Aside from the water supply activities in the commune, the committee is also responsible for the diffusion of knowledge relevant to health and sanitation and the improvement of the sanitary environment. The committee's responsibilities prior to and after the project are as shown below.

1) Prior to the Project

Selection of water supply facility construction site and coordination; formulation of the articles of the water supply organization; setting up of water charge; resident mobilization.

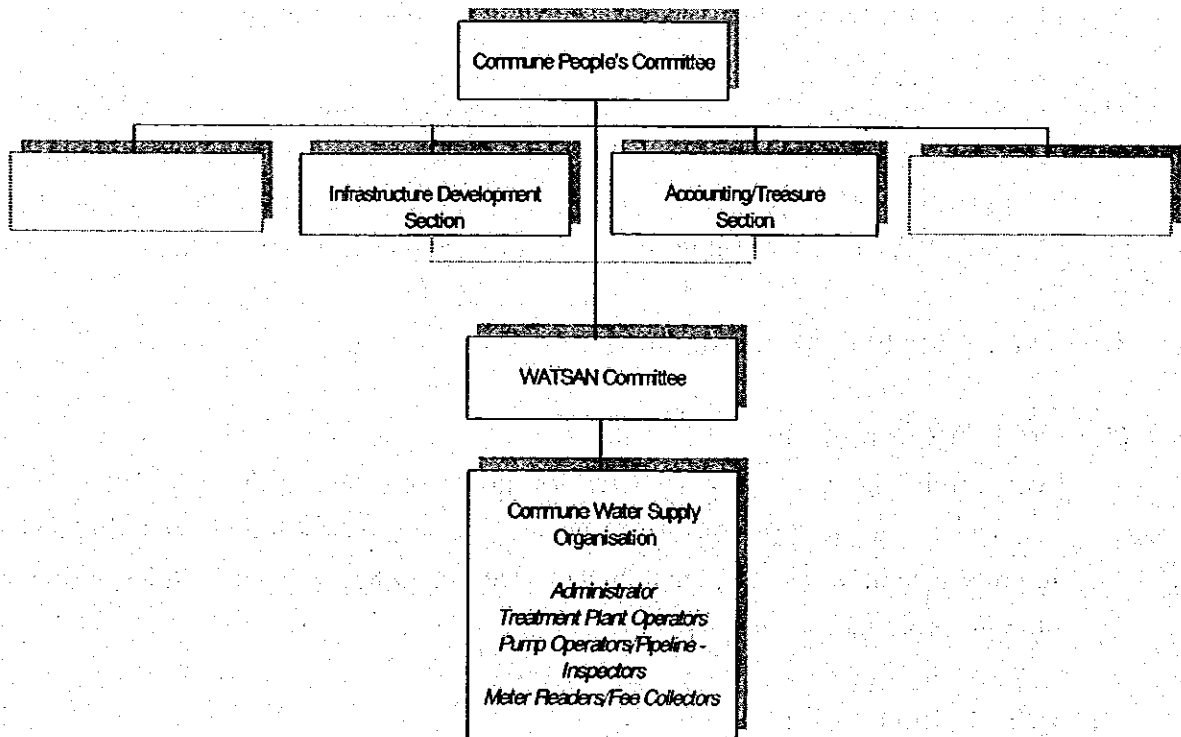
2) After the project

Formulation of supervisory and operation policies, water supply organization's budget, and water charge; supervision and monitoring of CWSO, accounting inspections; regular reporting to CPC; formulation of expansion plan; acceptance of users' needs; regular conduct of sanitation campaigns.

(2) CWSO

CWSO will be responsible for the daily operation and maintenance of the facilities. The O&M functions to be carried out by CWSO are as follows:

Figure 3.1 Organization of O&M in the Commune



1) **Distribution of water from the source to the users**

Intake of surface water; water treatment; water storage; water distribution

2) **Flow of money from users to CWSO**

- Water treatment facility operator
- Pump operation caretaker and pipeline inspector
- Meter reader and water fee collector

3.1.3 **Workforce Plan**

(1) **WATSAN Committee**

The committee will be made up of the following 10~15 members (depending on the number of villages in a commune):

CPC chairman, commune assembly chairperson, village head, elected representatives of the residents, representative of the commune health center (CHC), representatives of public organizations.

(2) **CWSO**

The following table shows the total number of CWSO staff required by 2010, calculated in accordance with the increase in the amount of water supplied by the facilities in every commune.

Personnel	Year	2002	2005	2010
Administrators		1	1	1
Water treatment facility operator		1	2	3
Pump and pipe caretaker		1	2	3
Meter reader and water fee collector		8	8	8
Total		7	11	15

3.2 **Financial Analysis & Economic Impact**

3.2.1 **Investment Cost**

Table 3.1 shows the construction cost of the water supply facilities in consideration of the population in 2002. As shown in the table, the costs vary widely by commune. In Xuan Dinh

in Ha Noi, Vin Loc Town and Vinh Thanh in Thanh Hoa, the cost is small, VND 120 million, because these communes are highly populated. In contrast, cost performance is low in the 4 communes in Thai Nguyen, Yen Thang in Ninh Binh, and Van Thang in Thanh Hoa where the construction cost is high, around VND 200 million.

Table 3.1 Comparison of Water Supply Facility Construction Cost

Province	Commune	2002 Population	Construction Cost (VND million)	Per Capita Share (VND million)
Thai Nguyen	Hoa Thuong	13,600	20,400	1.3
	Dong Bam	5,600	11,500	2.0
	Thinh Duc	6,600	13,700	2.1
	Nam Tien	6,700	13,100	2.0
Ha Noi	Dong Ngac	7,300	10,800	1.5
	Xuan Dinh	16,600	21,400	1.3
Ninh Binh	Dong Phong	10,500	13,400	1.3
	Quang Son	7,900	14,900	1.9
	Yen Thang	9,000	13,700	1.5
Thanh Hoa	Vinh Loc Town & Vinh Thanh	11,900	14,700	1.2
	Dinh Tuong	6,900	9,800	1.6
	Thie Hung	7,200	10,400	1.4
	Thieu Do	7,500	8,900	1.2
	Van Thang	7,100	13,700	2.9
Average		8,850	13,600	1.5

3.2.2 Household Connection

The installation of household connections is estimated to cost about VND 700,000 per household. The amount is considered to be acceptable to the residents as it is the same as in the drilling costs of shallow and tube wells in the commune. For the impoverished class, the commune should grant subsidies in accordance with the income level. Another option to be considered is having these residents carry out the water supply pipeline installation work.

3.2.3 O&M Cost & Financial Feasibility

The O&M cost covers the salary of the water supply system personnel, expenses for the purchase of chemicals, electric bill, repair costs, etc. The calculation of the O&M cost for the

water supply facilities to be constructed in 14 places is shown in the table below.

Table 3.2 Water Supply Facility O&M Cost

Province	Commune	Average O&M Cost (VND/m ³)
Thai Nguyen	Hoà Thuong	1,200
	Dông Bám	1,500
	Thinh Duc	1,700
	Nam Tien	1,700
Ha Noi	Dong Ngac	1,400
	Xuan Dinh	1,200
Ninh Binh	Dong Phong	1,300
	Quang Son	1,500
	Yen Thang	1,400
Thanh Hoa	VLT & Vinh Thanh	1,300
	Dinh Thuong	1,400
	Thieu Hung	1,400
	Thieu Do	1,500
	Van Thang	1,500
Average		1,400

According to the field survey results, the residents are estimated to be able to pay a water charge ranging from VND 4,500 per m³ (Ha Noi) to VND 1,800 per m³. Taking this into account, the table below shows the estimated water charge to be established in a ten year period (from 2002).

Table 3.3 Water Charge from 2002

(unit: VND/m³)

Year	Water Charge for Household Connections	Water Charge for Public Taps
2002	1,500	1,000
2003	2,000	1,400
2004	2,000	1,400
2005	2,000	1,400
2006	2,000	1,400
2007	2,000	1,400
2008	2,500	1,700
2009	2,500	1,700
2010	2,500	1,700
2011	2,500	1,700
2012	2,500	1,700

Table 3.4 shows the results of the analysis on the financial feasibility of the construction and operation of the water supply facilities in 14 places. All of these communes were analyzed to expect the revenue exceeding the expenditures, indicating the feasibility of the facility construction and operation. However, it is predicted that in 5 communes (Dong Bam, Think Duc, Nam Tien in Thai Nguyen province, Quang Song in Ninh Binh province and Van Thang in Thanh Hoa province) which are sparsely populated and the per capita facility construction cost is higher than other communes, operation and management would be severe in terms of finance for several years after construction. To stabilize the O&M at the beginning, the initial operation fund should be secured. In addition, in those communes where enough surplus is expected, the reserve fund for future renewal of the facilities should be considered.

3.2.4 Economic Impacts

According to the household questionnaire survey results, the annual medical expenses of the communes average about VND 30 million. Assuming a 10 % decrease in the expenses as a result of improved health and sanitary conditions brought about by the construction of the water supply facilities, the project is estimated to incur an economic gain of VND 1 billion per annum.

Although there are no past statistical data to substantiate this observation, household interviews indicate that the residents lose several number of work days per annum due to contagious water borne diseases. A loss of 10 work days per annum due to illness, therefore, would correspond to 3 % of the average annual income, that is VND 20 million. If this

assumption is correct, the increase in the opportunities to work in a year as a result of improved health conditions brought about by the implementation of this project is estimated to yield an economic gain of VND 6 billion per annum.

Table 3.4 Financial Viability of Water Supply Systems

Province	Commune	Population in 2002	Average Annual O/M Unit Cost (VND/m ³)	Average Annual O/M Cost (VND million)	Average Annual Revenue (VND million)	Annual Saving (Revenue - Annual Cost, VND million)	Annual Saving as % of Construction Cost
Thai Nguyen	Hoa Thuong	13,600	1,200	320	620	300	1.5%
	Dong Bam	5,600	1,500	210	360	150	1.3%
	Thinh Duc	6,600	1,700	190	240	50	0.4%
	Nam Tien	6,700	1,700	260	420	160	1.2%
Ha Noi	Dong Ngac	7,300	1,400	260	520	260	2.4%
	Xuan Dinh	16,600	1,200	490	1,170	680	3.2%
Ninh Binh	Dong Phong	10,500	1,300	320	690	370	2.8%
	Quang Son	7,900	1,500	280	530	250	1.7%
	Yen Thang	9,000	1,400	300	590	290	2.1%
Thanh Hoa	Vinh Loc Town & Vinh Thanh	11,900	1,300	380	860	480	3.3%
	Dinh Tuong	6,900	1,400	240	460	220	2.1%
	Thieu Hung	7,200	1,400	240	480	240	2.4%
	Thieu Do	7,500	1,400	250	500	250	2.8%
	Van Thang	7,100	1,500	260	480	220	1.6%
Average		8,900	1,400	290	570	280	2.1%

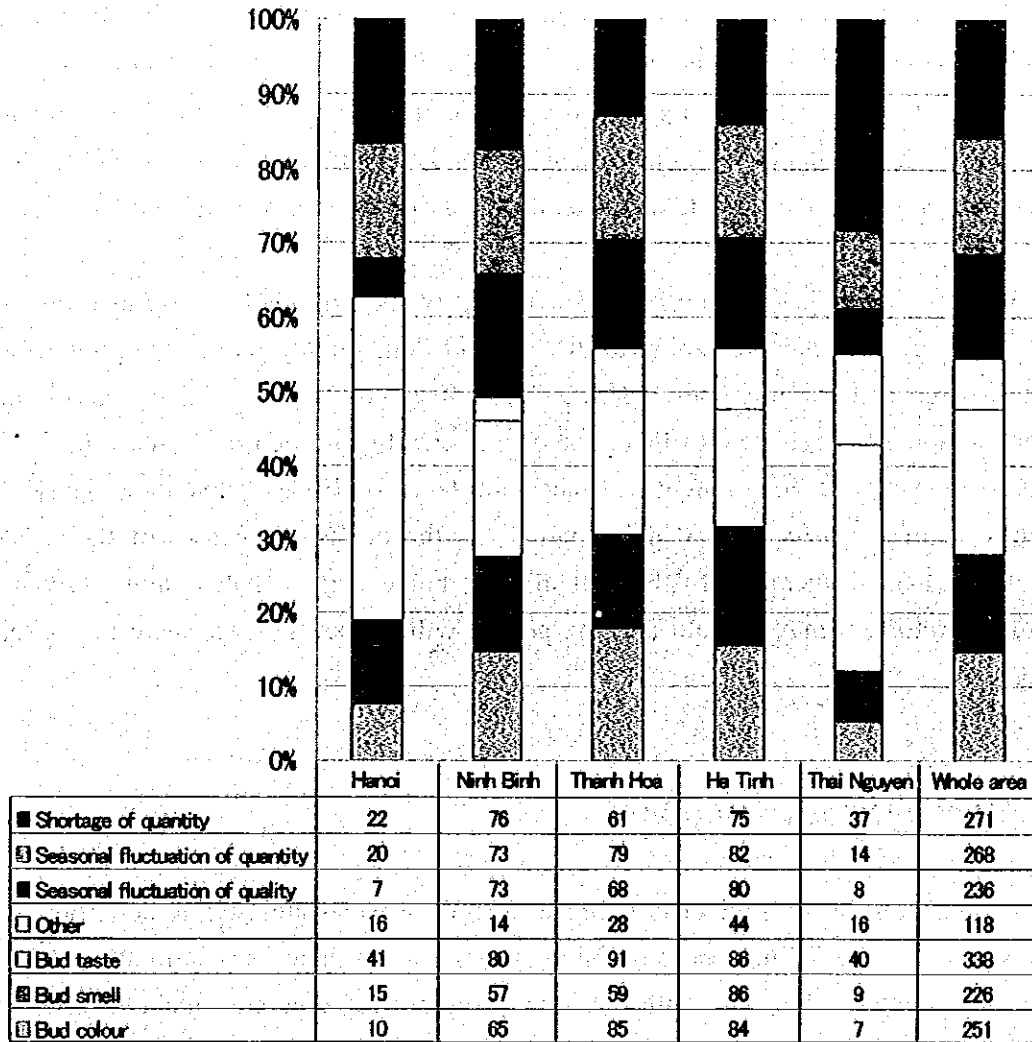
CHAPTER 4 PROJECT EVALUATION

4.1 Need for Safe Water Supply

Based on the results of the household questionnaire survey, the residents are highly dissatisfied with the yield and quality of the existing water sources. Feelings of dissatisfaction are mainly due to shortage in yield, bad taste, smell and unclear water, factors that are usually affected by seasonal changes (see Figure 4.1). Because of this, many of the residents have installed deferrization devices in an attempt to improve the water taste and color, and rid the water of its offensive smell. Nonetheless, the results have not always been satisfactory. In the analysis of the quality of these water resources, shallow wells were detected to contain exceptionally high levels of coliform bacilli, indicating the advanced contaminated conditions of the water resources due to improper domestic and livestock wastewater discharge.

The implementation of the priority project would realize the residents need for safe water as this would provide unrestricted access to chlorinated water through taps. In the long run, safe water supply and the convenience this provides would change the living environment and significantly improve health and sanitary conditions.

Figure 4.1 Water Problems in the Target Communes



(Household Questionnaire Survey)

4.2 Impacts on Household Economy

The implementation of the water supply project would increase expenses in the household. Studies should be carried out, therefore, to determine the extent of the project's impacts on the household economy. However, as mentioned in *Part 1*, the residents are deemed willing to pay for the services if it means being able to conveniently acquire safe water —as long as the water charge is in accordance with the present income level and equal or less than the electric bill. Separate considerations should be made, however, for the impoverished class.

The impacts of the project on the medical expenses of the households were also analyzed. The water supply project is not going to directly and immediately reduce the prevalence of various diseases in the communes. Through improvements in the sanitary environment, however, the number of disease inflicted patients is clearly foreseen to decrease in the long run. There are hardly no government assistance programs for disease prevention in any of the communes at present. As shown in Chapter 3.2.3, the medical expenses of the residents amount to an annual average of VND 30 million, not exactly a paltry sum. Given this condition, therefore, it may be said that the project will reflect the new share in household expenses.

4.3 Social Disadvantages

The implementation of the project is going to directly affect water selling activities or the producers of and shops selling bottled drinking water. This impact is seen to affect not only the target communes, but the entire northern region of Vietnam, including Ha Noi. Nonetheless, the study cannot forecast whether these enterprises will go out of business once the water supply system operation starts. Even if a 100 % coverage rate is attained, it is probable that these enterprises would survive to a certain extent in view of the principle of coexistence. The project is considered to bring about both social advantages and disadvantages, however the latter is deemed insignificant compared to the former.

The indirect disadvantages that the project may incur are in the form of what the public considers as partiality in the services. This partiality would be evident in communes where the population is scattered; this condition would raise the cost of the distribution pipelines and consequently deprive some of the residents who cannot afford the cost of the opportunity to receive the services.

Although the ratio is small, the communes also consist of impoverished households. The

possibility that these households would impartially receive the benefits of the water supply services is a moot point. Based on the PRA and PCM, the individual income in the communes, water charge the residents are willing to pay, and the residents opinion on having to shoulder a part of the cost for the installation of water supply pipelines, were determined and shown in the table below.

Table 3.2.6 Public Opinion Gleaned Through the PRA & PCM Workshop

	PRA	PCM Workshop
1. Average annual income/worker (VND/year)	Poor: 2,308,000 Middle class: 4,040,000 Affluent: 7,320,000 Average: 4,167,000	Revenue from rice cultivation: 1,250,000 Other source of income is unknown
2. Water charge willing to pay (VND/m ³)	Poor: 900 Middle class: 1,259 Affluent: 1,376 Average: 1,202	800~1,200
3. Cost of installation of household connection (VND)	unknown	180,000~1,000,000
4. Contribution to facility construction cost	Poor: 94,620 Middle class: 245,560 Affluent: 342,310 Average: 226,960	50,000~200,000

The ratio of the poor to the population of the communes varies widely from 5 to 20 %, 15 to 20 % in most. The middle class, on the other hand, make up 50~70 % of the population. The desired water charge and share in the household connection installation cost vary by social strata.

The financial analysis results also clearly show that the O&M cost in communes with dispersed villages and a small population will be high as the construction of the facilities in the area would require a large investment. Discussions and studies should be fully carried out, therefore, regarding the service level in these communes, the service coverage, the share of the residents in the service costs, and how subsidies will be granted. There is also a need to gain the consensus of the commune residents regarding the establishment of a water charge system that takes the conditions of the poor into consideration.

4.4 Community Participation

A number of public organizations, e.g. VWU, are being formed in the communes. Most of these organizations carry out various activities (construction of schools and health centers) with the participation of the residents. CPC directly manages and operates irrigation facilities, and is seen to be a sufficient foundation for the promotion of resident participation.

The table below summarizes the organizations in the study area and their recent community related activities. VWU, Farmers Union, War Veteran's Union, Old Aged Union, and Youth Union are organizations that can be found in any commune.

Table 3.2.7 Organizations in Target Communes and their Recent Activities

Province	Commune	Organization	Recent Activities
Ha Noi	Dong Ngac		Celebrate Health and Sanitation Day (Saturday)
	Xuan Dinh	WATSAN	
Ninh Binh	Yen Thang		Elementary school construction
Thanh Hoa	Thieu Do	Livestock union	1) Roof tiling, 2) irrigation drainage canal construction, 3) concrete pavement of roads, 4) electric installation work, 5) family planning, 6) sanitary education
	Dinh Thuong		Environmental sanitation
	Vin Loc Town		Environmental sanitation
	Vinh Thanh		Child health education
Ha Tinh	Yen Ho		Construction of cemetery
	Bui Xa		Organize wage increase activities

Public organizations, such as VWU, mainly promote the project through resident mobilization activities. And with the assistance of the regional CERWASS office and PTT, attaining community participation for the project is not impossible at all.

4.5 Conclusion

As aforementioned, the project should be implemented as it is assessed to bring about many social benefits. The financial analysis, on the other hand, showed that the per capita construction cost is high in sparsely populated communes and this would also incur high O&M costs. It is, therefore, necessary to fully conduct discussions on the details of the water

supply plan and the operation and management of the facilities. The discussions should involve all target communes in order to gain the consensus and the commitment of the public to promote the project.

PART V

RECOMMENDATIONS

PART V RECOMMENDATIONS

1. GROUNDWATER DEVELOPMENT PLAN

1.1 Comprehensive Groundwater Management in Ha Noi

An independent groundwater development plan was proposed for the 2 communes in Ha Noi, which are not covered by the city's water supply services despite their proximity. However, the Hanoi water works has already been pumping huge amount of groundwater, decline in groundwater level and land subsidence reportedly occur in Hanoi Area of the Red River delta. Taking these concerns into account, a plan to construct a new well field along the right bank of the Red River for the Ha Noi waterworks system is devised.

There is also a high possibility that the operation of the Ha Noi waterworks system would affect the groundwater, e.g. decline in groundwater level and deterioration in groundwater quality, in target communes. Relevant agencies should, therefore, urgently implement a comprehensive groundwater management plan by conducting studies involving a wide area to determine how to preserve and effectively use groundwater resources in Ha Noi.

1.2 Considerations in the Development of Limestone Aquifers

In Dong Bam in Thai Nguyen, a test well drilling was carried out in fractured limestone with cavities, and the surrounding ground collapsed when a well was being developed. The detailed reasons behind the collapse is unknown, although the runoff of the clay that filled the cracks in the limestone was observed when groundwater was pumped up during the well development. It is also estimated that the subsidence must have resulted from the occurrence of a cavity due to the suction of unconsolidated sediments in the basement rock. Most limestone with many cavities or cracks make good aquifers. Other limestone areas were also confirmed to have cavities filled with soft clay. If there are houses near this area, these conditions could precipitate accidents that may be life threatening or cause damage to properties. Taking this into account, sufficient studies should be carried out on surrounding ground and land use conditions when selecting well drilling points.

1.3 Improvement in Well Drilling Techniques

Deep well drilling under this study was entrusted to local well construction firms who are still using outmoded Russian well drilling machinery. Since the machinery was not a sufficient capability of drilling, the drilling works were carried out as: first drilling a small hole and then expanding the hole gradually. Drilling, therefore, was extremely time consuming resulting in the use of huge amounts of mud water, which again took time to remove during the well development work. All in all, the work was inefficient. As well drilling in areas with complex geological conditions, e.g. hard basement rock, is expected to increase, suitable drilling rigs should be introduced, along with highly advanced and efficient drilling and well construction techniques.

1.4 Periodical Analysis of Water in Test Wells & Continuous Groundwater Leveling

The quality of the water in the test wells was only analyzed once during pumping tests carried out after the well completed. The results were used to design the water supply facilities. Carrying out a water quality test once, however, would not determine seasonal changes in the water quality and the extent of these changes. It is recommended, therefore, that analysis of the water quality of the test wells should be carried out at least twice, once in the dry and in the rainy season.

This study installed automatic water level recorders in the test wells to successively measure groundwater level. Only about several month's worth of data has been acquired so far. Groundwater level monitoring is important to acquire the information basic and therefore essential to groundwater use and management, and hence should be carried out continuously.

2. WATER SUPPLY PLAN

2.1 Development of Alternative Sources

As a water source, the development of nearby groundwater resource would be the best idea. This type of groundwater development was not expected, however, for the communes in Ha Tinh (4) and in Thanh Hoa (1) which are excluded from the priority project. The communes to be covered by the priority project were restricted to those with favorable groundwater yield and quality, although it does not indicate a huge disparity exists in the water shortage problems among the communes. It is, therefore, important to immediately carry out studies

on the development of surface water or other alternative water source for these communes in line with the details specified in this report.

2.2 Unification of Water Supply Services

The waterworks industry is reliant on equipment and facilities, whose scale usually determines the cost of the water (the bigger the scale the cheaper the water cost). As clearly confirmed from the financial analysis results, several communes where construction cost is high requires the adoption of countermeasures for the administrative aspect of water supply services to successfully work. In particular, a single water supply system in scarcely populated communes like the 4 communes in Ha Tinh would be difficult as the development of surface water as a supply source would only further raise the estimated development costs. What would be most recommendable, therefore, is the development of a water supply service that covers a wide area and is jointly managed by the areas concerned. The desire of Vin Loc Town and Vinh Thanh in Thanh Hoa to jointly operate and manage a waterworks system is considered as a good idea. Studies should be carried out, therefore, regarding the possibility of developing a water supply system jointly operated and managed by Nong Cong Town, which is excluded from the priority project, and its neighboring communes.

The development of a piped water supply system in every commune in Vietnam would result in the birth of a large number of small scale water supply systems that is feared to cause problems in water resource and service operations in the future. Strategies should be adopted therefore in view of the nationwide implementation of the rural water supply plan to unify the services in the future.

2.3 Ha Noi Waterworks System Expansion & the Two Communes

The 2 target communes in Ha Noi are situated within the zone where the water source targeted for the expansion project of the city's waterworks system is located. The urban development plan of Ha Noi covers the administrative area of these communes, and these communes are not responsible for the water supply in this development plan. Therefore, the proposed water supply plan of these two communes considers supply of domestic use only. Because these two communes are both highly populated, the implementation of a water supply project is assessed as a high cost-performance and would be feasible therefore. However, since this would mean the utilization of the groundwater resource which is also exploited by the Ha Noi waterworks system, concurrent groundwater pumping is presumed to

take place in the future. Originally, it was considered that these two communes should be covered by the Ha Noi waterworks system expansion project. Planning adjustments should be carried out therefore by discussions with relevant authorities.

2.4 Water Supply Through Household Connections

With the use of piped water supply, the disadvantage is in the installation of service pipes that would connect the system to the recipient households. Majority of the leakage in the system takes place in these service pipes. The pipe material, structure, standards for completion inspection, cost allocation, etc. are issues concerning the water supply facilities that have to be clearly specified prior to construction.

3. FINANCIAL PLAN

3.1 Public Understanding

Because the population is comparatively less concentrated, the rural waterworks system is less efficient than the urban and the facility O&M cost is relatively high. Because the rural household income is generally lower than the urban household income, it is inevitable that the water charge to be imposed under this project would occupy a considerable share of the household economy. If the residents can not bear the water charge, facility operation and maintenance would be difficult to implement. Gaining the residents full understanding of this issue is, therefore, considered a major premise to the promotion of this project.

3.2 Establishment of Water Charge

There will be a need to keep the water charge comparatively low at the beginning of project implementation, to promote the waterworks system. If the O&M expenses are estimated to exceed the revenue form the water charges several years after the project is commenced, the WATSAN committee should pool in advance a certain amount for service management. Adopting method should be discussed with the commune authorities prior to project implementation.

3.3 Consideration of Facility Renewal Cost

Because the social implications of the project are very significant, the investment and depreciation costs were excluded from the financial calculation. A reserve should be put away for the costs that will be incurred in the future renewal of the facilities. In communes where the operations can be efficiently carried out due to a relatively high population density, the introduction of a water charge that also covers future renewal costs may be possible.

4. ORGANIZATIONAL PLAN

Generally, the construction of the water supply facilities is expected to be done faster than the building of new organizations in rural areas. Because of this, forming organizations that would help mobilize the residents and implement facility O&M prior to facility construction is of extreme importance. At least 4 to 6 months prior to construction, resident mobilization should be carried out and the forming of organizations should be commenced. In addition, these organizations should be reinforced by holding training programs along with the construction work. After construction, on-the-job training should be carried out to develop an organization capable of realizing the sustainable operation and management of the facilities.

5. SANITARY ENVIRONMENT

5.1 Education on Sanitary Issues

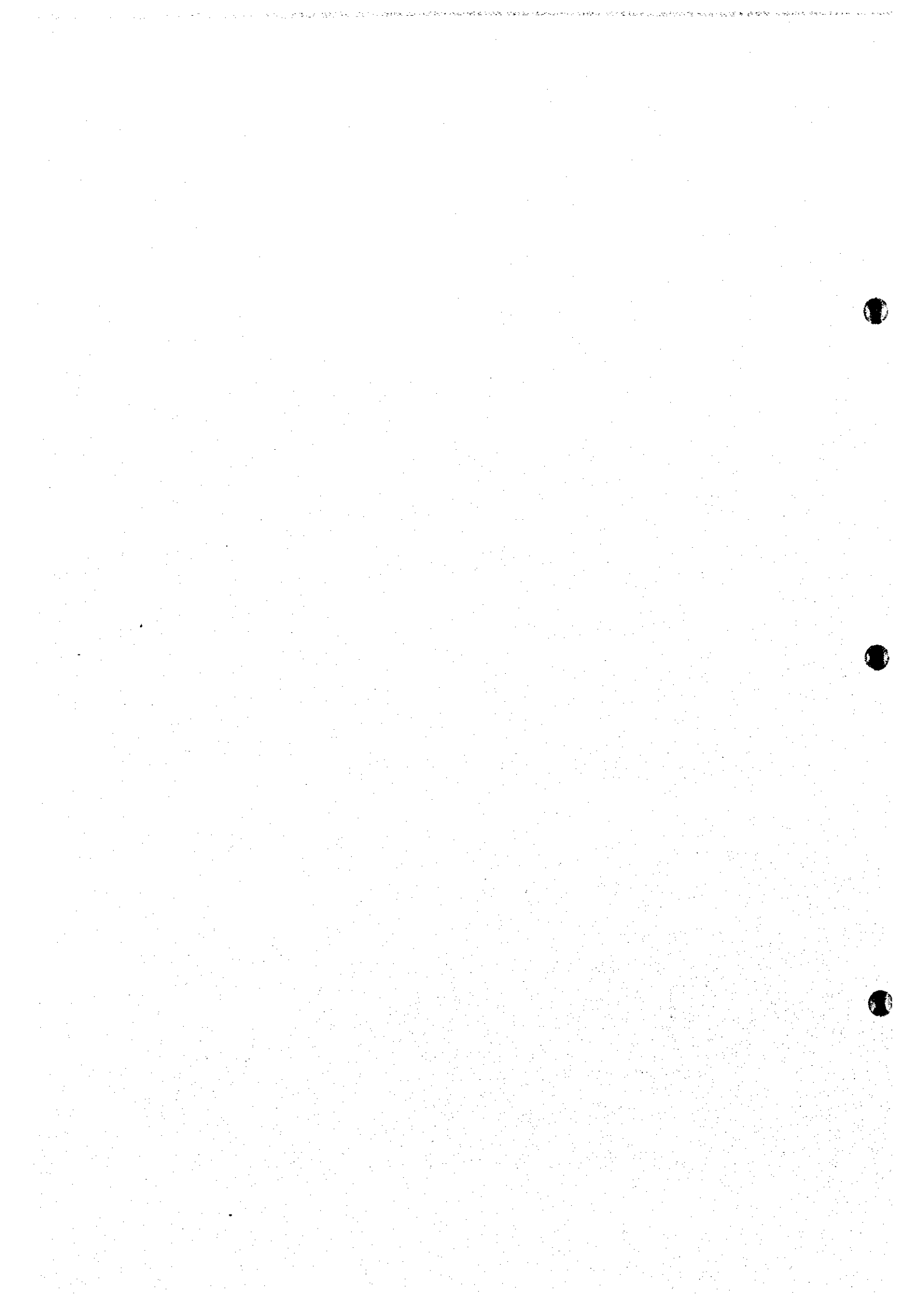
Basic means of educating the residents of every commune regarding sanitary issues have already been taken. What would be most desirable next is the conduct of a sanitary campaign in connection of the water supply facility construction project. In particular, a continuous education program should be held for households and schools to encourage the residents to acquire deeper knowledge on the issues concerned. The production of relevant texts is also recommended.

5.2 Environment

Night soil is currently used as fertilizer. To eliminate pathogens and promote composting, the construction of a septic tank with double storerooms should be encouraged. The use of simple alternative techniques, e.g. construction of a simple drainage connected to the garden in the backyard, installation of a stabilization pond, adoption of a biogas tank system, should

also be promoted for domestic and livestock wastewater treatment.







111