CHAPTER 3 SOCIO-ECONOMY

3.1 Overview of National Economy

The population of Vietnam was estimated at 75 million in 1996. In 2000, the population is forecast to increase to 83 million and 118 million in 2025. Vietnam has been undergoing a shift from a centrally planned economy to a market economy since 1990. Notwithstanding a 9 % growth rate over the last 10 years, however, the GNP is only US$ 250/person (1996). In particular, economic conditions in the rural area, which holds 80 % of the population, are underdeveloped. Due to limited resources, urban infrastructure is not properly maintained and facility rehabilitation is not being carried out.

The table below shows the GDP in the study area.

Table 3.1 Study Area GDP (1997 estimates)

Study Area	Agriculture, Forestry, & Fisheries (VND billion)	Industries & Construction (VND billion)	Service (VND billion)	Total (VND billion)	Per Capita GDP (VND million)
Ha Noi	913 (4 %)	7,300 (36 %)	12,094 (60 %)	20,307 (100 %)	8.6
Ninh Binh	877 (55 %)	309 (19 %)	417 (26 %)	1,603 (100 %)	1.8
Thai Nguyen	805 (37 %)	753 (34 %)	634 (29 %)	2,192 (100 %)	2.2
Thanh Hoa	3,352 (43 %)	1,746 (23 %)	2,661 (34 %)	7,759 (100 %)	2.2
Ha Tinh	1,440 (55 %)	298 (11 %)	878 (34 %)	2,616 (100 %)	1.9
Nationwide	295,696 (26 %)	77,520 (31 %)	92,357 (43 %)	125,819 (100 %)	1.6

Source: Socio-economic Statistical Data of 61 Provinces and Cities in Vietnam, 1997, Statistical Publishing House.

Of the study areas, Ha Noi has the largest GDP, more than 4 times the other provinces. The industrial and construction sector contributes to 95 % of the area economy, and the agricultural sector only 5 %. Although 1/3 of the population is employed in the agricultural sector, the per capita GDP is low. On the other hand, there are numerous opportunities to work for the urban industries at the outskirts of Ha Noi, where income from cash crops is

high. In Ninh Binh, the agricultural sector makes up 55 % of the GDP, and although 77 % of the working population is in the agricultural sector, the per capita productivity is low. The agricultural sector in Thai Nguyen makes up 37 % of the province's GDP, and the contribution of the industrial and construction sector to the GDP is the highest in the study area, that is of course excluding Ha Noi. Thanh Hoa has the second highest GDP, with the agricultural sector occupying 43 % —the highest of the five study areas. In Ha Tinh the agricultural sector occupies 57 % of the GDP and employs 75 % of the province's population. Ha Tinh has the lowest GDP in the study area.

3.2 Social Conditions

The social conditions in the target communes are summarized below based on interviews with the commune Peoples Committee (CPC), results of the Participatory Rapid Appraisal (PRA) and the questionnaire survey on 600 households.

3.2.1 Number of person per household and source of income

The questionnaire survey shows that 50 % of the households consist of less than 4 people. About 60 % of the households have lived in the same commune for over 30 years. Majority of the residents are engaged in agriculture.

3.2.2 Agriculture

Agriculture is the main industry in all communes. Rice is cultivated based on the double cropping system, and harvested in April and September. Of the 20 communes, Quang Song in Ninh Binh cultivates sugar cane, tea, and pineapple as the soil is not suited for rice cultivation. Livestock raising thrives in any of the communes.

3.2.3 Water Use

Many of the communes use shallow wells constructed in every household premises. There are more tube wells in the two communes in Ha Noi than shallow wells. The communes in Thanh Hoa and Ha Tinh mainly collect water from rivers and ponds, while Yen Thang in Ninh Binh and Trung Le in Ha Tinh use public wells.

Existing water resources have bad water quality and always dry up in the dry season. Although majority of the residents live within 25 m, some communes take time to draw water

from the public wells. All households store water in jars or tanks, and boil water prior to drinking.

There are also communes that purchase water in the dry season for a price of VND 17,500 to 25,000 per m^3. Interviews with CPC indicate that the desired monthly water charge per household ranges from VND 500 to 15,000.

3.2.4 Community Participation

There are several public organizations in the communes. These organizations work hand in hand in the construction of roads, schools, canals, etc. Those who cannot volunteer their services are obliged to contribute a certain amount. The communes showed willingness to participate in the construction, operation, and maintenance of future water supply facilities, when the need arises.

3.2.5 Gender

Agricultural activities, particularly major fieldwork, are mainly carried out by the men. Women are relegated with minor tasks. Water collection is carried out by both men and women. Although women share the ownership of livestock and household effects with men, only men can own lands. Household revenue and expenses are jointly managed by both sexes. During the busy season (agricultural), women work more than men in terms of hours, with the former spending 15.4 hours and the latter 12.6 hours. Although men and women have equal rights, only a few women hold high positions in the CPC.

3.3 Sanitation & Environment

The prevalence of water borne diseases, i.e. contagious diseases, parasitic diseases, and hepatitis is high in the target communes. In some communes, dysentery and typhoid fever are prevalent.

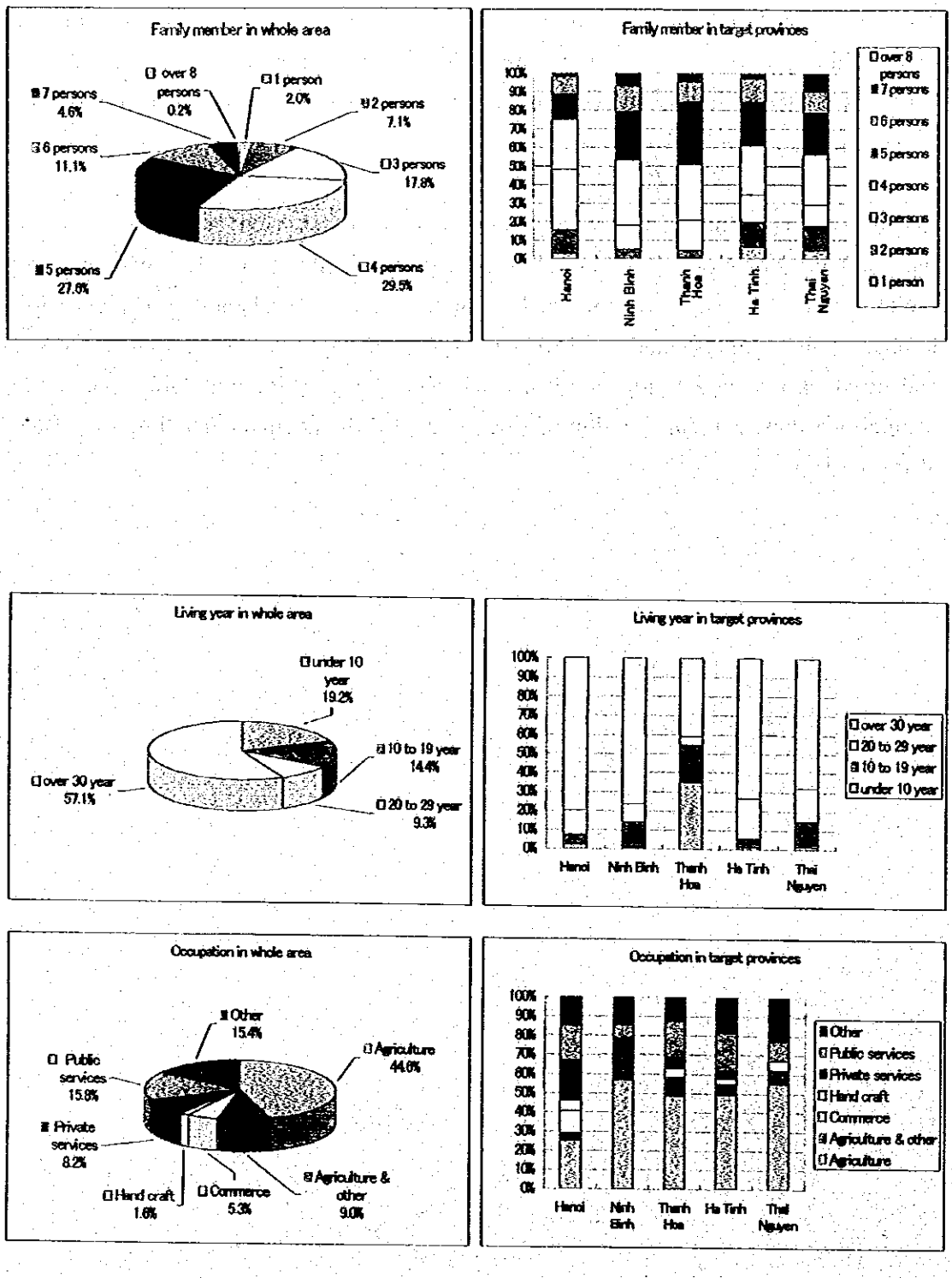
The washing of hands before meals and after toilet use, and the boiling of water prior to drinking are relatively encouraged in the communes. Water drunk during fieldwork and in the markets is not boiled. Households wash vegetables with water from shallow wells infected with coliform bacilli, thereby highly exposing the family to secondary contamination. In general, the residents are not fully aware of the importance of sanitation, and skin diseases, eye diseases (trachoma), and diseases that only affect women are prevalent due to a shortage

in clean and safe water supply.

Medical expenses take up the bulk of the income and are, therefore, a major burden to the household economy. Although there are various mutual aid systems in the target communes, activities related to disease prevention are limited to door to door explanation of prevention measures by a league of women residents.

Because the residents in the target communes hardly showed any interest in sanitation, relevant educational programs should be carried out to enhance resident awareness regarding sanitary issues. In particular, knowledge regarding the proper handling of night soil and the improvement of toilets should be diffused among the residents. Wastewater from household and livestock raising activities are just discharged in the surrounding area. The adoption of countermeasures, e.g. construction of side drains, for the adequate handling of wastewater is also necessary.

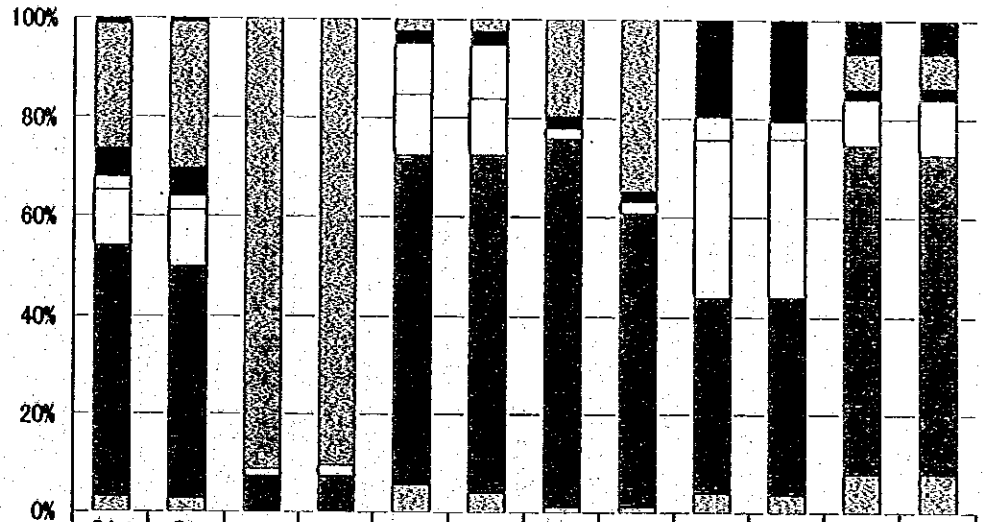
Figure 3.1 Living Conditions of the Communes



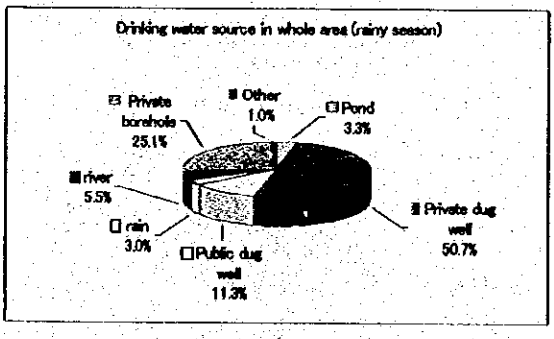
(Household Questionnaire Survey)

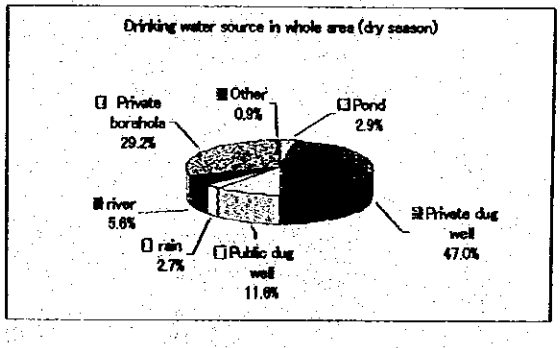
Figure 3.2 Comparison of Drinking Water Source

Comparison of drinking water source



	Rainy season Whole	Dry season Whole	Rainy Hanoi	Dry Hanoi	Rainy Ninh Binh	Dry Ninh Binh	Rainy Thanh Hoa	Dry Thanh Hoa	Rainy Ha Tinh	Dry Ha Tinh	Rainy Thai Nguyen	Dry Thai Nguyen
Other	7	6	0	0	0	0	0	0	1	0	6	6
Private borehole	169	192	126	123	3	3	34	60	0	0	6	6
river	37	37	0	0	3	3	4	4	28	28	2	2
rain	20	18	0	0	13	13	0	0	7	5	0	0
Public dug well	76	76	2	3	15	14	4	4	47	45	8	10
Private dug well	341	309	10	10	83	82	131	104	59	56	58	57
Pond	22	19	0	0	7	5	2	2	6	5	7	7

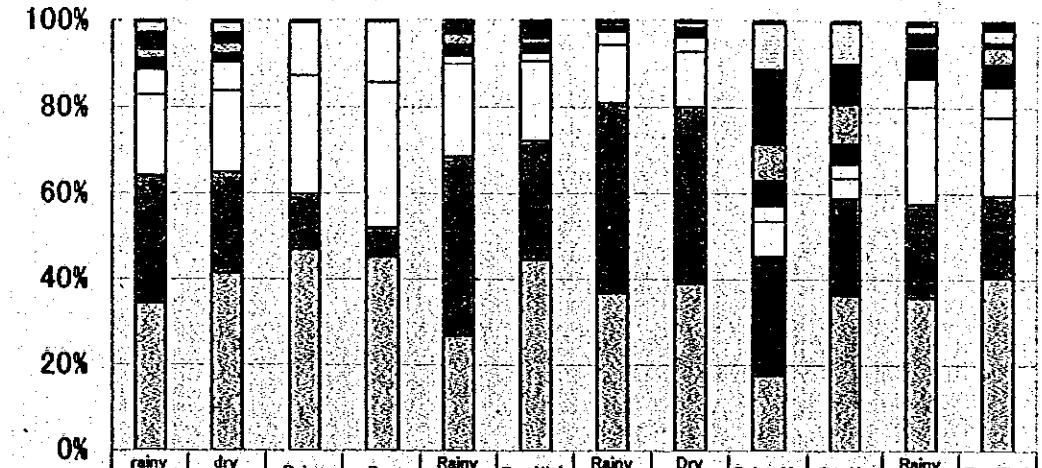




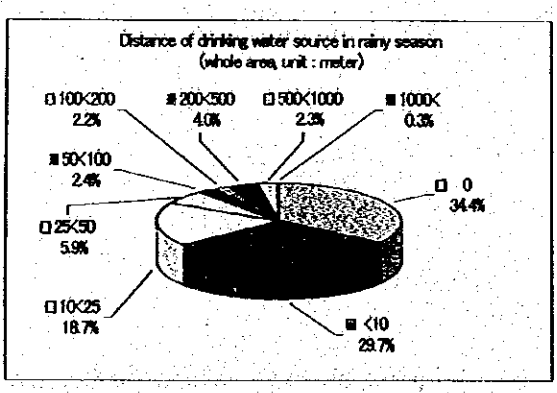
(Household Questionnaire Survey)

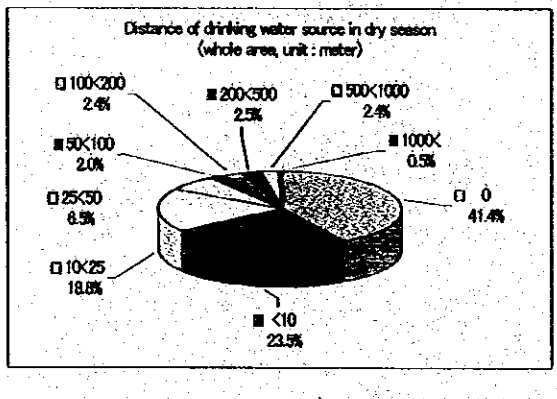
Figure 3.3 Comparison of Drinking Water source in Distance

Comparison of drinking water source in distance
(unit : meter)



	rainy season whole	dry season whole	Rainy Hanoi	Dry Hanoi	Rainy Ninh Binh	Dry Ninh Binh	Rainy Thanh Hoa	Dry Thanh Hoa	Rainy Ha Tinh	Dry Ha Tinh	Rainy Thai Nguyen	Dry Thai Nguyen
■1000<	3	4	0	0	0	0	1	1	1	1	1	2
□500<1000	21	21	0	0	0	1	2	3	17	14	2	3
■200<500	36	22	0	0	5	5	1	2	27	14	3	1
□100<200	20	21	0	0	4	2	1	1	14	14	1	4
■50<100	22	18	1	1	4	3	1	2	9	7	7	5
□25<50	53	58	30	35	3	3	7	8	6	5	7	7
□10<25	169	167	87	85	34	27	31	30	13	7	24	18
■<10	268	208	32	17	66	41	103	97	44	34	23	19
□0	310	367	115	114	43	66	86	92	28	55	38	40





(Household Questionnaire Survey)

CHAPTER 4 RURAL WATER SUPPLY

4.1 History & Policy

The Vietnamese government has been promoting the construction of shallow wells, toilets, and showers in the rural areas since the 1960s to provide safe drinking water and ensure a sanitary environment. In addition, UNICEF started the Water and Sanitation (WATSAN) program in 1982 in three provinces, expanding its coverage to a total of 61 provinces by 1996.

Under the UNICEF program, each water supply facility was constructed to provide water for 120 people. The facilities consist of the following:

- Tube wells
- Pipelines for distribution by gravity
- Rainwater tank or rainwater jar

The table below lists the water supply facilities constructed in 1996.

Table 4.1 Water Supply and Sanitation Facilities (UNICEF, 1982~1996)

Year	Number of Provinces	Number of Facilities	Cumulative Water Points	Number of Latrines	Cumulative Latrines
1982	3	17	17	-	
1983	6	320	337	-	
1984	6	381	718	-	
1985	6	1,970	2,668	-	
1986	6	2,515	5,203	-	
1987	13	2,400	7,603	-	
1988	13	5,330	12,993	802	802
1989	13	8,800	21,763	4,471	5,273
1990	26	12,160	33,893	9,867	15,140
1991	26	14,570	48,463	9,487	24,627
1992	34	14,733	63,196	10,500	35,127
1993	53	25,625	88,821	28,200	63,372
1994	53	29,000	117,821	21,500	84,827
1995	53	31,700	149,521	30,225	115,052
1996	61	18,600	168,121	11,000	126,052

(Source: NRWSS Study, WATSAN Evaluation Report, 1997)

4.2 Rural Water Supply Conditions

The rural areas use surface water (e.g. rivers, springs, ponds), groundwater (shallow wells), and rainwater, as well as the facilities (tube wells with hand pump, shallow wells with lining, pipelines, rainwater tank) constructed under the WATSAN program. The study area particularly abounds with shallow wells.

The facilities constructed under the WATSAN program were estimated to have a coverage rate of 30 %, although this would vary depending on the standard for safe water supply to be adopted. If the existing water supply facilities are assumed to have a protective structure against contamination from sewage, fertilizer, night soil, and other contaminants resulting from man-made activities, the coverage rate is estimated at 9.25 % as shown in the table below.

Table 4.2 Rural Water Supply Coverage Rate by Facility

Facility	NRWSS Study (%)	VNLS Study (%)	Remarks	Rate of Facilities with Protective Structure (%)	Coverage Rate (%)
Shallow wells	45	57	Mostly uncovered	5	2.85
Surface water	35	23	Some springs are protected	5	1.15
Rainwater	10	13	Mostly uncovered	5	0.65
Tube wells	8	4	With apron	90	3.6
Pipelines	2	2	50% from the well	50	1
Total					9.25

(Source: NRWSS Study, Interim Report, 1997)

4.3 Rural Development Plan & RWSS Strategies

The underlying principles of Vietnam's Rural Development Plan (1996~2000) are as follows:

(1) Give top priority to rural development.
(2) Establish a sturdy regional economy based on competitive regional ranking.
(3) Promote phased implementation of development plans and improve the welfare and social conditions of the local residents.
(4) Place emphasis on environmental conservation in planning and implementing projects.
(5) Promote plans under the supervision of the local residents and restrict government intervention to the support level.

This plan places emphasis on infrastructural development with the aim to provide safe water to 80 % of the rural population and 13,000 primary school students.

At the same time, institutions related to water supply, e.g. Ministry of Construction, Ministry of Agricultural and Rural Development, etc., are implementing the National Rural Water Supply and Sanitation Strategy (NRWSS) with the cooperation of DANIDA. The strategies involve the attainment of the following by 2020:

(1) Provide safe domestic water to 90 % of the households
(2) Provide sanitary latrines to 80 % of households
(3) Educate 80 % of the residents on personal hygiene

The fundamental principle of the RWSS is to establish sustainable water supply services in terms of operation, maintenance, and financing. In respect to this principle, the following approaches need to be adopted.

- Decide the level, technology and operation methods for water supply in view of users' needs.
- Planning formulation and notification and education of residents prior to construction.
- With the exclusion of the poor and the minorities, the users will be made to cover 50 % of the construction costs and 100 % of the operation costs.
- Establish an administration system prior to construction.
- Use of suitable technology in facility construction.

4.4 Existing Water Supply Facilities

Five types of water supply facilities exist in the study area.

4.4.1 Hand dug wells (shallow wells)

Most of the hand dug wells (5~10 m deep, 0.8~1.2 m in diameter) in the study area are constructed for domestic use. There are two types of shallow wells in the study area: protected (concrete framework) and unprotected shallow wells. In areas where groundwater was found to be high in iron, small sand filters are installed. Quite a number of shallow wells are contaminated by manmade activities and some were found to contain coliform. Many of the shallow wells get depleted in the dry season. Due to deep well pumping in the vicinity,

many of the shallow wells in the communes at the outskirts of Hanoi have been depleted.

4.4.2 Rainwater tanks

Rainwater tanks are used to store rainwater collected using pails placed on rooftops. Tank capacity ranges from 200 liters to 10 m^3. In the rainy season, rainwater is used for drinking, cooking, laundry, and bathing. Tanks, however, enables the storage of rainwater for use in the dry season for drinking and cooking.

4.4.3 Tube wells (drilled wells)

Tube wells are drilled either by hand or drilling rig, with a diameter ranging from 50~150 mm. Tube wells are inserted with PVC pipes and either attached with a hand pump or motor pump. However, because the tube well diameter is small at around 50 mm, the local VN6 suction pipe is mostly used instead to draw groundwater from shallow layers.

4.4.4 Small pipeline systems

A system used for surface water exploitation that is comparatively easy and inexpensive to construct. No form of treatment, however, is adopted under this system. This system entails: (1) gravity distribution of water from mountain torrents and streams, (2) pumping of water from ponds and rivers, and (3) a mini-system (tube well) servicing 20 households. None of these, however, are established in the study area.

4.4.5 Central supply system

The central supply system involves tube wells or surface water intake system, purification system, elevated tank, and distribution system. This system provides water to at least more than 1,000 households. Due to high iron content in the groundwater, an aeration tower is generally installed for deferrization. This type of system is new to rural water supply and CERWASS has been promoting its construction at every area since 1995.

4.5 Achievements of CERWASS in the Study Area

After the implementation of the WATSAN Program of UNICEF the accomplishments attained by CERWASS regarding the construction of rural water supply facilities are as detailed hereunder.

4.5.1 Thai Nguyen

CERWASS has constructed water supply facilities in about 2,000 areas. These facilities consist of: machine drilled tube wells (20 places), hand drilled tube wells (260 places), shallow wells (1,511 places), rainwater tank (100 places), gravity system (10 places).

4.5.2 Ninh Binh

The facilities constructed by CERWASS consist of: rainwater tank (81,289 places), hand dug shallow wells (with protection: 12,695 places, without protection: 83,775 places), public wells (844 places). A central water supply system is also being constructed in 12 places. Except for some, however, these facilities generally produce water of poor quality.

4.5.3 Thanh Hoa

CERWASS constructed hand drilled tube wells in 9,974 places, shallow wells in 281 places, rainwater tanks in 420 places, and a central water supply system in 29 places.

4.5.4 Ha Tinh

CERWASS constructed water supply facilities in about 4,000 places. The facilities consist of: hand dug shallow wells and tube wells (about 3,000 places), central water supply system (12 places), rainwater tanks, etc. With the cooperation of UNICEF and DANIDA, CERWASS has also distributed about 1,000 rainwater jars.

4.5.5 Hanoi

Hand dug shallow wells are still predominantly the water supply source of the residents in the suburbs of Hanoi. Recently, however, these wells are only being constructed in the districts of Soc Soc and Dong Anh. Due to deep well water pumping to provide for the demands of urban Hanoi, shallow wells in Tu Liem and Thanh Tri are getting depleted. Consequently, the number of these old facilities are decreasing, while modern facilities, e.g. central water supply system (completed in 13 places and under construction in 4 places in Tu Liem and Thanh Tri) are increasing.

4.6 Central Water Supply System

A central water supply system is constructed in 17 places (9 in Tu Liem south of urban Hanoi, 7 in Thanh Tri south of urban Hanoi, 1 in Dong Anh north of urban Hanoi), within the suburbs of Hanoi, and 13 of these facilities are in operation while 4 are still under construction (see Table 4.3).

Table 4.3 Central Water Supply System in Hanoi Suburbs

No.	District	Commune	Village	Commune population	Service population	Water supply amount (m^3/day)	Pipe length (m)	Cost ($x10^6$ VND)
1	Than Tri	Dai Ang	Vinh Trung	7,600	1,200	30	5,108	550
2	Than Tri	Thanh Tri	Vinh Thuan	-	-	-	-	345
3	Than Tri	Tam Hiep	Huynh Cung	7,400	3,000	160	3,240	484
4	Than Tri	Tan Trieu	Trieu Khuc	10,850	650	150	3,300	510
5	Than Tri	Tran Phu	1, 2, 3, 4	5,540	-	-	4,300	610
6	Than Tri	Thinh Liet	Giap Tu	11,953	2,500	150	4,340	402
7	Than Tri	Dong My	1, 2, 3	6,100	-	-	3,750	650
8	Tu Liem	Tay Tuu	Thon 3	12,000	3,810	300	5,743	520
9	Tu Liem	Phu Dien	Duc Dien	9,400	2,180	120	2,460	361
10	Tu Liem	Phu Dien	Kien Mai	-	1,920	120	1,862	350
11	Tu Liem	Me Tri	Phu Do	13,145	-	-	-	455
12	Tu Liem	Minh Khai	Nguyen Xa	9,000	1,000	140	3,750	413
13	Tu Liem	Me Tri	Thon Thuong	13,115	4,500	200	2,300	563
14	Tu Liem	Tay Tuu	Thon 2	12,000	3,900	340	4,500	509
15	Tu Liem	Phu Dien	Dinh Quan	9,100	800	70	1,716	355
16	Tu Liem	Phu Dien	Phu Dien	9,100	3,600	200	2,636	482
17	Dong Anh	Lien Ha	Dai Vi	12,700	920	90	1,420	399

(Source: CERWASS)

4.6.1 Service Population

The population of the target communes ranges from 5,540 to 13,415. Accordingly, the service population is from 650 to 4,500, and the service ratio varies by commune.

4.6.2 Water Supply Facilities

Groundwater is extracted through deep wells constructed 55 to 65 m deep and 200 mm in diameter. The facilities consist of a deep well, aeration tower, filter, storage tank, distribution

pump, and distribution pipelines. The aeration tower capacity is 15 to 30 m^3/hour and the storage tank capacity is 30 to 70 m^3. Distribution pipelines are PVC pipes 90~100 mm in length. PVC pipelines (32 mm) are used to supply water to every household; the length of these pipelines varies from 1.4 to 5.7 km.

4.6.3 Water Supply Amount

The amount of water supplied is 30 m^3 in minimum and 340 m^3 in maximum, that is 50 to 80 liters/capita/day. Interviews, however, reveal the actual monthly consumption to be 6~7 m^3/household, that is about 50 liters/capita/day.

4.6.4 Construction Cost

The construction cost ranges from VND 350 to 600 million with the distribution pipelines making up 50 % of the costs. Many of the communes receive full government subsidy, while some have to cover 20 % of the costs from the commune's coffer and/or through funding from UNICEF. Connecting households to the water supply system through pipeline installation costs VND100 to 120 thousand.

<Technical Problems in the Central Water Supply System>

(1) Management of Water Conveyance Amount

None of the water supply facilities are installed with a flow meter and the water conveyance amount is estimated by multiplying the pump capacity by the hour of operation. Although essential to management and technical evaluation, none of the records are reliable.

(2) Water Quality Control

Water quality inspections are not carried out daily but only once every several months. Since the problem in water quality is mainly due to high iron levels and coliform, the color of the water should be analyzed to determine the potential impacts of treatment.

(3) Distribution Pump Operation Hour

The distribution pump is operated 3 to 10 hours a day, and is exposed to the risk of polluted water entering the pipe interior during breaks in operation.

(4) Water Treatment

Since the groundwater contains iron, aeration tower and filtering equipment are installed. The technical standards involved in the use of these devices are however

unclear. The backwash time and amount will be decided in view of drainage. Polluted water is also observed to directly drain into neighboring ponds.

(5) Storage Tank

The combination of a storage tank and distribution pump is not concordant with the water demand. Since pump operation hours are restricted, the users have their own storage tanks, which function as the distribution reservoir.

(6) Distribution Pipeline/Supply Pipeline

The distribution pipelines and supply pipelines are not deeply lain underground. As they are exposed on the road they are easily damaged. The pipelines are not attached with air and drainage valves.

CHAPTER 5 ORGANIZATIONAL & INSTITUTIONAL SYSTEM

As in all other sectors in Vietnam, the water supply sector is the responsibility of both the central government and relevant regional departments. Whereas the former deals with policy decisions and technical guidelines, the latter is in charge with administration and execution.

At the national level, rural water supply is supervised by the Center for Rural Water and Environmental Sanitation (CERWASS), which is directly under the Ministry of Agriculture and Rural Development (MARD). The Ministry of Construction (MOC) is directly responsible for urban water supply and its responsibilities include the establishment of a network of companies nationwide for water supply facility design and construction.

The responsibilities of CERWASS are as outlined below.

(1) Prepare rural water supply and environmental sanitation plans
(2) Allocate and manage the budget for rural water supply and environmental sanitation
(3) Coordinate with relevant national agencies, UNICEF, and other international cooperation agencies
(4) Train personnel in rural water supply development and environmental sanitation.

The responsibilities of CERWASS in the field of environmental sanitation are limited to those related to livestock, crops, fertilizer and insecticides.

At the regional level, a Department of Agriculture and Rural Development (DARD) is established in every province, each of which has a CERWASS. DARD is in charge of forming organizations for rural water supply and environmental sanitation planning, and implementing and monitoring related projects and services. DARD responsibilities are as follows:

(1) Construction of water supply facilities (well drilling, etc.)
(2) Technological studies and water quality analysis
(3) Formation of and assisting operation and management organizations
(4) Training in operation and maintenance

The organizational chart of CERWASS at the national level is shown in Figure 5.1. In Hanoi, CERWASS has 43 employees. CERWASS at every province is made up of about 2,500 employees. CERWASS at the national level consists of the following 5 divisions:

Planning & Investment Division:	project planning and operation; preparation of the project cost of regional CERWASS offices; coordinate with UNICEF and other international cooperation agencies
Technical Construction Division:	approval of technical aspects of the projects of regional CERWASS offices; cooperate with the water resource management division of MARD
Environment/Communications/ Sanitation Division:	maintain communications with regional CERWASS offices; hold information education campaigns (IEC); address agriculture related environmental problems
Construction Materials/Machinery Control Division:	office management including materials and equipment in regional sectors, in addition to personnel and financial administration
Testing & Training Division:	manage construction materials and water quality analysis, test new technologies and carry out training, all for Rural Water Supply & Sanitation

Provincial CERWASS offices consist of a General Affairs Section, Technical Section, Planning Materials Section, Finance Section, Environmental Sanitation Section. The technical section is made up of several units for drilling, maintenance, and management that are mainly supervising the construction, maintenance and management of wells under the WATSAN program (Figure 5.2).

Figure 5.1 Organization of Central CERWASS

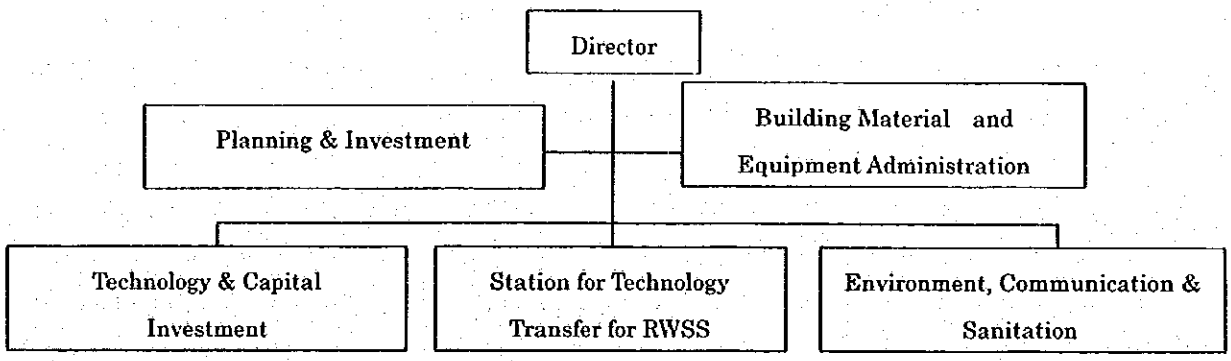
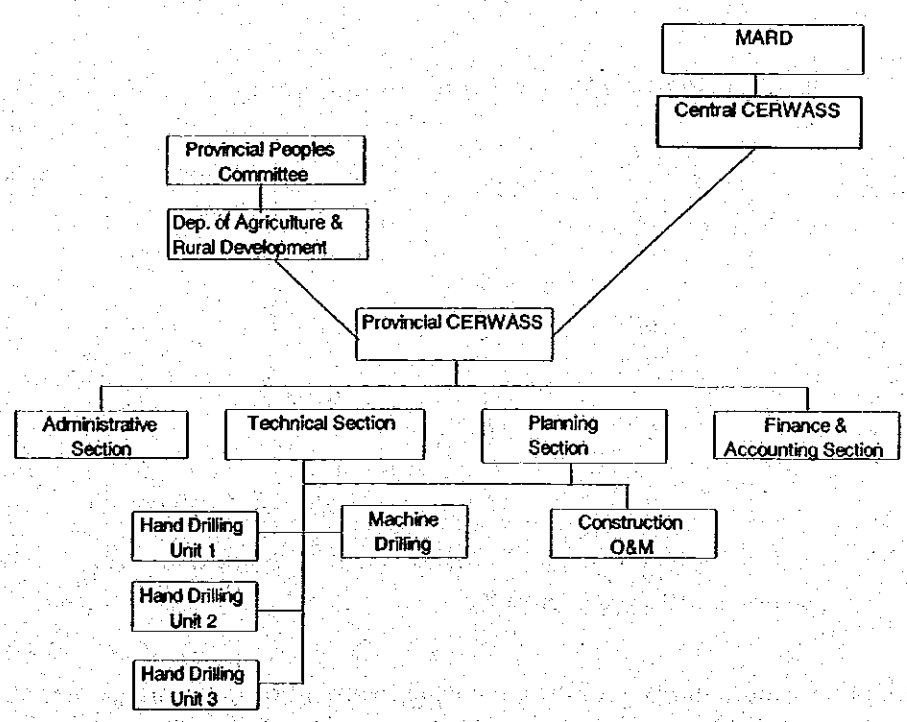


Figure 5.2 Organization of Provincial CERWASS and Relation between MARD and Central CERWASS



CHAPTER 6 FINANCE

6.1 Investment in Rural Water Supply

Investments made in Vietnam in the 1991~1995 period totaled US$ 18 billion and approximately US$ 4 billion was allocated for the public sector. Public investment is estimated to increase fourfold in the 1996~2000 period, with the rural water supply sector occupying 0.2 % (about US$ 30 million) of the total amount.

Water supply programs are currently financed by the central government (CERWASS), international cooperating agencies, e.g. UNICEF, local government (provincial, district, commune peoples committee), and the users (residents). In particular, investments in the WATSAN program of UNICEF, which commenced in 1982, made up 80 % of the overall rural water supply project expenses. The finances of the program were provided by UNICEF (56 %), the central government (17 %), and the local government and the users (27 %). Other related programs receive 51 % financial support from international cooperating agencies other than UNICEF, 49 % from the central government, and less than 1 % from the local government and the users.

Table 6.1 Rural Water Supply Investment

(unit: US$ million)

Investment Source		1991~1995 (total)	1996	1997 (estimate)	Overall Investment	Share (%)
WATSAN program	UNICEF	18.75	2.66	1.89	23.30	56
	Central gov't.	3.92	1.36	1.73	7.01	17
	Local gov't. & users	8.19	1.36	1.61	11.16	27
	Subtotal	30.86	5.38	5.23	41.47	100
Other programs	International donors	2.77	2.44	0.67	5.88	51
	Central gov't.	0.14	2.88	2.64	5.66	49
	Local gov'ts. & users	0.03	N.A	0.04	0.07	<1
	Subtotal	2.94	5.32	3.35	11.61	100
Overall Investment		33.80	10.70	8.58	53.08	

(Source: NRWSS Economic and Financial Situation, June 1998)

In comparison with other water supply facilities, the establishment of the central water supply system requires a larger capital, hence the government's share in the investment is huge. On the other hand, the share of the local government (including communes) depends on financial capability and the importance of the project. Table 6.2 shows the investment required for the central water supply system and the share of the target provinces.

Table 6.2 Share of Target Provinces in Investment for Central Water Supply System

Provinces	No. of Facilities	Investment (VND million)					
		Project Cost	Central Gov't.	UNICEF	Provincial Gov't.	District Gov't.	Users*
Ha Noi	16	5,503	1,625 (30 %)	311 (5 %)	2,615** (48 %)	-	952 (17 %)
Thai Nguyen	6	1,026	587 (57 %)	108 (11 %)	173 (17 %)	-	158 (15 %)
Ninh Binh	6	3,058	1,572 (51 %)	643 (21 %)	30 (1 %)	-	813 (27 %)
Thanh Hoa	11	2,222	1,533 (69 %)	328 (15 %)	60 (3 %)	65 (3 %)	236 (10 %)
Ha Tinh	11	3,711	2,205 (60 %)	526 (14 %)	-	-	980 (26 %)
Total	50	15,520	7,522 (48 %)	1,916 (12 %)	2,878 (19 %)	65 (<1 %)	3,139 (20 %)

Source: Provincial CERWASS Offices

As shown in the table, the users' share in the investment for the central water supply system is estimated at 20 %, and this will cover the expenses for installing household connections (piping and installation costs).

6.2 Budgetary System & Water Supply Project Expenses

A third of the government's expenditure is directed toward regional development. Nonetheless, even with the existence of guidelines, the allocation of the share in the expenses actually depends on negotiations between the central and local governments. Even with tax revenues, the authority of the central and local governments vary.

Most of the rural water supply project investment is allocated from the central government budget under the administration of MARD. The budget amount requested from MOF by the central CERWASS office through MARD is granted to CERWASS by the Department of Finance (DOF). MOF, on the other hand, grants every provincial Peoples Committee with the funds for water supply projects; this is either carried out by the district PCs or directly by the communes. Provinces under financially tight conditions need the assistance of the communes in terms of money or labor.

6.3 Possibility of Rural Credit

Water supply projects need contributions from the users in terms of money and labor. For poor households, it is assumed that the granting of loans would enable these households to cover their share in the expenses. Vietnam has three financial institutions operating in rural areas: Vietnam Bank for Agricultural and Rural Development (VBARD), Vietnam Bank for the Poor (VBP), and the Peoples Credit Funds (PCF). Obtaining credit from these institutions is deemed difficult, however, due to the following reasons:

- Rural financial institutions give priority to the production sector in terms of credit
- The loans will be only required by low income residents and their cash revenues are not likely going to increase with water use.
- Low income residents are more likely going to borrow money from relatives and acquaintances, rather than financial institutions.
- The financial institutions themselves are fragile, in need of reinforcement and sound countermeasures.

6.4 Residents' Willingness & Ability to Pay

In general people appear to be willing and able to pay for water access (UNICEF, WATSAN Evaluation Report, 1995). Nonetheless, the following points should be taken into consideration.

- Tendency of residents with water supply facilities, e.g. shallow wells, within their premises reluctantly pay.
- Difficulty of the extremely poor to offer their services let alone cash.
- Residents (households) in developing communes along main roads generally pay VND 500 thousand to VND 1 million for water supply by distribution pipelines.
- Mixed opinions on the water tariff (VND 1,500 to 4,000 per m^3); some state its reasonable while some think its expensive.

It is assumed that the ability to pay can be assessed from the level of income and expenditure. However, because it is difficult to determine the revenues in the rural areas, focus should be placed on the level of expenditure. In the study area, firewood, coal, tree stumps, etc., are used as fuel, and electricity is used for lighting, ironing, and watching TV. It is assumed, therefore, that the residents are at least able to pay for electricity, which is very essential, and

the water tariff (almost equivalent in price) next to food and fuel.

The results of interviews with the commune PCs and 600 households show that 20 communes have a mean annual income of VND 6.73 million. The annual electric bill ranges from VND 100 thousand to VND 820 thousand, about 2 to 5 % (4 % on average) of the annual income of most communes. On the other hand, fuel expenses average 5 % of the annual income (see Table 6.3).

Most shallow wells in 11 of the 20 target communes are equipped with a filter for deferrization. The filter usually costs VND 280 thousand on average. The replacement cost of the sand for the filter, which is done once or twice a month, ranges from VND 4 thousand to VND 30 thousand, averaging VND 9 thousand.

The construction of shallow and tube wells in the study area usually costs from VND 450 thousand (Van Thanh) to VND 2.22 million (Quang Son), that is 6 % (Dinh Tuong) to 33 % (Vinh Thanh) of the annual income. The residents are assumed to at least agree to pay the same amount if clean and safe drinking will be provided through distribution pipelines.

Table 6.3 Household Annual Income, Electric Bill, Fuel Expenses in the Target Communes (1998)

Province	Commune	Respondents	Household Annual Income (thousand VND) (a)	Electric Bill (thousand VND) (b)	(b)/(a)	Others Fuel Expenses/(a)
Ha Noi	Xuan Dinh	60	8,800	820	9 %	4 %
	Dong Ngac	82	7,380	460	6 %	5 %
	Average		**8,090**	**640**	**8 %**	**5 %**
Ninh Binh	Quang Son	32	7,430	190	3 %	4 %
	Yen Thang	44	5,460	246	5 %	5 %
	Dong Phong	34	9,470	300	3 %	6 %
	Average		**7,453**	**245**	**3 %**	**5 %**
Thanh Hoa	Nong Cong Town	24	7,980	380	5 %	6 %
	Van Thang	22	4,260	100	2 %	3 %
	Thieu Hung	36	4,530	250	6 %	6 %
	Thieu Do	30	5,020	291	6 %	7 %
	Dinh Tuong	23	10,080	320	3 %	4 %
	Vin Loc Town	17	5,500	230	4 %	11 %
	Vinh Thanh	33	4,110	230	6 %	14 %
	Average		**5,926**	**257**	**4 %**	**7 %**
Ha Tinh	Duc Yen	26	5,620	270	5 %	7 %
	Yen Ho	26	7,670	190	2 %	4 %
	Trung Le	17	5,370	190	4 %	3 %
	Duc Xa	24	6,850	210	3 %	6 %
	Average		**6,378**	**215**	**3 %**	**5 %**
Thai Nguyen	Dong Bam	14	9,810	400	4 %	3 %
	Hoa Thuong	28	6,720	340	5 %	5 %
	Nam tien	24	6,360	220	3 %	4 %
	Thinh Duc	6	6,260	280	4 %	n. a.
	Average		**7,288**	**310**	**4 %**	**4 %**
Average			**6,734**	**296**	**4 %**	**5 %**

6.5 Financial Problems in the Existing Water Supply System

A study was carried out to determine the operation and maintenance of the central water supply system constructed by CERWASS in the provinces of Thanh Hoa and Ha Thinh.

Yen Dinh Town, Thanh Hoa Province:

The overall construction cost was VND 1.2 billion: the central government provided VND 1.1 billion and the local government VND 100 million. Currently used by 600 households; coverage will be increased to 200 households by 2010. The water fee amounts to VND 1,200 per m^3, and the revenue totals VND 5 million, 2 million of which is allocated for repairs. The system was established not due to the potential difficulties in the use of public taps, but because the households are comparatively affluent.

Thanh Ngoc Commune, Ha Tinh Province:

The facility was constructed in 1997 with the central government financing 60 % of the expenses, UNICEF 10 % and a public agricultural firm 30 %. Operation and maintenance is carried out by the public firm. The collection of a water fee has not been established yet. There are no negotiations carried out between the public firm and the users, and services are only provided in the summer (6~8 hours/day). Although the residents acknowledge the importance of having clean and safe water, some are not willing to pay a water use fee.

Cay Town, Ha Tinh Province:

The system is currently under construction and costs approximately VND 1.1 billion: the government funding VND 500 million, UNICEF VND 60 million, the province VND 300 million, and the users VND 200 million. Although nothing has been finalized yet, the water fee is estimated at VND 1,000 to 1,200; this is only enough to cover the O&M costs. Each household is expected to put in an average of VND 500 thousand, an amount that will cover a part of the water supply pipes and main distribution pipes. This amount is, however, limited to the poor households. Relatively affluent households will be required to pay more, regardless of proximity to the distribution pipes.

Based on these conditions, the issues that financially ail the system are as follows:

- The water fee does not include the depreciation cost (or equipment replacement cost). The "beneficiary pays principle" does not permeate the consciousness of the residents

who consider water a public resource and its supply as the government's responsibility.

- Awareness regarding the importance of sanitation is low. To encourage the use of clean and safe water, a cheap water fee is established.
- Ways to acquire and implement financial assistance should be looked into so poor households can have access to the water supply system.

CHAPTER 7 O&M ISSUES

7.1 O&M of Existing Water Supply Facilities

The O&M of several existing central water supply systems were investigated (see section 4.6 for the O&M of water supply facilities at the outskirts of Ha Noi).

7.1.1 Thai Nguyen

The water supply facilities in Dong Hy Town were constructed with UNICEF funds. Although the filter for treatment works, the chlorinator does not. Because the filter is hardly managed properly, the water is quite contaminated with coliform bacilli contained in the surface water that flows into the well. In La Hien, the construction of a facility using a spring as a source was completed in 1999. The O&M of this facility is easy as it only involves the removal of sand contained in the surface water. This facility produces good water quality and is only operated for a short period. The residents expressed satisfaction with the operation and the water charge of VND 1,000.

7.1.2 Ninh Binh

The construction of a water supply facility in Gia Hoa Commune started this year (1999) and although it has been completed it is still not in operation. The facility operator has undergone initial training, but would still require further training in the overall water treatment process. UNICEF is currently planning the training course.

The facility in Gia Sinh which was also completed this year only serves 135 out of the 1,550 households it was originally designed to serve. It is operated for 4 hours a day in summer, and every other two days in winter. The PC in this commune is not adopt in managing finances and O&M conditions are seen to cause serious problems in the future especially due to numerous illegally installed household connections. Technical problems were seen in the design and the construction of the facility in various places in the form of cracks in the tank and the protrusion of distribution pipelines in the surface.

7.2 PC Role in O&M and Assistance

The major role of PC in facility O&M is the setting up of water charges. The water charges

are not decided based on the actual expenses involved, but instead based on negotiations with the residents and in view of the cost imposed by other communes. Some communes established a water charge that would only cover the salary of the operator without due consideration of the electric bill that would be incurred. Facility renewal expenses are hardly ever taken into consideration. Repair expenses are usually allocated from the PC budget and if this is not possible, contributions from the residents are collected. In this case, the operation of the facility is terminated for a certain period of time.

The CPC should hold campaigns to popularize the supply of water through household connections. The CPC, however, is not experienced in this matter, and in order to efficiently fulfil its role, needs the technical and administrative guidance and assistance of CERWASS in water quality monitoring, economic management, etc.

Many projects are carried out mainly from the viewpoints of the party providing the services. These projects usually focus on the possible contributions the beneficiaries can offer without due consideration of their needs. Further, the planning of these projects focused more on the technical issues than the financial and economic aspects that are relevant to O&M. The training program held by UNICEF is restricted financially as well as in the extent of guidance offered. The program is held not in compliance with one project in particular, and is, therefore, attended by a wide variety of people. CERWASS carries out O&M training mostly upon the completion and turn over of the project. To establish sustainable O&M operations, CERWASS should carry out continuous O&M support and guidance.

PART II

GROUNDWATER INVESTIGATION

PART II GROUNDWATER INVESTIGATION

CHAPTER 1 HYDROGEOLOGY

1.1 Geological Settings by Province

The mountains in the northern part of Thai Nguyen mainly consist of shale from the Cambrian to the Ordovician period. The south is mainly made up of sandstone, shale, and limestone from the Triassic to the Jurassic period. The southern extremity of the province is situated on the Red River Delta and is made up of unconsolidated Pleistocene and alluvium from the Quaternary period.

Ha Noi is geologically made up of thick unconsolidated sediments of the Quaternary layer that are also distributed in the Red River Delta. The Quaternary layer overlies Pleistocene sediments.

The mountains in Ninh Binh are primarily made up of Triassic limestone, and the hilly area is made of sandstone, shale and marl from the same period. The low-lying area in the east is on the southern extremity of the Red River Delta where Quaternary unconsolidated sediments overlie the surface layer.

The hilly area of Thanh Hoa is formed by limestone from the Ordovician to the Permian period that crops out as a solitary hill in the middle of the plain inland. Mountains in the west and southwest are mainly formed from the distribution of sandstone, shale, and conglomerate of the Triassic. The northwestern mountains are mainly made up of granite and tuff.

The coastal area of Thanh Hoa is made up of Quaternary unconsolidated sediments mainly along the Ma River.

In Ha Tinh, the western mountains consist of sandstone, shale, tuff and limestone from the Ordovician to the Devonian period. Triassic sandstone, shale, tuff and limestone are distributed in a belt-like shape in the central area. The section below the plains extending from the eastern to the central area consists of sediments, mainly in the clay layer, from the Neogene period. This is overlain by the unconsolidated gravel and sand layers, and a Quaternary clay layer.

1.2 Hydrogeological Features

Groundwater in the target communes exists in the Quaternary unconsolidated sediments in the upper layer and basement rock (mainly limestone). The majority of the communes is made up of Quaternary layers, although somewhat less thicker in some parts of Thai Nguyen, Ninh Binh and Thanh Hoa. The thickness of the Quaternary layer in four of the areas in Thai Nguyen where test well drillings were carried out ranges from 12.8 to 18.6 m. In the communes of Quang Son and Dong Phong in Ninh Binh, the thickness ranges from 2.0 to 9.4 m, while in the Van Thang Commune of Thanh Hoa, the layer is 6.0 m thick.

On the other hand, past records indicate that the Quaternary layers in the communes in Ha Noi were found to be very thick, about 80 m. Although limestone, sandstone and shale crop out in some parts in the Yen Thang Commune in Ninh Binh, the Quaternary layer at the test well site was 44.0 m thick. Quaternary layers are also thickly distributed in the communes situated from the center to the northern sections of Thanh Hoa: from 23.0 to 48.0 m thick at the borehole test sites. The layer is also thick in Ha Tinh: from 28.0 to 68.4 m in three of the test well sites.

The gravel and sand layers of the Quaternary formation generally form aquifers of favorable groundwater quantity. At least 2 to 3 horizons of gravel layers in Ha Noi and 1 to 2 horizons east of Ninh Binh, central Thanh Hoa, and in Ha Tinh are documented. In Ha Noi, the underground gravel layers are divided into two aquifers: the First Aquifer between 20 and 40m deep, and the Second Aquifer (main aquifer) between 40 and 80 m deep. Both aquifers are separated by a clayey layer (confining layer) between 3 and 37 m thick The Quaternary layer in the target communes in Thai Nguyen is relatively thin, but sand and gravel layers are distributed in some parts, forming aquifers.

The basement rock of the target communes in Thai Nguyen are made up of limestone, sandstone, siltstone and shale from the Carboniferous to the Permian. In Ninh Binh, the basement rock consists mainly of Triassic limestone. In Thanh Hoa and Ha Tinh, it is made up of Triassic limestone and sandstone, and Neogene mudstone, respectively. Among these, fractured limestone or cavernous limestone form good aquifers of favorable groundwater quantity. However, limestone with a few fine cracks and fractured limestone filled with clay do not produce much groundwater and are not considered as aquifers. Fractured sandstone and shale rich in fractures may form aquifers, but they do not produce as much groundwater as limestone. Sandstone layers are sandwiched between the Neogene mudstone layers in parts of Ha Tinh, forming a semipermeable bed yielding very little groundwater.

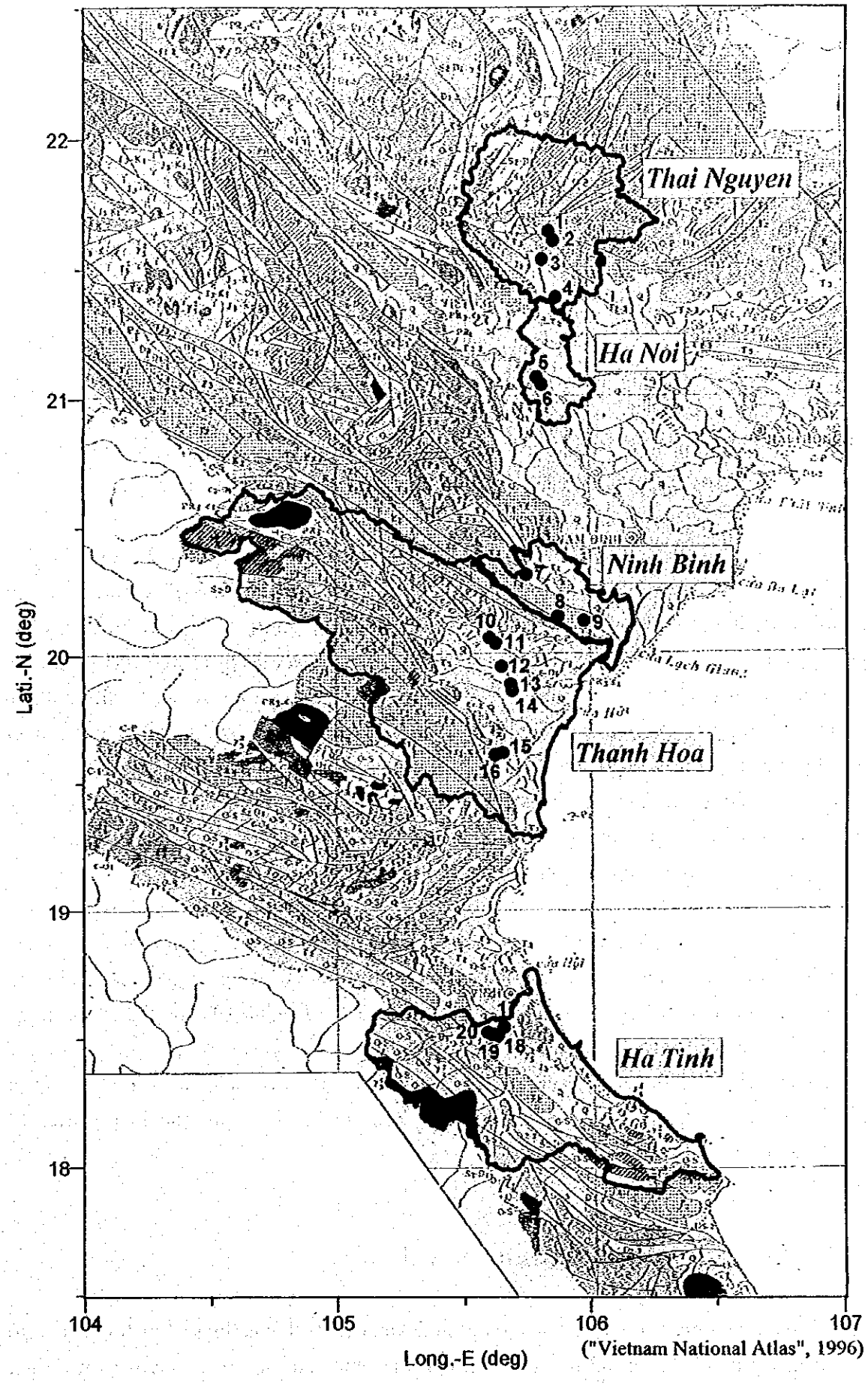


Figure 1.1 Geological Map of the Study Area

CHAPTER 2 GROUNDWATER LEVEL

2.1 Distribution of Groundwater Level

Groundwater level measurements in the existing wells in the target communes were conducted between September and October 1998 (latter half of the rainy season). The results show that groundwater level in the plains was within 2 m from the ground surface. Mainly due to topographic conditions, groundwater level in the hilly areas of Thai Nguyen, Ninh Binh and Thanh Hoa was between 4 and 10 m deep, and deeper, between 10 and 14 m, in the western Quang Son in Ninh Binh. In Ha Noi, a decline in groundwater level in shallow wells (between 6 to 10 m) was observed due to groundwater development near the area.

In Ha Noi, the groundwater level varies by area and aquifer. The level is high along the Red River, approximately at the same level as the river, but gradually declines from the center of Ha Noi towards the southwest. Groundwater level in deep aquifers (Second Aquifer, main aquifer) is lower than in shallow aquifers (First Aquifer). Data taken in May 1991 shows a decline in the groundwater level in the First Aquifer, mainly from the center to the southern sections of central Ha Noi, to a minimum of 26.5 masl (meter above sea level). On the other hand, the piezometric head of observation wells tapped at the Second Aquifer indicated a piezometric head lower than the First Aquifer. The same data also indicate that decline in the piezometric head formed a cone shaped depression similar to that formed by the decline in the First Aquifer: minimum groundwater head in southern Ha Noi was 210.7 masl.

In May 1991, the dynamic water level (when pumping) in the Second Aquifer dropped down to 225.0 masl. According to the Department of Geology and Minerals (1998), the decline in groundwater head in the Second Aquifer was as its lowest in January 1992 at 220.64 masl; the piezometric head below 28 masl and below 214 masl covered 42.74 km^2 and 4.77 km^2,respectively. On the other hand in December 1997, the lowest piezometric head was at 223.82 masl, a piezometric head below 28 masl covered 64.52 km^2, and the area below 214 masl occupied 11.26 km^2.

2.2 Changes in Groundwater Level

In the study area, only Ha Noi had data on groundwater level fluctuations. Existing data also showed that groundwater level measurements in the remaining 4 target provinces were not successively carried out. Automatic water level recorders were installed in 12 of the test

wells drilled under this study. However, since the observations did not start until sometime in March till June 1999, data acquired do not cover a full hydrological year.

According to interviews conducted during the survey of the existing wells, groundwater level fluctuates with the seasons: some shallow wells dry up in the dry season due to the drop in the water level. Groundwater level in areas near rivers is influenced by fluctuations in river water level, and the impact intensifies the closer to the river the groundwater resource is situated.

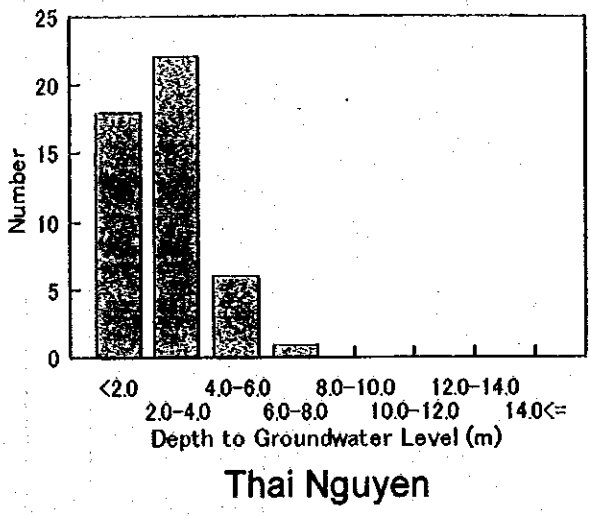
According to the records of the automatic groundwater level recorder installed at JICA-6 test well (Yen Thang in Ninh Binh), a 0.6 m increase in the groundwater level was observed from March to June 1999. Due to tidal influences, two cycles of water level fluctuation were observed per day: daily water level fluctuation ranges from 30 to 70 cm. A slight fluctuation in a range of 0.8~1.0 m from ground surface was observed in the groundwater level in the JICA-7 test well (Dong Phong in Ninh Binh) from May to August 1999. This, however, was not associated with precipitation or river water level. From May to mid-July of 1999, the groundwater level in the JICA-11 test well (Van Thang in Thanh Hoa) gradually increased from 7.5 to 4.5 m and slowly declined to 5.15 m by the middle of August. The fluctuation pattern did not evidence any steep peaks that can be attributed to precipitation. Rather, it indicates the influence of the water level of the Muc River nearby.

Groundwater level records (1988~1997) of the monitoring wells set up in the Red River Delta (Department of Geology and Minerals, Ministry of Industry of Vietnam) show comparatively well-regulated groundwater level fluctuation patterns (declines in dry season and rises in rainy season) along the Red River and northern Hanoi on the left bank of the Red River.

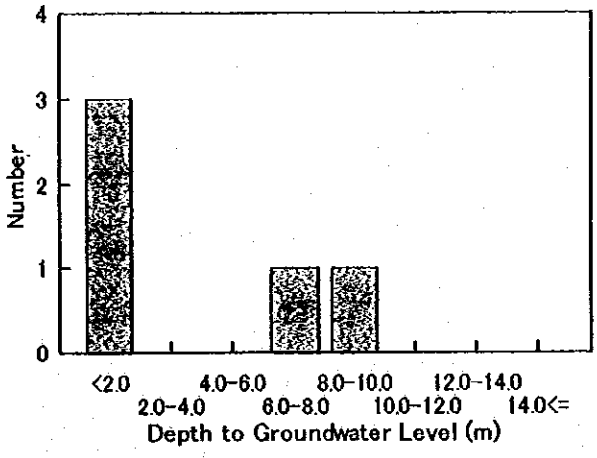
This seasonal (dry and rainy) fluctuation is clearly observed both in the First and Second aquifers in Minh Khai in Tu Liem District approximately 2 km southwest of Dong Ngac. The groundwater level of the First Aquifer has been gradually decreasing, fluctuating at a range of 2.8~6.7 masl in 1988, and 2.0~4.8 masl in 1997. The groundwater level in the Second Aquifer has also been gradually decreasing: groundwater head is 4 m lower than the groundwater level of the First Aquifer. In 1992, the groundwater level in the Second Aquifer fluctuated at a range of 21.0 and 11.0 masl, and 21.7 and 10.2 masl in 1997.

In Dich Vong in Cau Giay District approximately 2 km southwest of Xuan Dinh Commune, the groundwater level both in the First and Second Aquifers has also been on the decline over the years, although not because of seasonal influences. In particular, from 26 masl in early 1992, the groundwater level in the First Aquifer fell to 212 masl by mid 1995, and further down to 215 masl in the middle of 1996. The groundwater head in the Second Aquifer was

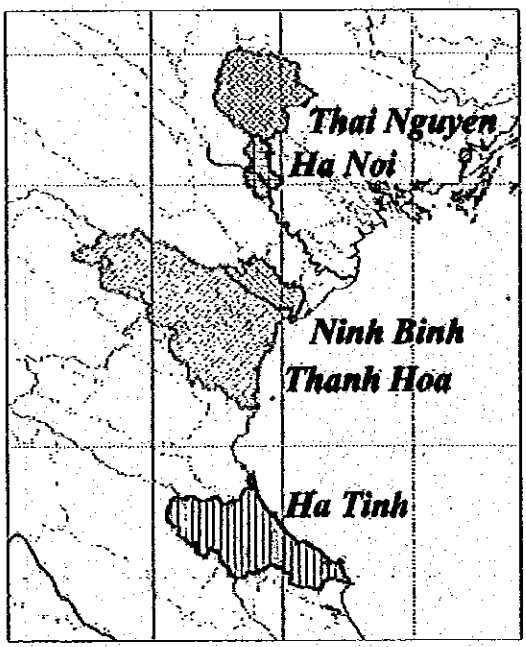
close to 215 masl in the middle of 1992, and less than 216 masl in 1997.

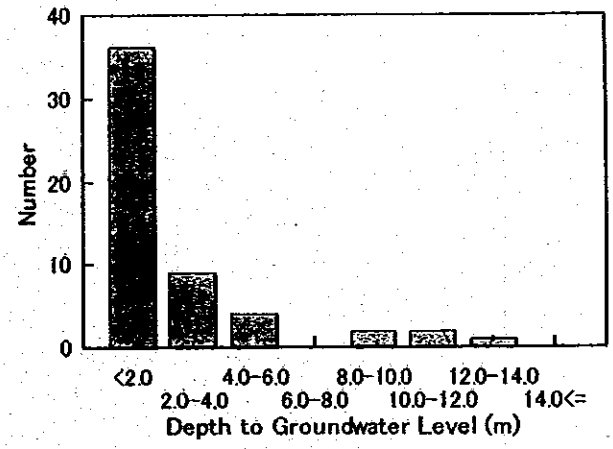


Thai Nguyen

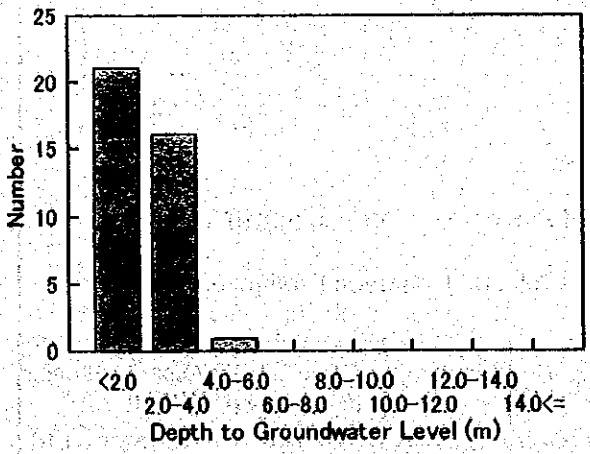


Ha Noi

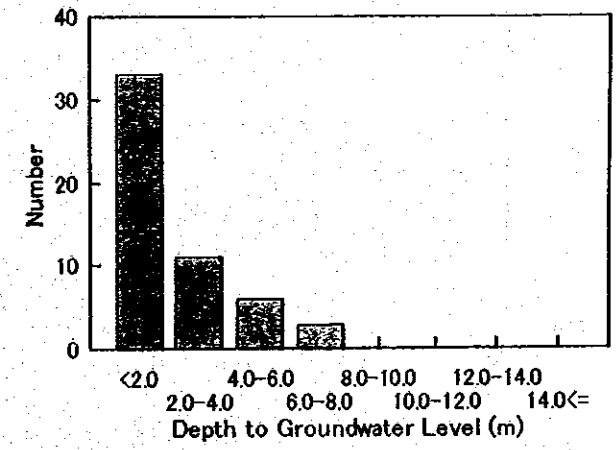




Ninh Binh



Ha Tinh



Thanh Hoa

(Depths to groundwater levels from ground surface were measured at existing dug wells.)

Figure 2.1	Distribution of Depth to Groundwater Level from Ground Surface by Province
THE STUDY ON GROUNDWATER DEVELOPMENT IN THE RURAL PROVINCES OF NORTHERN PART IN THE SOCIALIST REPUBLIC OF VIETNAM	
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	

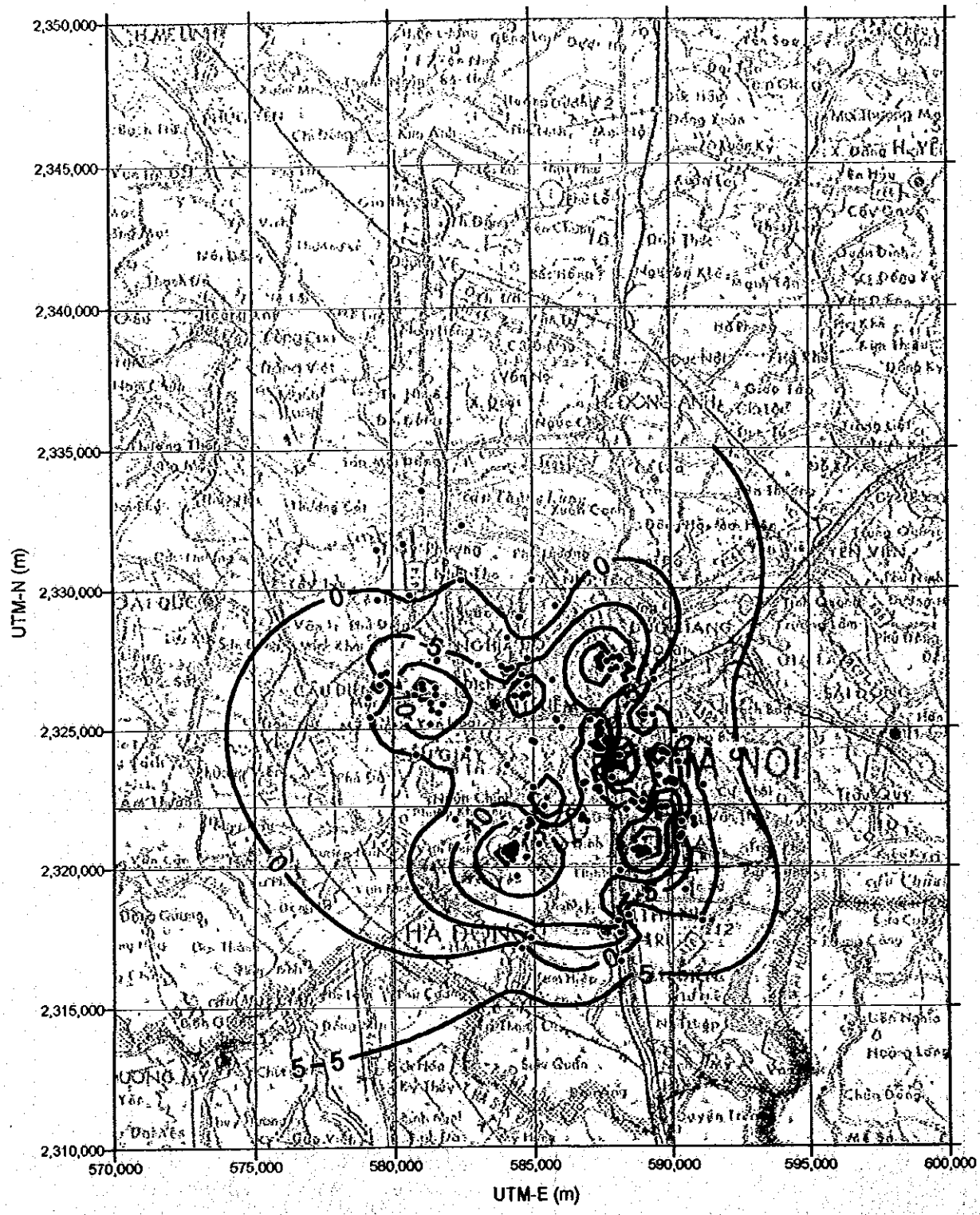


Figure 2.2 Distribution of Dynamic Piezometric Surface in Hà Nội Area (May 1991)

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(Pure observation wells and observed production wells were used to draw dynamic piezometric surface.)

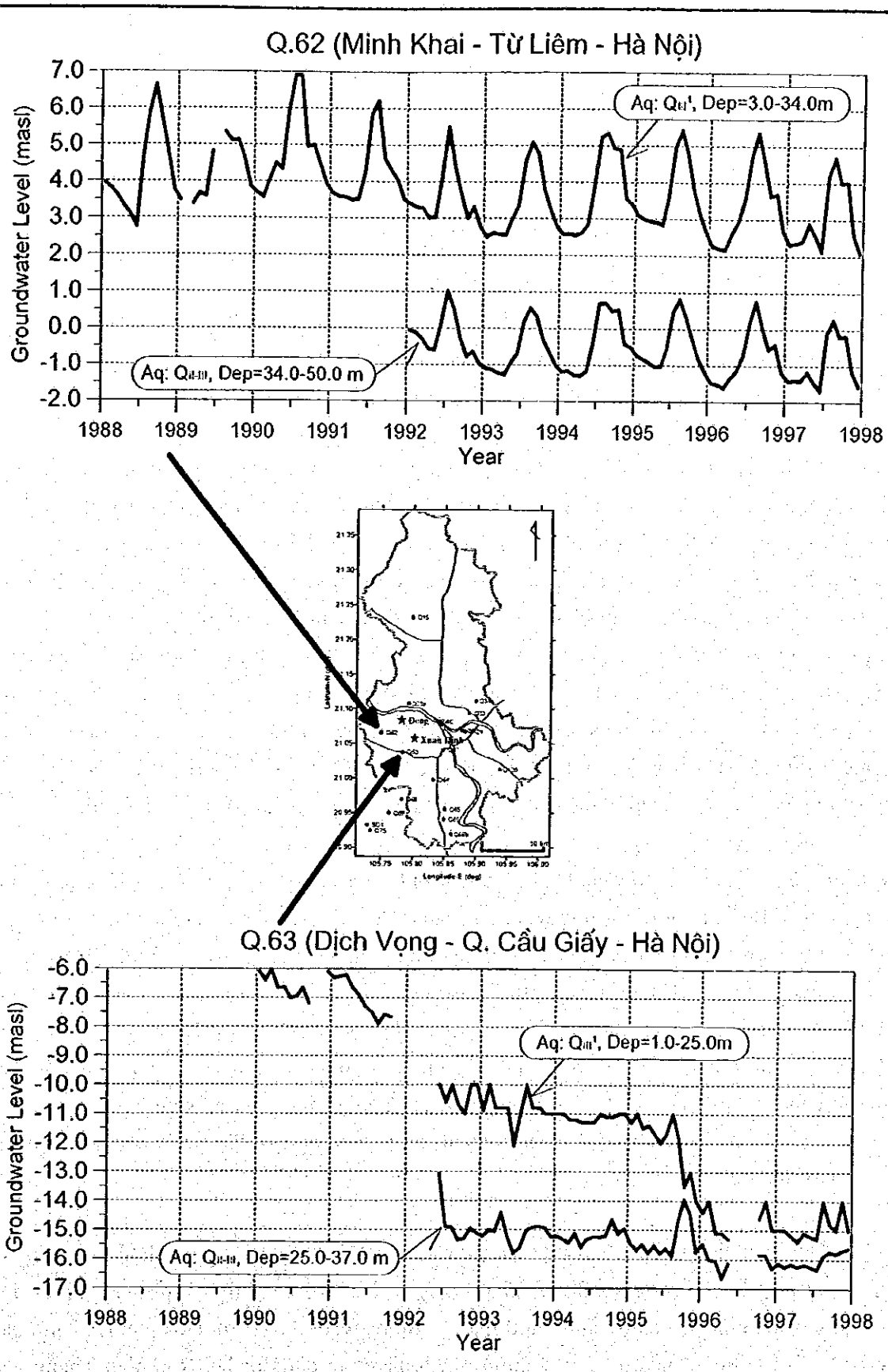

Figure 2.3 Changes in Groundwater Level in Hà Nội Area (2)

[Data Source: ĐẶC TRƯNG / ĐỘNG THÁI NƯỚC DƯỚI ĐẤT VÙNG ĐỒNG BẰNG BẮC BỘ (1988-1997)]

THE STUDY ON GROUNDWATER DEVELOPMENT IN THE RURAL PROVINCES OF NORTHERN PART IN THE SOCIALIST REPUBLIC OF VIETNAM

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)