2.4.2 RRA and In-depth Survey

The RRA (Rapid Rural Appraisal) enables to rapidly and intensively assess the features of the living conditions of the rural population for diagnosis of issues and problems. The basic concept underlying RRA is that the people know their own life best and have wisdom empirically. RRA is designed as an on-going learning process for both local as well as external team members in a more cross-sectional way. They evaluate local know-how and relevant technology transfer with the communities. Similar approaches are applied in the development field with adjustments to its own field such as the Action Learning Research. When it is applied in a more participatory way involving the community, it is called PRA (Participatory Rural Appraisal) which was conducted in the baseline survey of Phase I. Based on the objective and basic concept of RRA, an inter-disciplinary team should be formulated in an ideal case. However, due to the assignment scheduling constraints for this study, only those available during the survey period conducted the RRA study. Members who have deep insights and abundant respect for villagers' life and wisdom need to be selected by avoiding bias such as urban bias and ethnic bias. Wherever possible gender bias, if any, should be offset by including female in the appraisal team.

In Phase I, physical layout mapping including infrastructure, water resources and land utilization mapping has been drawn by the villagers and survey team members, and other basic village socio-economic data were identified. In Phase II, social assessment was conducted in Daen Kang and Hoai Mo villages on 7 December 1999 and Chakhamping village on 15 December 1999 as preparation for monitoring. The reason for selecting these villages is that these villages are regarded as the most difficult pilot villages due to the features of their ethnic affiliation and their perception on water and sanitation related issues. The survey was carried out for more precise items such as time line village development history, religious and festival calendar including beliefs and taboos on water related practice, information on historical background of water-related rights, life time survey including water fetching time, examination of payment capability, and willingness and their understanding of cost of effectiveness as well as other items.

Table 2-18 Social Survey Results of L-13 Chakhamping (Akha Village)

Luang Namtha Province, Long District

I.	General Information		II.	Social Infrastructure	
(1)	Location	Along road and river (Zone2)	(1)	Transportation	Distance from provincial capital: 90 km Type of transportation: transport car, bicycle
(2)	Topography	Plain			
(3)	Population	107 persons (data year:1999) (male 54, female 53)			
(4)	Ethnic Group	Lao Sung (Ahka)	(2)	Water Sources	1 river/lake
(5)	Households	27 households	(3)	Toilet	None
(6)	Occupation	Farmers 16 households Government officials 13	(4)	Electricity	No
			(5)	Primary School	1 school, male 8 female 5 Distance: NA
(7)	Village Area	NA (Forest reserve 30 ha]	(6)	Lower Secondary	1 school in village male NA, female NA
(8)	Agriculture Land	Upland field 6 ha Paddy field 15 ha	(7)	Family Planning	No
(9)	Communication	Akha Language Lao Language(a few people)	(8)	Primary Health	No village dispensary
			(9)	Major Disease	Malaria (rainy season) Diarrhea (dry season)
(10)	Religion	Animist 27 households Sacrifice ceremony for healing of sick villagers	(10)	Practice for Cleanliness	Washing clothes: once a month or every two months Don't take shower
III.	Village History		IV.	Village Life	
(1)	Resettlement History	Moved from Muang Meung (Tonpheung) in Bokeo province in 1973 Many people died due to malaria outbreaks in the 1980s	(1)	Kinship & Marriage	After marriage, women enter men's house and take care of family-in-law. Polygamy found in some cases
			(2)	Inheritance	Men inherit from their parents
(2)	Village Development History	Village established in 1991 Primary school built in 1996 Food shortage, rice supplied by GTZ in 1997 Water supply and sanitation improvement project by JICA in 1999-2000	(3)	Indigenous Belief	If female twin babies are born, family has to kill both of them right after their birth, because villagers believe twin girls bring bad luck to the family. etc.
			(4)	Life at Night	Woman massage for parents-in-law and her husband
V.	Village Economy		VI.	Community Organization and Social Issues	
(1)	Agricultural Products	Rice, corn, green vegetable cabbage, cardamon, palm fruits	(1)	Village Headman	Mr. Phaesay
			(2)	Village Meeting Place	None
(2)	Land Resources	Landless households: NA Paddy field:16 households	(3)	Water Committee	Established
			(4)	Lao Women's Union	10 members
(3)	Irrigation	Traditional irrigation	(5)	Youth Organization	14 members, meeting three times per month
(4)	Major Cash Income	Livestock			
(5)	Rice Self-sufficiency	16 households suffer from rice insufficiency for 6 months per year due to limited land and they mostly borrowed from relatives	(6)	Security Org	Meeting once a week
			(7)	Social Issues	Divided into two groups of different geographical location due to conflict on land use
(6)	Livestock	Cow 18, buffaloes 24, pig 30			
VII.	Household Economy* (9 household members)		VIII.	Daily Schedule*	
(1)	Yearly Income	Rice production 100,000 kip, crops 400,000 kip, livestock 1,900,000 kip, non-timber forest products 150.000 kip, others 50,000 kip	(1)	Women's Work	4:00: get up, 5:00-12:00: cooking, fetching water, collecting woods, feeding animal, 14:00-18:00: work in forest or field, 18:00 sewing, 20:00: massage for parents and husband, 21:00: sleep
(2)	Yearly Expense	Gasoline 40,000 kip, housing 300,000, clothing 250,000 kip, medicine 100,000 kip, education 10,000 kip, salt 30,000 kip, seasoning 30,000 kip, others 500,000 kip	(2)	Men's Work	4:00: get up, 5:00 -12:00: hunting, field, fishing, 14:00-18:00: work in forest or field, 18:00-20:00: stay at home, 21:00: sleep

*One example from household survey

Figure 2-1 Planning Map Drawn by Daen Kang Villagers (Water Tap Locations)

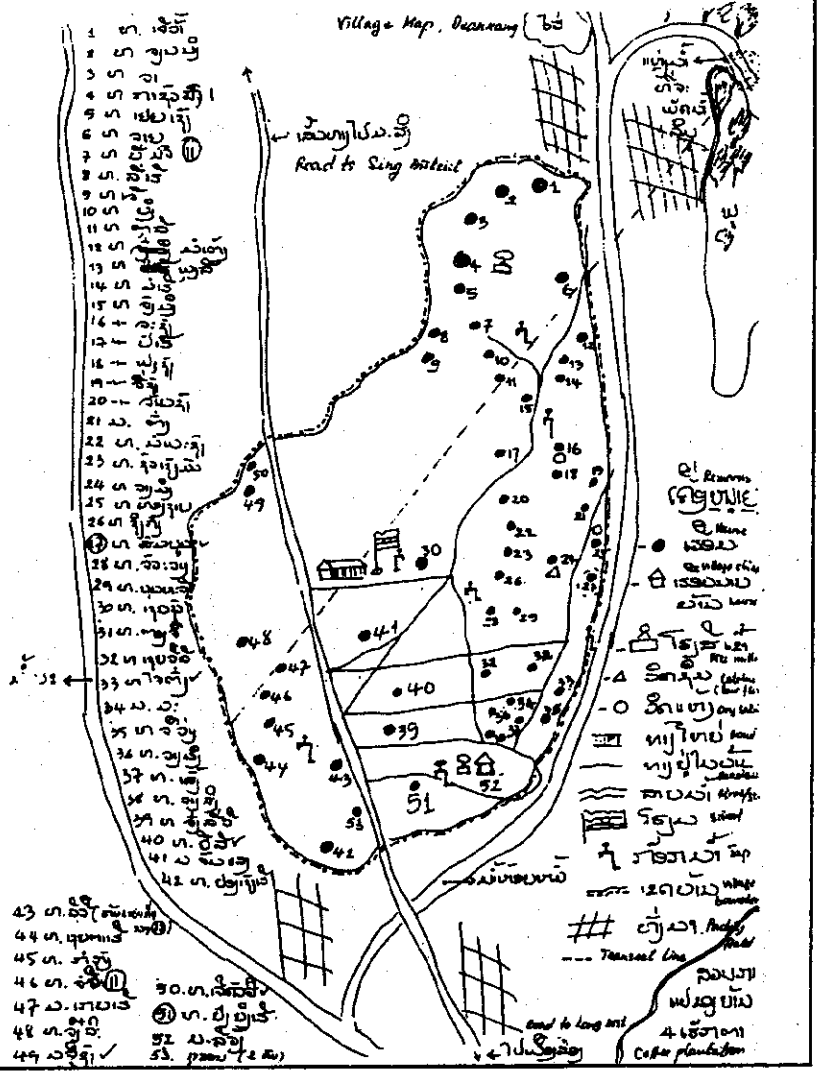
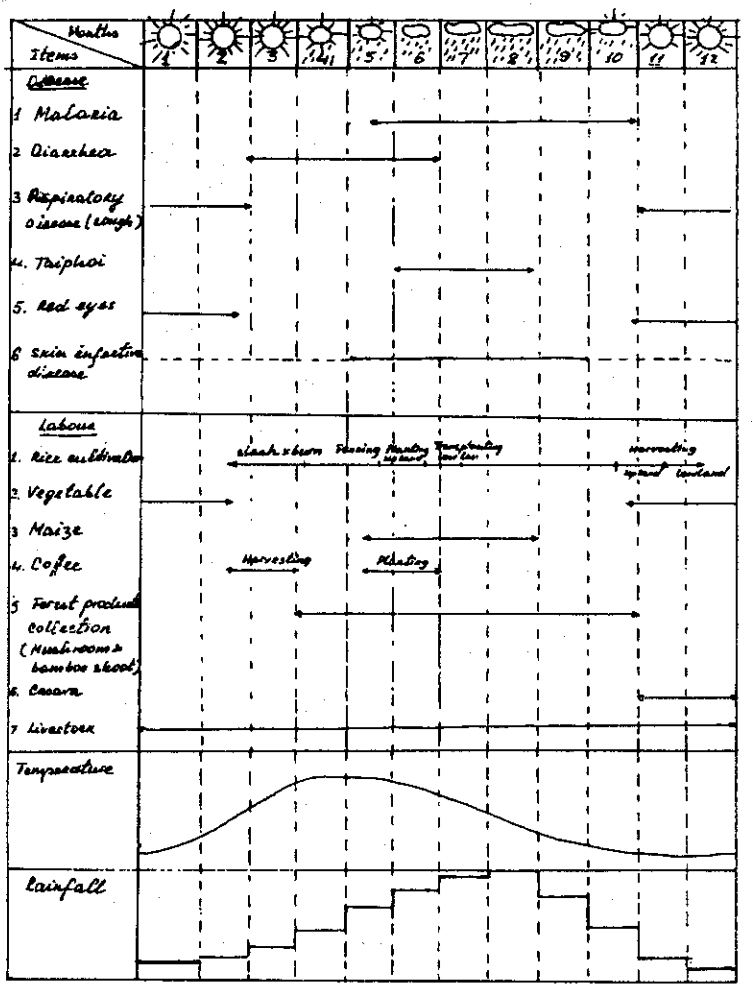


Figure 2-2 Seasonal Calendar of Daen Kang Village



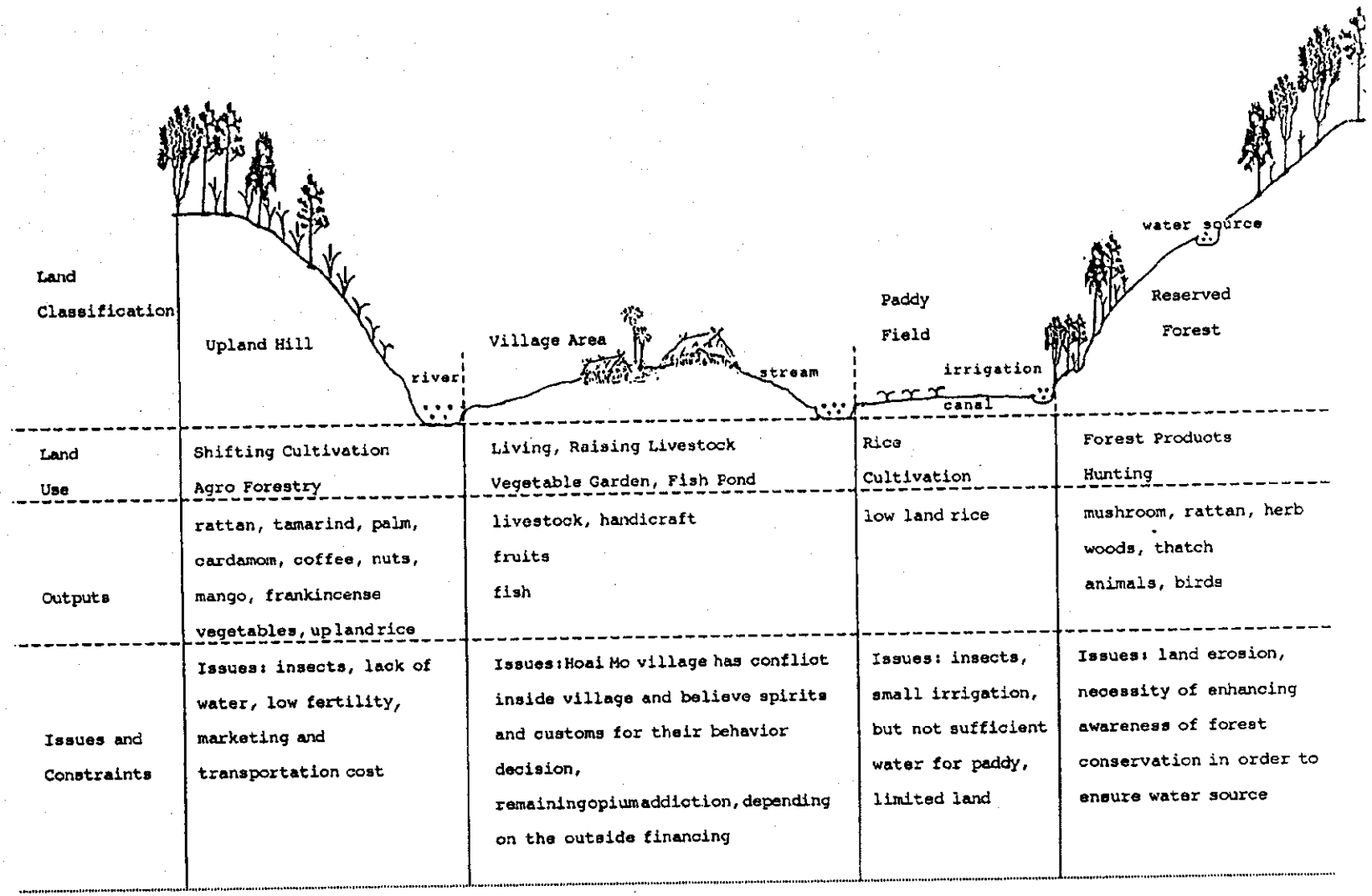


Figure 2-3 Land Use and Its Transect in Daen Kang and Hoai Mo Villages

2.4.3 PCM and its Results

PCM (Project Cycle Management) workshops were conducted in Long District at Daen Kang Village (Hmong tribe) and Hoai Mo Village (Akha tribe) from 7 to 10 December 1999 and Chakhamping Village (Akha tribe) from 14 to 17 December 1999. The preparations for the workshop were done on respective previous days. The participation analysis, the problems analysis on water and sanitation including socio-economic-cultural issues, and consecutively the objective analysis were conducted. Based on these analyses, the necessary measures and actions were organized into the format of the Project Design Matrix. District level officials as local language communication facilitators helped in communication between villagers and moderators. The workshops also aimed to demonstrate and share the knowledge on participatory village planning to Nam Saat personnel from central down to district levels.

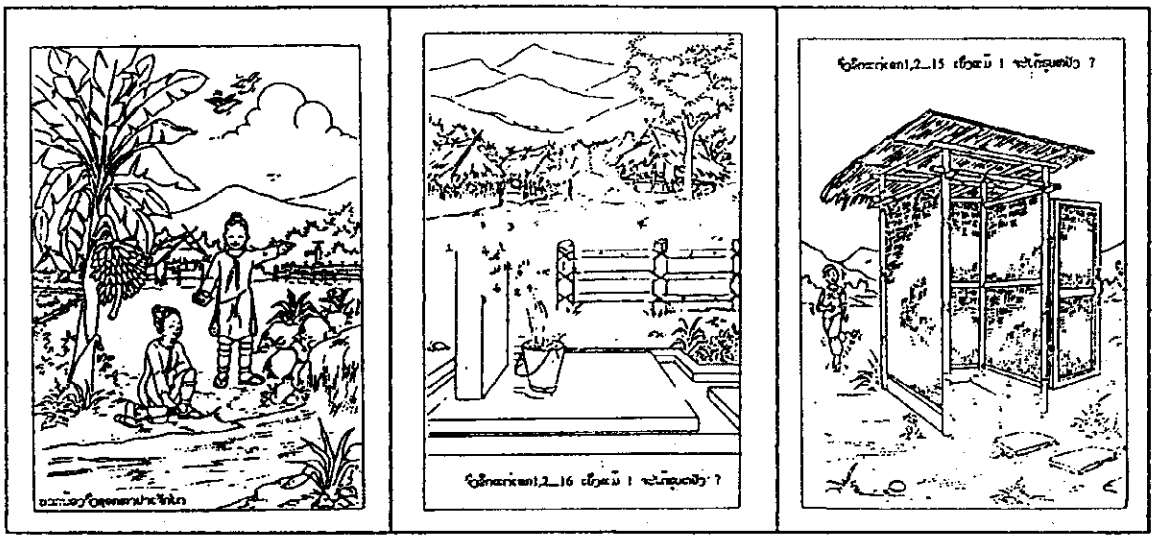
On the preparation day in each village, the village headman and group representatives attended the preparation meeting with the PCM team. The villagers enthusiastically attended the whole workshop continuously. The moderators had good technique in handling participatory workshops by using simple words for explanation and brainstorming the villagers to express their ideas. The moderators inserted educational games and quizzes related to water and sanitation improvement, which made the atmosphere enjoyable. Effects of the four-day workshop are summarized as follows.

(1) Involvement of villagers, both men and women, in this participatory workshop encouraged villagers to have a feeling of ownership in order to implement and sustain the project.
(2) The workshop helped village women and other vulnerable people to articulate their daily problems and issues related to water, and to get more confidence to participate in the project.
(3) A team working spirit and solidarity among villagers was created.

Another effect observed was that local officials who attended the workshop were very pleased to join in the PCM workshop and appraised its effectiveness for building the integration and raising their potential ability to participate, which was contrary to their expectation that the four-day workshop would be boring. They said they would like to learn how to conduct this kind of workshop with full villagers' participation.

On the other hand, constraints and difficulties could be pointed out that the majority of the participants, especially women, do not have a good command of the Lao language, and so it is hard to understand the Lao language without a translator. The Daen Kang Village headman, who has a strong leadership among the villagers, played a fine role in coordination of translating languages for the villagers. Also, Akha tribes are considered to be much more difficult than Hmong tribes to reach an adequate understanding due to their illiteracy, their own religious and cosmic beliefs, and their indigenous culture.

Figure 2-4 Educational Quiz and Game Used during PCM Workshop



*Using Namsaat Manual for Women and Clean Water for Health and Environment (Lao Version)

Figure 2-5 Problem Analysis
in PCM Workshop by Daen Kang Villagers

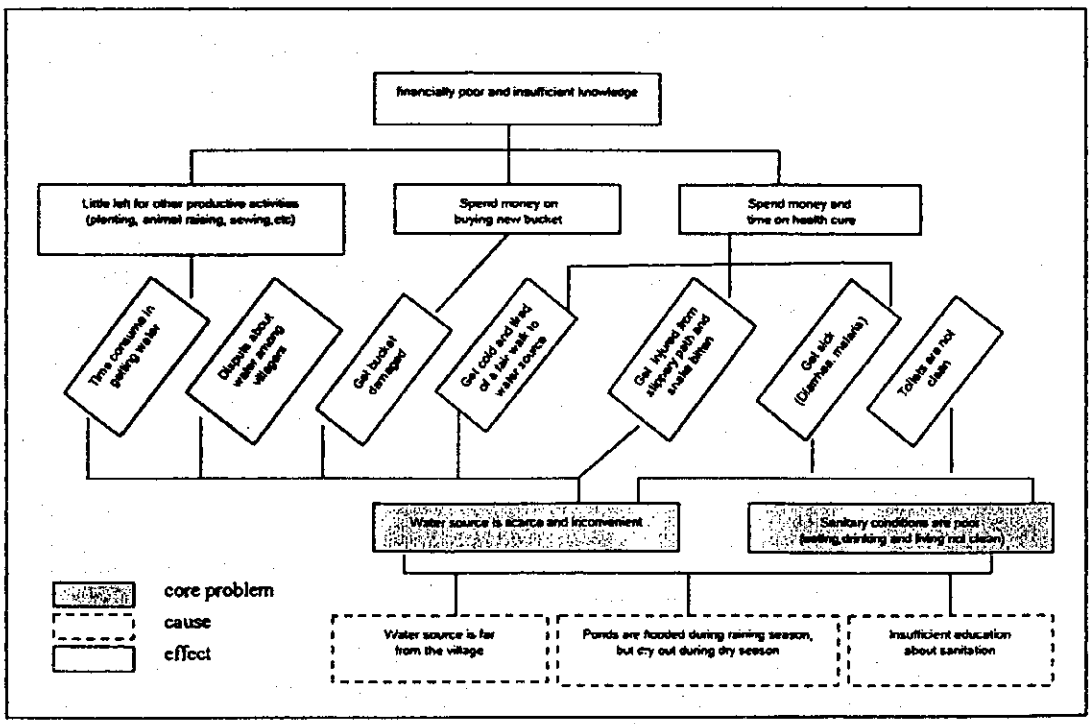


Table 2-19 Participation Analysis of PCM Workshop
Articulated by Villagers at Daen Kang and Hoai Mo Villages

Participants	Interests	Potential Contribution
☐ *Village Committee*	- reduction in water fetching time - latrine - water for daily use such as cleaning house & dishes, bathing - irrigation - decreasing water-borne diseases such as diarrhea	• education to villagers on using clean water • preparation of space for storing construction materials • protection of materials • encouragement towards villagers' contribution to the project
☐ *Villagers*	- clean water supply - latrine - healthy life - improvement of productivity	• being laborers for all activities of construction • procurement of local materials
☐ *Senior Organization*	same as committee and villagers	• inculcating and supervising villagers
☐ *Youth Organization*	same as committee and villagers	• labor, wood, gravel and sand
☐ *Women's Organization*	- reduction in water fetching time - latrine - having time to do other things such as taking rest, sewing and feeding animals	• caring for the people during the construction • participating in the water supply project
☐ *Security Organization*	same as committee and villagers	• security during construction

Table 2-20 Project Design Matrix
Articulated by Villagers at Daen Kang and Hoai Mo Villages

Project Design Matrix	Person in Charge
Project Objectives: ☐ Clean water will be sufficiently and conveniently supplied to the villagers of Ban Daen Kang and Hoai Mo ☐ Sanitation conditions of the villages in Ban Daen Kang and Hoai Mo will be improved	
Means: 1. Villagers of Ban Daen Kang and Hoai Mo will jointly contribute to the construction. 2. Villagers of Ban Daen Kang and Hoai Mo learned about and will implement the sanitation principles 3. Gravity Fed System will be maintained.	Mr. Yachong Mr. Touly water committee water committee
Activities: 1.1 collection of gravel and sand in: - Daen Kang Village - Hoai Mo Village 1.2 preparation of wood for construction for: - Daen Kang Village - Hoai Mo Village 2.1 education to villages on sanitation 3.1 education to villagers on maintenance (so that they will not break the facilities) 3.2 organization of the village water committee* 3.3 draft the facilities management rules - inspection 3 times/month - cleaning/clearance of surrounding area 3 times/month - monthly maintenance fee 100 kip/person	Mr. Lee Her Mr. Mea Thou Mr. Vangmenglee Mr. A-Lee district officers district officers water committee water committee
Inputs by Villagers: - sand= 4.4t - timber (20cm×5cm×2cm)= 32 pieces - gravel= 9t - timber (4cm×8cm)= 26 pieces - labors - timber (round shape)= 26 pieces - money 20,000kip/household (construction)	

* the committee is already organized, consisting of Mr. Vangmenglee, Mr. Jurva and Ms. Jurya of Daen Kang; Mr. Paou and Ms. Bouxe of Hoai Mo

2.5 Gender and Ethnic Minority Issues

2.5.1 Gender Considerations

In order to incorporate gender considerations into the program, the survey was conducted through interviews regarding women's situation and social gender roles. Lao Lum women are better off in the access to resources such as land and capital. In accordance with matrilineal tradition, Lao Lum women inherit their parents' land and property, especially the youngest daughter of the family. Lao Lum men will marry and go out to live with their wives and the wives' parents, and work for the wives' families. Unlike Lao Lum women, Lao Theung and Lao Sung women have fewer rights and little control of their resources according to their patriarchal tradition. However, men of Lao Theung and Lao Sung have control over most of the resources such as land and in the decision making process. Participation of women in meetings or political events is limited. The number of women's participation is always less than that of men. Without special considerations, men speak more than women, especially in public occasions. In most places, women and children, especially girl children are responsible for collection of water for domestic use. However, women have less opportunity to make decisions related to the fetching and usage of water than male. Therefore, women have been encouraged to participate in each workshop so they can address their situation and requirements in the project cycling.

2.5.2 Ethnic Minorities Issues

1) Ethnic Minorities Distribution

In Lao PDR, 68 ethnic minority groups are recognized and officially classified into three categories, that is, Lao Lum, Lao Theung and Lao Sung. In Long District, 86% of the total number of villages are Lao Sung, in contrast to 12% Lao Lum and 2% Lao Theung. Akha (Ikor) is the major minority tribe under the Lao Sung minority group in Long District. In Viengphoukha District, 40 % is Lao Sung, whereas 53% is Lao Theung and Lao Lum shares only 7%. 32% of the total target villages is Lao Lum (Leu, Thaidam, Phoutai, Phounoi), 47% is Lao Theung (Khmu, Lamae, Yuan, Doi) and 21% is Lao Sung (Hmong, Akha, Yao, Qui, Mouser). The ethnic composition of the surveyed villages in the fieldwork is shown below.

Table 2- 21 Ethnic Composition of Surveyed Villages in Field Work

Classification	No.of Villages	Ratio	Ethnic Group
Lao Lum	26	32%	Leu, Thaidam,Phoutai,Phounoi
Lao Theung	38	47%	Khmu, Lamae, Yuan, Doi
Lao Sung	17	21%	Hmong, Akha, Yao, Qui, Mouser
Total	81	100%	

Source: Results of Field Survey, March-May 1999

Table 2-22 Minority Village Distribution by District

District	Leu	Thaidam	Khmu	Lamac	Yuan	Hmong	Akha
Houayxai	10	0	8	7	0	1	0
Pha Oudom	1	1	4	2	1	0	0
Viengphoukha	0	0	1	0	4	1	0
Long	8	2	0	0	0	1	7

Source: Results of Field Survey, March-May 1999

2) Ethnic Minorities Characteristics

Ethnic minorities in the target villages mostly live in the mountainous area and preserve their own cultural heritage with a long history. They are independent and have pride in their skills for their own way of life such as farming, hunting and handcrafting. They have their own traditional water supply schemes using bamboo to transport water from the source. Characteristics of some of the Lao Sung ethnic minorities are described below.

The Akha tribe (Ikor in Lao Language) is classified into the U Lo Akha and Ubya Akha from the different features of their costume. Linguistically, it is sorted as a Tibetan Burmese group. Akha tribes in Long District came from eastern Myanmar and settled in the north-western part of the District. Akha villages are distinguished by their carved wooden gates, presided over by guardian spirits. Their lives depend on shifting cultivation and paddy field cultivation. In order to supplement their income, many Akha are selling handicrafts, employing the traditional skills used in making their own clothing and cultural items. Women wear heavy headwears covered with silver coins. They wear the headwears all the time because they believe the bad spirits will come into their heads if they take them off.

The Yao originated in southern China. They have a written language. L-22 Ban Namoun is the only Yao village among the target villages. There are three celebrations each year. Yao women are skilled with cross-stitch embroidery. Long black jackets with lapels of bright scarlet wool are worn with loose trousers and big black turbans. They are good at bartering their goods and commodities among the hill tribes.

Hmong tribes also originated in southern China. There are three Hmong villages in the target villages. The Hmong are divided into two sub-groups, White Hmong and Blue Hmong. V-1 Ban Nam Mai is an example of a Blue Hmong village. Houses are built on high stilts with walls of bamboos or wooden planks, thatched with grass. They use the Hmong language. They are quite diligent and live in the hillside or mountainous area in a more independent way. The government is trying to provide social services for their resettlement. However, historical tension and prejudice towards the Hmong still exist in the society. Some of these refugees have been given residence in the United States of America or other countries. Others were repatriated to Lao PDR in 1998.

Some of the villages in Bokeo and Luang Namtha Provinces are engaged in the production of opium. Especially, Luang Namtha Province has special climatic and geographical conditions suitable for the cultivation of the poppy plant, where the weather during the dry season is cool at night, foggy in the morning, and dry, warm and sunny during the day. The major opium producers are Lao Sung. According to the questionnaire survey, the villages planting poppy in the target villages are Akha, Hmong, Mouser, Samtao, Yuan, Yao villages. Some of the Lao Lum villages, such as Lamae, Thaidam, Leu also produce poppy. The number of addicted persons varies from 2 to 28 for one village. For instance, L-18 Ban Phaeo Yae, an Akha village, 28 persons are addicted: 21 are male and 7, female. Male are more addicted than female in the villages.

CHAPTER 3 SANITATION AND HEALTH CONDITIONS

3.1 Epidemiology

3.1.1 Health Statistics at the Hospitals

The four target districts have been covered by corresponding four governmental hospitals[1] as their main health service provider. Each hospital provides certain statistics for in-patients, out-patients and other hospital activities. However, the formats differ from one to another as well as duration of data compilation. Furthermore, due to the strong tendency of self-treatment by the general population, hospital records may not represent well enough the actual health status of the local people. Nevertheless they are important source of information to approach to the real health situation in the area.

Bokeo Provincial Hospital has kept health data since 1990 as shown below. Other available health records from hospitals covering the target area are presented hereafter. Pha-Oudom District Hospital has not been contacted.

Table 3-1 Bokeo Provincial Hospital Data for Number of Patients

Case	1990	1991	1992	1993	1994	1995	1996	1997	1998
Malaria	1,128	2,537	1,338	3,277	1,405	2,875	2,905	4,012	2,440
Diarrhea	410	509	296	338	188	197	214	469	349
Dysentery	169	152	148	150	71	113	92	214	114
Cholera	0	0	0	0	5	0	0	0	0
Tuberculosis (TB)	79	83	63	64	141	85	56	41	20
Pneumonia	197	275	176	363	385	574	1,044	1,104	931
Grippe	152	157	149	274	41	216	229	315	185

Table 3-2 Viengphouka District Hospital Data for Number of Patients

Case	1997			1998								
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.
Malaria	41	32	32	35	28	19	16	30	44	92	60	41
Diarrhea	2	1	0	1	0	3	18	2	2	2	4	2
Pneumonia	8	10	2	8	6	4	10	9	2	0	1	2
Others	21	12	17	7	18	8	13	23	24	11	17	18

[1] One provincial hospital (Bokeo) and three district hospitals.

Table 3-3 Long District Hospital Data for Number of Patients

Case	1998			1999		
	October	November	December	January	February	March
Malaria	15	9	23	16	12	10
Diarrhea	0	0	0	2	5	1
Dysentery	0	1	1	0	1	0
Pneumonia	3	5	3	8	6	12
Fever	0	0	0	6	2	0
Gastonia	1	0	2	1	1	1
Others	3	2	2	9	9	1

3.1.2 People's Perception

Among the 356 households surveyed at the four target districts, interviewees have responded to the question "*What are the most common diseases experienced by members of your family?*" with 61 kinds of disease or symptoms. The most frequent answer is Malaria (31%), followed by Diarrhea[2] (23%) and Fever (9%). The others category includes: Cough, Headache, Measles, Stomachache, and so on. These results are listed in the following table.

Table 3-4 Common Diseases Perceived by Villagers

Diseases	Frequency	Ratio
Malaria	203	31%
Diarrhea	148	23%
Fever	61	9%
Others	233	36%
Total	645	100%

Those interviewees also responded to the specific cause of the diseases they believe. The responses are summarized below.

For Malaria, the majority could not identify its specific cause as can be seen in the table below.

[2] Dysentery included

Table 3-5 Causes of Malaria Presumed by Villagers

Cause	Frequency	Ratio
Don't know	120	59%
Sleep without mosquito net	33	16%
Mosquito bite	20	10%
Unsanitary condition	12	6%
Go to forest	6	3%
Don't know how to prevent	2	1%
Don't protect	2	1%
Drink unboiled water	2	1%
Food and water are not clean	2	1%
A lot of water around the house	1	0%
Go to work	1	0%
Weather	1	0%
When doing something	1	0%
Total	203	100%

For Diarrhea, one third of the respondents refer to some risk of contamination from drinking water or food, while still more than half could not identify the causes.

Table 3-6 Causes of Diarrhea Presumed by Villagers

Cause	Frequency	Ratio
Don't know	83	56%
Drink unboiled water	32	22%
Food is not clean	20	14%
Eat many fruits	4	3%
Bad practice in sanitation	4	3%
Children	2	1%
Fever	1	1%
Hard work	1	1%
Sun stroke	1	1%
Total	148	100%

The survey also investigated people's preference for variety of health services. The most common practice when they feel sick is, stay home and take some medicines by themselves. Because the interview allowed multiple answers, it may be said that the preference for a hospital is rather low. Although the share is small, appearance of "sacrifice" or "opium" seems to be representing a wide cultural background in the target area.

Table 3-7 Disease Treatment Preferences

For Treatment	Frequency	Ratio
At home	146	24%
Hospital	98	16%
Hospital (province)	95	16%
Hospital (district)	71	12%
Buy and take medicine	67	11%
Traditional medicine	39	7%
No treatment	24	4%
Sacrifice	22	4%
Village nurse	11	2%
Dispensary	5	1%
Use opium	5	1%
Hospital (Thailand)	5	1%
Hospital (China)	3	1%
Hospital (Myanmar)	3	1%
Go to quack	1	0%
Total	595	100%

3.2 Diarrhea

Due to the lack of bacteriological laboratory functions in both provincial and district hospitals in the study area, the term "diarrhea" generally includes Cholera, Dysentery and other variety of causes. However, as some local words for the disease indicate, health staffs as well as villagers differentiate Cholera and Dysentery from other diarrhea.

The local word "ton-ki-ha", which means a syndrome with watery diarrhea and vomiting, is used for Cholera. Experienced medical doctors can also identify the disease by its particular smell at clinical diagnosis. In Long district, an outbreak has occurred in July 1997 when 30 people got sick including one death at a village. A local doctor has identified it as coming from the nearby Myanmar border. In Houayxai district, another outbreak has been identified in 1994 with about 40 patients and 9 casualties. After the large outbreak of Cholera in Khammouan province in 1992, the risk of the disease seemed to have been reduced in this country. However, small-scale outbreaks still can occur particularly in those areas near the borders.

Dysentery is called "tom-bit" locally, and diagnosed clinically by severe stomach aches and stools with blood. Although it is very difficult to make a distinction between bacillary dysentery and amebic one without bacteriological laboratory, local doctors

see the latter as the major one in this area. No major outbreaks of Dysentery have been reported in those areas recently. However, it seems endemic there with some hospitalized patients throughout a year. The Tetracycline tablet, called "Teta" locally, is one of the most popular drugs in the local Drug Revolving Fund. People can access it without any prescription like in many developing countries. It may have affected epidemiological outcomes observed at the hospital levels.

Infection routes of those diseases have not been clearly identified yet, mostly due to the lack of epidemiological investigation capability at the local level. A part of this study result shows a significantly high rate of bacillary contamination in sampled dug wells. While people commonly prepare boiled water for drinking in the form of tea or some traditionally prepared herbal plant, "pakdomn" or "la" in it, some people in some ethnicity believe "raw" water is better for their health.

According to the KAP study done by UNICEF in 1996, people see benefits of having latrine as a convenience of not having to go far from the house, prevention of diseases, keeping area clean, and for privacy. Those reasons explain well the result of another village survey conducted by the Bokeo provincial health department and MSF, an NGO, in Houayxai district in 1998. That survey revealed that the population density and the length of stay at the current place are the major parameters to affect latrine demand, and this coincides with the observation of HASWAS as well.

3.3 Malaria

Two types of Malaria, *P. falciparum* and *P. vivax*, are endemic in the study area, and the former is the major one. People call it as "khai-nyung", which literary means "mosquito fever", and take anti-malaria drugs whenever they think it is Malaria. At the hospital level, they have a microscope in each hospital for blood tests.

There is a certain drug resistance in this area. Some doctors differentiate patients coming from easy access villages and those from remote ones because they have higher risks of drug resistance and are treated with different drugs.

In Bokeo and Luang Namtha, where they are rich in natural forests and small streams, countermeasures against mosquitoes breeding seems not practically feasible. Under such circumstances, protection of individuals might be the only choice for disease prevention. Mosquito nets are commonly used in some villages but they are not perfect. Commonly employed tactics to reduce Malaria are: to distribute impregnated mosquito nets; to impregnate existing mosquito nets in the village; and to promote awareness of Malaria and the need for protection.

CHAPTER 4. WATER RESOURCES AND WATER USE SITUATION

4.1 Climate

The study target area, Bokeo and Luang Namtha Provinces, in the north-west region of the country belongs to the tropical monsoon climatic zone of Southeast Asia, and is characterized by the distinct division into the rainy season and the dry season: the rainy season is from April to October and the dry season, November to March. The precipitation rate in this area is very high at 1,400 mm to 3,000 mm per year, and especially in the mountainous areas of the study area, the annual precipitation rate can reach over 3,000 mm. The Figures in the following pages display annual average precipitation and monthly average precipitation of the Study target area. The average monthly precipitation rate is the highest in July and August, where it reaches 430 to 480 mm in Houayxai town and 200 to 250 mm in Namtha town. Another characteristic of this area is for example, in Houayxai town, the monthly precipitation rate is still 250 mm in October at the end of the rainy season. On the other hand, records of many years have revealed that there was no precipitation at all from November to February, which is the dry season.

The monthly average temperature in the target area is very high ranging from 20℃ to 30℃ throughout the year. The difference in monthly average temperatures is very low at below 10℃, contributing to another characteristic of the tropical climate zone.

4.2 Topography, Geology and Hydrogeology

Considering the available water resources for water supply in the Study area such as groundwater and surface water, we must take careful attention to the natural environment in terms of topography, geology and hydrogeology.

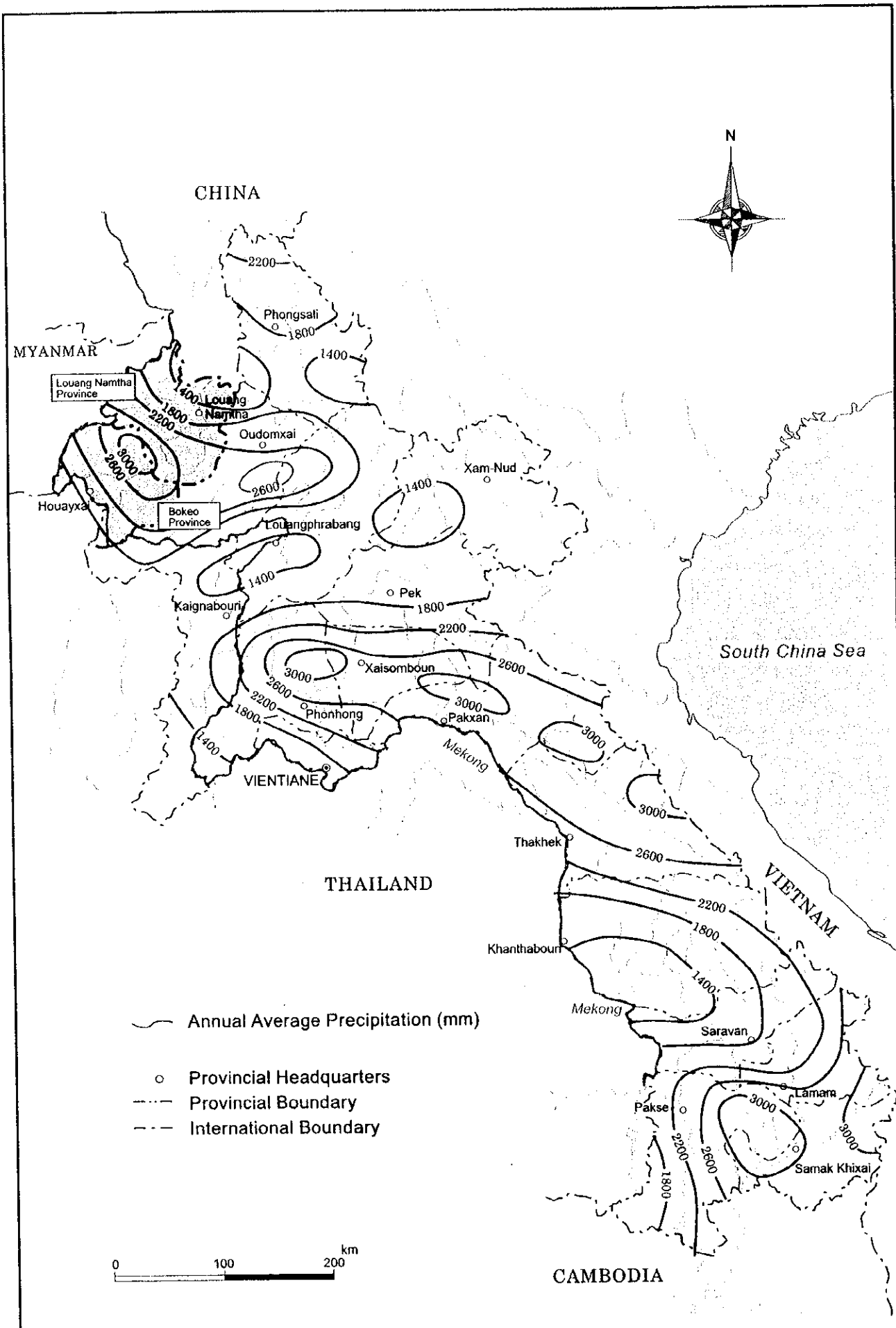


Figure 4-1 Annual Average Precipitation of Lao PDR

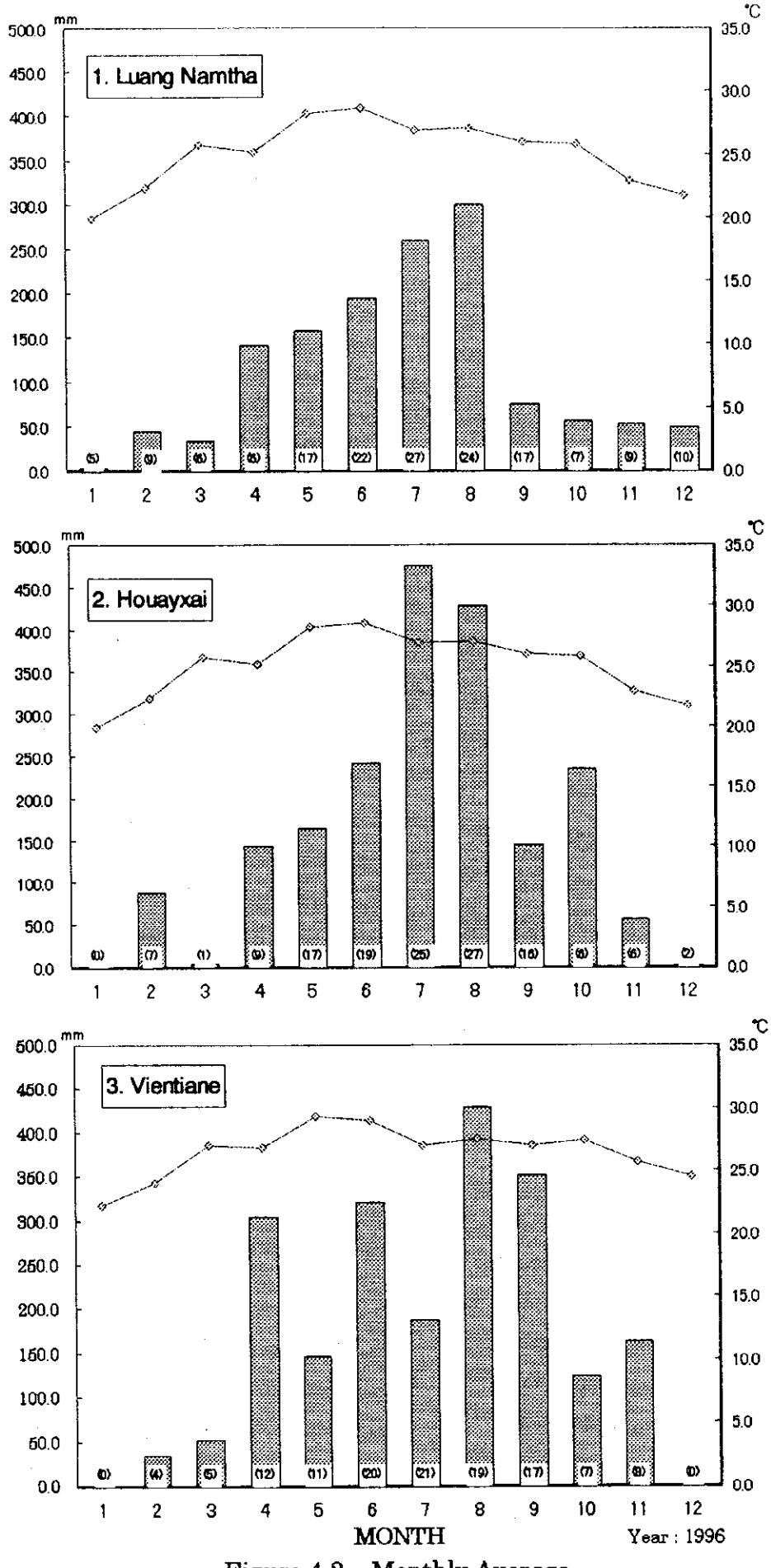


Figure 4-2 Monthly Average
Precipitation and Temperature of Target Area and Vientiane

Based on the field survey and the Figure shown in the following page, the topography of the study area can be classified into four zones as listed below:

Table 4-1 Classification of Topographical Zones

Zone	Area	Elevation
Alluvial Fan Zone	Bokeo Province	350 m to 500 m
River Terrace Zone	Long Dist., Viengphoukha Dist.	550 m to 750 m
Mountainous Basin Zone	Luang Namtha Dist., Sing Dist.	520 m to 850 m
Steep Mountain Zone	Bokeo Prov., Luang Namtha Prov.	900 m to 1,180 m

Alluvial fan is developed in the area of Houayxai and Pha Oudom in Bokeo Province. The river terrace zone along the narrow valley surrounded by the steep mountains is found in Long and Viengphoukha Districts, and Luang Namtha and Sing Districts are located on the typical mountainous basin. These topographic areas are covered by Alluvial and Diluvium deposits consisting of sands, silts, gravel and clay having thicknesses of several meters to several tens of meters with expected abundance of groundwater.

On the other hand, as depicted in the geological map, the steep mountain zone consists of sedimentary rocks such as sandstone, siltstone, shale and limestone ranging from the Paleozoic Era of the Silurian and Devonian Ages to the Mesozoic Era of the Triassic and Cretaceous Ages, and also intrusive rocks of granodiorite and granite of the Paleozoic Era of the Carboniferous to Permian Ages. This is where we can find spring waters and clean rivers flowing which can be used as the sources for the Gravity Fed System (GFS).

From a hydrogeological point of view, groundwater is found in the riverbeds of relatively flat areas in the river terrace zone, alluvial fan zone and mountainous basin zone. Groundwater in these areas has good water quality and is presently used for drinking. However, groundwater potential is limited due to thin unconfined aquifers. Also, confined groundwater exists in the hard rocks of the sandstone, shale, metamorphic and granite layers of the Tertiary, Cretaceous and Paleozoic Ages associated with cracks and faults. However, survey and development of groundwater is hardly carried out in both Luang Namtha and Bokeo Provinces due to poor water quality for drinking, such as the content of iron in the water.

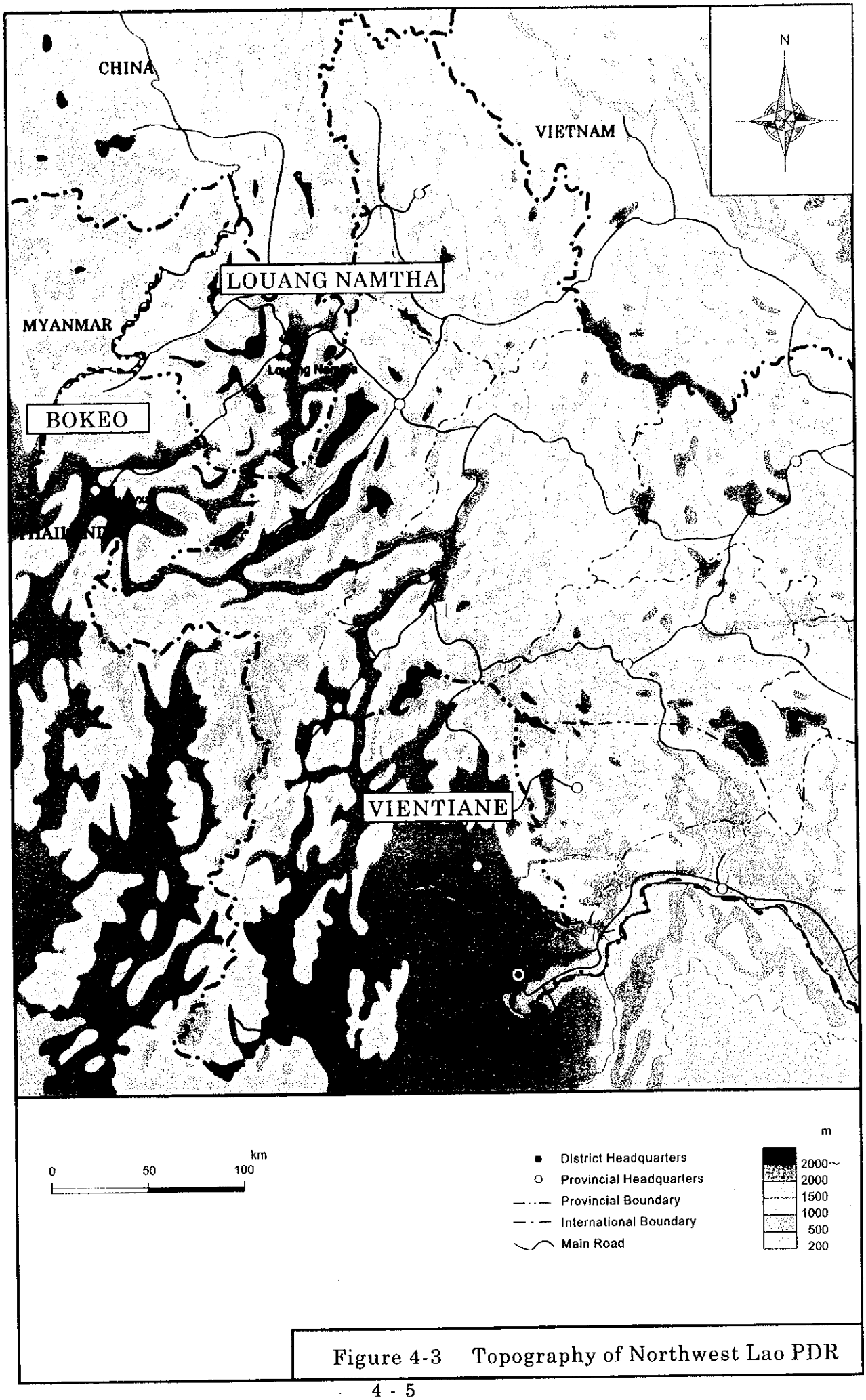


Figure 4-3 Topography of Northwest Lao PDR

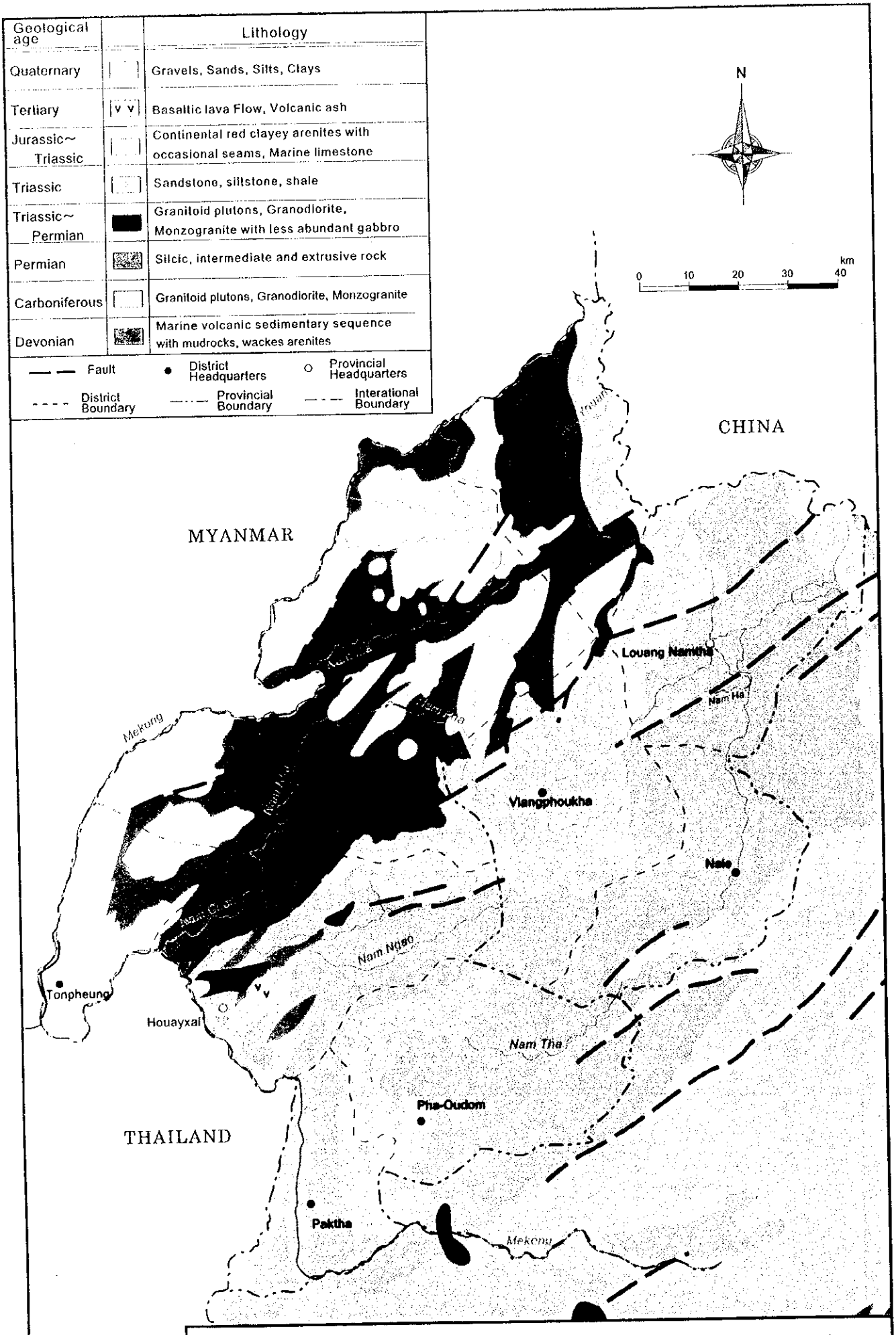


Figure 4-4 Geology of Bokeo and Louang Namtha Provinces

4.3 Available Water Sources

The Mekong River which originates in the Himalaya mountains is the main river course of Laos, and most of the rivers flowing inside the country are tributaries of the Mekong River. The main river in the study area is the Nam Tha River originating from Luang Namtha Province flows from northeast to southwest into the Mekong River passing through Bokeo Province. Other rivers in the study area are Nam Ma river, Nam Ngam river, Nam Hoo river and Nam Tin river which flow from northeast to southwest all terminating into the Mekong River.

The water sources expected to be used as sources for the study target villages are further tributaries of the above rivers or springs related to the above sources. In the past, the rivers had stable base flow with abundant quantity and good quality owing to abundant rainfall and protected by deep forests. The recent deforestation activities in upstream areas and slash and burn farming have contributed to the decrease in flow rates of water resources. The decrease in river base flow in the dry season and increase of turbidity due to topsoil outflow in the rainy season are causing environmental problems in water quality and quantity.

On the other hand, abundant groundwater can be found as unconfined and confined aquifers in the riverbank terraces of Viengphoukha and Long Districts where villages have settled along the river; the inland basins of Luang Namtha, Sing and Pha Oudom Districts; and the Alluvial fan of lowlands of Houayxai District. However, it is reported that the confined groundwater in both Luang Namtha and Bokeo Provinces has a problem with water quality and cannot be used as drinking water in some areas. Groundwater surveys are not carried out scientifically in this area. In Houayxai District, only a few groundwater development projects using boreholes were implemented in the past, which were mostly by EU. Also, a groundwater development project to develop confined water was implemented in Luang Namtha Province through the support of the World Bank in 1994, where 18 boreholes were drilled, and due to dry wells and water quality problems, only 8 wells were successful (success rate of about 44%). Then, 3 boreholes were drilled in the river terrace zone found in the central part of the District capital of Viengphoukha, and these were successful. The depths of these boreholes are about 30 m and the

water quality is acceptable. Tara pumps were installed and are still functioning without any major problems even after more than 3 years of operation and supplying precious drinking water to the villagers. As for unconfined groundwater, it is being drawn from traditional hand dug wells and concrete lined shallow wells, and is supplying drinking and domestic water to the villagers in many areas. These wells have depths of a few meters to 10 m or so with static water levels of a few meters, and water is fetched by hand using buckets. While the water quality of unconfined groundwater is good and water can be fetched easily, quantity can become a problem in the dry season and also these type of wells are easily contaminated by human sources, and therefore proper construction techniques, sanitary control and careful maintenance are necessary.

4.4 Water Use Situation

4.4.1 Existing Water Supply Facilities and Water Use Pattern

Presently, the existing water sources and water intake facilities for villagers are mainly river water and groundwater as follows.

(1) Traditional hand dug well
(2) Concrete lined shallow well with cover
(3) River and stream water
(4) Spring water
(5) Borehole

According to the annual calendar of water use, which was surveyed at a few villages in Long District, the shortages in water become prevalent at the end of the dry season and the villagers tend to use less water, whereas in the rainy season when water is abundant, more water is used, but problems with turbidity, odor and bad taste become apparent. The daily water use pattern reveals that water is used the most in the evening from about 5 p.m. to 9 p.m. for cooking, cleaning and bathing; the second most used period is in the morning from around 5 a.m. to 9 a.m. where water is used for cooking breakfast and cleaning; the tertiary water use period comes around noon to 3 p.m. when water is needed to cook lunch and other minor uses; and at other hours of the day, water is hardly used at all.

4.4.2 Situation at Study Villages

The village survey results concerning water use are summarized in the attached table, and the present situations at some of the study target villages are exemplified below.

1) Situation at 9 Villages (H-17 to H-25) in Houayxai District of Bokeo Province

a. Existing Water Source

The water sources presently used by the 9 villages are traditional hand dug well being the most, concrete lined shallow well next, followed by river water. Springs are used only by a few villagers. Out of the 9 villages, only 6 villages replied that they can receive a stable supply of potable water throughout the year. The remaining villages said they cannot receive sufficient supplies in the dry season. The distance to water sources can be divided into two categories: one is those fortunate to have water 7 to 10 m away from their houses, and the other is those who have difficulties fetching water which are situated 200 to 500 m away.

b. Water Supply Improvement

The GFS (gravity fed system) was chosen as the most wanted water supply scheme by all of the villagers. The amount of cash that the villagers are willing to contribute to the construction ranges from 5,000 to 50,000 Kips per household (assuming an average of 5 to 6 persons per household). Also, they agreed to contribute labor during the construction period and they are able send 25 to 100 persons per day from each village during the off-farming season from December to April, which implies that they can contribute about one laborer per household per day. The villagers further said they can contribute materials such as sand and wood within their abilities. In relation to maintenance of water supply facilities, presently water committees are organized for concrete lined shallow wells with the support of Nam Saat and NGOs. Therefore for maintenance of the GFS, new water committees can be formed and they are willing to pay water fees of about 100 Kips/person/month, or 500 Kips/household/month.

Table 4-2 Basic Water-Use Profile of Study Target Villages

District	No.	Zone	No. of HH	Pop.	Exsiting Water Source						Dist to Water Source (m)	Period of Water Shortage	Choice of Water Supply	No. of Existing Latrines	Water Commi ttee	Contribution to Water Supply				Contribution		
					Stream	Trad. Well	Dug Well	Spring	Trad. GFS	Bore hole						Construction			Maintenance	Sanitation		
																Cash	Mat'ls	Labor Available		Cash	Mat'ls	Labor
Houayxai	H-1	3	90	542	1	19	3	-	-	-	5 - 110m	May - Nov	GFS	79	-	Yes	Yes	Feb - Apr	Yes		Yes	Yes
	H-2	3	40	210	-	2	1	-	-	-	5 - 100m	-	GFS		-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-3	3	65	377	1	-	-	-	-	-	40 - 300m	Mar - Apr	Dug Well		-	Yes	Yes	Jan-Feb	Yes	Yes	Yes	Yes
	H-4	3	25	101	1	1	-	-	-	-	70 - 150m	Jul - Oct	Dug Well		-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-5	3	36	173	-	-	1	-	-	-	30 - 200m	-	GFS	36	Yes	Yes	Yes	Jan - Mar	Yes		Yes	Yes
	H-6	3	85	556	-	5	1	-	-	-	5 - 25m	-	GFS	4	-	Yes	Yes	Jan - Feb	Yes		Yes	Yes
	H-7	3	61	352	-	5	-	-	-	-	10 - 110m	-	GFS	20	-	Yes	Yes	Jan - Jun	Yes	Yes	Yes	Yes
	H-8	3	82	385	2	9	2	-	-	-	5 - 150m	Feb - Mar	GFS	42	-	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	H-9	3	29	133	-	1	1	-	-	-	30 - 100m	-	Borehole	16	-	Yes	Yes	Jan-Feb	Yes		Yes	Yes
	H-10	3	97	369	-	-	-	-	23	-		-	No need		Yes	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-11	3	78	420	-	-	-	-	1	4		Apr - May	No need	58	Yes	No	No	No	Yes	Yes	Yes	No
	H-12	3	35	169	-	2	2	-	-	-	5 - 100m	Mar - Apr	GFS	32	-	Yes	Yes	Jan - Mar	Yes		Yes	Yes
	H-13	3	44	246	2	34	-	-	-	-	5 - 50m	-	GFS	39	-	Yes	Yes	Feb - Mar	Yes	Yes	Yes	Yes
	H-14	3	41	218	1	7	2	-	-	-	10m	-	GFS	33	-	Yes	Yes	Jan-Feb	Yes		Yes	Yes
	H-15	3	59	284	1	16	4	-	-	-	5m	-	GFS	22	Yes	Yes	Yes	Jan - Mar	Yes		Yes	Yes
	H-16	3	30	169	1	-	2	-	1	-	10 - 250m	-	GFS	15	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-17	2	18	98	1	2	-	-	-	-	10m	2 Months	GFS	3	Yes	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-18	2	132	686	4	11	3	-	-	-	5 - 70m	-	GFS	71	Yes	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-19	2	31	207	1	1	2	-	-	-	100m	-	GFS	28	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-20	2	42	224	-	18	-	-	-	-	5 -10m	-	GFS	16	-	Yes	Yes	Jan - Apr	Yes		No	No
	H-21	2	55	284	1	3	3	-	-	-	100m	-	GFS	50	Yes	Yes	Yes	Dec - Mar	Yes		Yes	Yes
	H-22	3	40	335	-	2	-	-	-	-	150 - 200m	Apr - Jun	GFS		-	No	No	Jan - Feb	No	Yes	Yes	Yes
	H-23	2	39	209	-	4	1	-	-	-	50 - 60m	-	GFS	34	-	Yes	Yes	Jan - Feb	Yes	Yes	Yes	Yes
	H-24	2	74	426	-	3	6	-	-	-	50m	-	GFS	55	-	Yes	Yes	Dec-Mar	Yes	Yes	Yes	Yes
	H-25	2	117	658	-	15	6	-	-	-	10m	-	GFS	18	Yes	Yes	Yes	Jan - Feb	Yes	Yes	Yes	Yes
	H-26	1	60	318	-	5	-	-	-	-	5 - 30m	Apr - Jun	GFS	56	-	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	H-27	1	28	144	2	2	1	-	-	-	50 - 200m	Jun - Jul	GFS	2	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-28	1	103	535	-	27	-	1	-	1	5m	Apr - Jun	GFS	104	-	Yes	Yes	Jan-Apr	Yes		Yes	Yes
	H-29	1	98	219	1	9	1	-	-	-	10m	Apr - May	GFS	36	-	Yes	Yes	Jan - Mar	Yes		No	No
	H-30	1	60	340	1	-	-	-	-	-	100 - 200m	-	GFS	40	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-31	3	45	230	-	3	2	-	-	-	50 - 100m	May - Jun	GFS		-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-32	3	29	132	2	-	-	-	-	-	50 - 500m	-	GFS		-	Yes	Yes	Dec - Mar	Yes	Yes	Yes	Yes
	H-33	3	60	315	-	2	4	-	-	-	5 - 50m	-	Dug Well	58	Yes	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	H-34	3	149	783	-	-	11	-	1	-	10 - 70m	3-5 months	Borehole		Yes	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-35	3	109	589	1	-	6	-	-	-	5 - 100m	-	Borehole	46	-	Yes	Yes	Jan - Feb	Yes	Yes	Yes	Yes
	H-36	3	58	380	1	2	2	-	-	-	10 - 150m	-	Borehole		-	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	H-37	3	48	220	1	1	3	-	-	-	5 - 40m	May - Jun	Borehole		-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-38	3	71	467	1	1	3	-	-	-	200 - 500m	Feb - Jul	GFS	15	Yes	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	H-39	3	56	325	1	-	-	-	-	-	50 - 250m	-	GFS	6	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
Pha Oudom	P-1	1	84	445	1	2	1	-		-	150m	Mar - Jun	GFS	3	-	Yes	Yes	Jan - Feb	Yes	Yes	Yes	Yes
	P-2	0	59	307	1	4	3	-		-	10 - 200m	Mar - May	GFS	7	-	Yes	Yes	Jan -Mar	Yes	Yes	Yes	Yes
	P-3	0	55	310	1	1	3	-		-	100 - 150m	Apr - Jun	GFS	27	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	P-4	0	46	252	1	4	2	-		-	25 - 150m	Mar - May	GFS	7	-	Yes	Yes	Jan - Feb	Yes	Yes	Yes	Yes
	P-5	0	130	807	1	5	3	-		-	150m	3-5 Months	GFS	24	-	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	P-6	0	34	175	1	4	2	-		-	200m	-	GFS		-	Yes	Yes	Dec - Feb	Yes	Yes	Yes	Yes
	P-7	1	77	369	-	5	2	-		-	10 - 1,000m	Mar -May	GFS	7	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	P-8	1	61	327	-	19	1	-		-	25 - 30m	Mar - Jul	GFS	10	Yes	Yes	Yes	Sep - Mar	Yes	Yes	Yes	Yes
	P-9	1	37	363	-	-	1	-		-	20 - 25m	Feb - Jul	GFS		-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
Viengphoukha	V-1	3	28	168	1	-	-	-	-	-	10 - 1,000m	-	GFS		-	Yes	Yes	Jan - May	Yes	Yes	Yes	Yes
	V-2	2	27	478	1	-	-	-	-	-	50 - 400m	May - Jun	Borehole		-	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	V-3	3	43	376	-	-	-	-	3	-	5 - 500m	-	GFS		-	Yes	Yes	Jan - Feb	Yes		Yes	Yes
	V-4	3	96	668	-	-	-	2	1	-	10 - 200m	-	Borehole	1	Yes	Yes	Yes	Dec - Apr	Yes		Yes	Yes
	V-5	3	49	222	-	-	-	1	2	-	1,000m	-	Borehole		-	Yes	Yes	Dec - Apr	Yes	Yes	Yes	Yes
	V-6	3	34	175	1	-	-	-	-	-	25 - 70m	-	GFS		-	Yes	Yes	Mar - Apr	Yes	Yes	Yes	Yes
	V-7	3	109	444	1	7	-	-	-	-	130 - 150m	4 Months	GFS		-	Yes	Yes	Dec - Jan	Yes	Yes	Yes	Yes
	V-8	3	83	368	-	-	-	-	2	-	50 - 100m	-	GFS		-	Yes	Yes		Yes	Yes	Yes	Yes
Long	L-1	2	51	239	2	5	-	-	-	-	20 -100m	Mar - May	GFS	18	-	Yes	Yes	Jan -Mar	Yes		Yes	Yes
	L-2	2	67	317	2	8	-	-	-	-	5 - 1,000m	3 Months	GFS	8	-	Yes	Yes	Jan - Dec	Yes	Yes	Yes	Yes
	L-3	1	26	136	1	-	-	-	1	-	10 -20m	-	GFS		-	Yes	Yes	Feb - Mar	Yes		Yes	Yes
	L-4	0	53	304	2	1	-	-	-	-	25 - 300m	-	GFS	34	-	Yes	Yes	Mar - May	Yes	Yes	Yes	Yes
	L-5	1	179	308	1	-	-	-	-	-	15 - 300m	Mar - Jun	GFS	4	-	Yes	Yes	Jan - Mar	Yes	Yes	Yes	Yes
	L-6	1	39	198	1	-	-	-	-	-	40 - 250m	-	GFS	4	-	Yes	Yes	Nov - Jun	Yes	Yes	Yes	Yes
	L-7	2	280	280	1	-	-	1	-	-	100 150m	Jul - Sep	GFS		Yes	Yes	Yes	Dec - Apr	Yes		Yes	Yes
	L-8	2	53	330	1	2~3	-	-	-	-	20 - 200m	-	GFS	1	Yes	Yes	Yes	Nov - May	Yes	Yes	Yes	Yes
	L-9	2	40	157	1	2	-	-	-	-	90 -130m	-	GFS	5	-	Yes	Yes	Nov - May	Yes	Yes	Yes	Yes
	L-10	2	48	331	2	-	-	-	-	-	70 - 500m	-	GFS	2	-	Yes	Yes	Jan - Dec	Yes	Yes	Yes	Yes
	L-11	3	38	178	-	-	-	2	-	-	100 - 180m	5 Months	Dug Well		-	Yes	Yes	Dec - Apr	Yes		Yes	Yes
	L-12	2	24	68	-	2	-	-	-	-	80 - 200m	-	GFS		-	Yes	Yes	Nov -May	Yes	Yes	Yes	Yes
	L-13	2	27	107	1	-	-	-	-	-	50 - 150m	Feb - May	GFS		-	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	L-14	2	21	80	1	1	-	-	-	-	100 -150m	Feb - May	GFS		-	Yes	Yes	Dec - Apr	Yes	Yes	Yes	Yes
	L-15	2	49	253	1	6	-	-	-	-	5 - 200m	-	GFS	90	-	Yes	Yes	Nov - Apr	Yes	Yes	Yes	Yes
	L-16	1	31	148	1	-	-	1	-	-	150m	-	GFS		-	Yes	Yes	Dec - May	Yes		Yes	Yes
	L-17	3	41	195	1	-	-	-	-	-	15 - 500m	May - Oct	GFS	1	-	Yes	Yes		Yes	Yes	Yes	Yes
	L-18	3	35	135	2	-	-	-	-	-	180 - 1,500m	-	GFS		-	Yes	Yes	Nov - May	Yes	Yes	Yes	Yes
	L-19	3	17	70	1	-	-	-	1	-	50m	-	GFS		Yes	Yes	Yes	Jan - Apr	Yes	Yes	Yes	Yes
	L-20	3	19	84	2	-	-	-	-	-	10 - 60m	-	GFS		-	Yes	Yes	Nov - May	Yes	Yes	Yes	Yes
	L-21	2	50	316	1	1	-	-	-	-	150 -200m	-	GFS	3	-	Yes	Yes	Nov - May	Yes	Yes	Yes	Yes
	L-22	2	12	58	1	1	-	-	-	-	120 - 200m	-	GFS	1	-	Yes	Yes	Dec - Apr	Yes	Yes	Yes	Yes
	L-23	2	13	58	2	-	-	-	-	-	20 - 500m	-	GFS		-	Yes	Yes	Dec - Apr	Yes	Yes	Yes	Yes
	L-24	0	24	236	2	-	-	-	-	-	50 - 200m	-	GFS	4	-	Yes	Yes	Jan Apr	Yes	Yes	Yes	Yes
	L-25	3	27	102	-	-	-	1	-	-	150m	-	GFS		-	Yes	Yes	Dec - May	Yes	Yes	Yes	Yes

c. Sanitation Improvement

Concerning the construction of latrines as a means of improving sanitation conditions, 5 villages out of the 9 villages already have household latrines with support from donors. Four villages were supported by an NGO, CONCERN, where 167 latrines were constructed giving a latrine coverage rate ranging from 15 to 90%. While at one other villages, Nam Saat has supported latrine construction for 55 households giving that village 74% coverage. The households which presently do not yet have latrines in these 5 villages are strongly requesting the construction of additional latrines (about 22 to 100 latrines per village), and if these are completed these villages would have 100% latrine coverage. The requests for latrines from villages that presently have no latrines at all reveal an average of 31 latrines per village which means about 88% of the households want latrines. The amount of cash they are willing to pay for the latrine construction is between 5,000 and 20,000 Kips per household. Also the villagers replied that they would provide labor and construction of the above ground shack would be done by themselves. Therefore, the outputs of this study could be the latrine bowl, cement and reinforcing bars, along with technical support. The type of latrine mostly requested by the villagers is the pour flush bowl single pit latrine, which implies that a sufficient water supply is an absolute prerequisite for this type of latrine.

2) Situation at Poung Village (H-1) in Houayxai District of Bokeo Province

Ban Poung has a dispensary. The dispensary use to receive medical goods from the Bokeo Provincial Hospital, but in 1997, this support was ended. Therefore, using contribution from each household, a medial fund of 300,000 Kips was established at this village. The fund was entrusted to the dispensary, and with this fund necessary medical goods are procured and supplied to the villagers. The villagers pay according to their ability to pay to keep the fund operating. This system has spread out to include 13 villages. Of the 13 villages, 6 villages are included as target villages for this Study.

Presently, about half of the villagers have access to hand dug wells and latrines. In 1995, UNICEF supported a project to construct latrines to 83 households, and each household contributed 6,000 Kips. The cash amount was used to pay per diems to the technicians and offset transportation costs of materials procured by UNICEF. The facilities were completed in about one month. On the other hand, concrete lined shallow wells with roofs were constructed in 1986 supported by an NGO, CONCERN. The well depths were about 10 m, with static water levels at 7-8 m. According to the village field survey for this Study, the villagers selected the GFS as their water supply scheme. The water source for this scheme is a stream located about 1.5 km from the village, and water quantity and quality are appropriate for their use.

3) Situation at 9 Villages (P-1 to P-9) in Pha Oudom District of Bokeo Province

a. Existing Water Source

The presently used water sources are traditional hand dug wells, concrete lined shallow wells and river water, in that order. Out of the 9 villages, only one village replied that they have a stable supply of water all year round. The other 8 villages said they cannot get enough water in the dry season from February to July. In the rainy season, water can be reached at 10 to 30 m away from their houses, but during the dry season, they must travel 1,000 to 1,500 m to fetch their water.

b. Water Supply Improvement

All of the villagers of these 9 villages selected the GFS for their water supply and they are willing to pay from 4,000 to 30,000 Kips per household for the construction of the facilities. Labor will also be provided during the construction period, where 5 to 241 persons per day can contribute to the work during their off-farming season from December to April. Materials such as sand and wood would be contributed as needed. Maintenance will be carried out by forming new water committees following their experience of water committee

organization for concrete lined shallow wells supported by EU and Nam Saat. After concluding an agreement, the villagers replied that they are willing to pay monthly water fees of 100 to 10,000 Kips per household.

Accessibility for transportation of materials during construction would present problems for this area. Crossing the Namtha river to reach these villages might become a problem during the rainy season. The crossing point has no bridge and in April 1999, which is in the dry season, the river width was about 60 m with depths of 20-30 cm. The situation is predicted to be worse in the rainy season. Using a boat might be a solution, but the landing place is Ban Pakhat where the materials must again be transported from there to the villages.

c. Sanitation Improvement

Concerning sanitation improvement, 5 villages out of the 9 villages presently possess 83 latrines with the support of EU. The villagers in these five villages who do not yet have latrines as well as those villages, which have no latrines at all, are requesting the construction of latrines. The required number ranges from 39 to 83 depending on the village which would contribute to attaining 100% latrine coverage for these villages. Contributions for the latrine construction consist of cash ranging from 10,000 to 20,000 Kips per household, labor force and construction of above ground shacks. The requested type is the pour flush bowl single pit latrine, which requires sufficient water supply as prerequisite.

4) Situation at 2 Villages (L-1 and L-2) in Long District of Luang Namtha Province

Before this study started, accessibility to the center of Long District from Luang Namtha took almost 5 hours. However, thanks to a World Bank supported road rehabilitation project, the access time is now about 3.5 hours, and when a bridge is completed this can be reduced to less than 3 hours.

Two of the target villages, Xieng Kok Mai (L-1) and Xieng Kok Kao (L-2), have much in common, being new and old villages. Their choice of water source for both villages is the GFS using one source in common between the two villages.

A case study was made for a village which received both the GFS and latrines at the same time. In 1998, UNICEF and Nam Saat supported construction of latrines at 27 households out of the total of 45 households. The project procured the materials, and the villagers provided labor, wood and sand along with 5,000 Kips in cash. The cash was contributed as a village fund, but through the idea of Nam Saat District doctors, this would be used as a sanitation improvement fund to buy medicines when needed. This concept is not actually working and needs further guidance and development.

5) Situation at 4 Villages (V-4 to 7) in Viengphoukha District of Luang Namtha Province

Out of the 4 example villages, some villages chose boreholes for their water supply. Therefore these villages were resurveyed, and revealed that borehole drilling cannot be carried out at these villages since they are situated on mountaintop ridges. However, an alternative is to pump up spring water flowing in the deep valley using a motorized pump. According to the villagers, many donors and NGOs have surveyed the villages with no results. The villagers are willing to pay 15,000 Kips per household for water supply facilities and 10,000 Kips per household for latrines.

An UNICEF/Nam Saat supported village which constructed latrines along with the GFS was surveyed. Communal taps were constructed at 4 locations in the village and the villagers paid 140,000 Kips for this construction. A volunteer who can repair a broken tap at 50 Kips per household presently manages the water committee. All 47 households of the village constructed latrines. The villagers contributed labor, wood and sand. Although cash was not contributed, accommodations and food to the technical supervisors were provided during the work. Other materials were

procured by ADRA, an NGO. A sanitation committee is established but livestock feces can be found around the village implying the necessity for further education on sanitation and hygiene.

4.5 Water Quality

Through the village field survey, the survey teams carried out water quality analyses for existing and available water sources. Though some analyses were conducted at the sites, water samples were collected for analysis at the laboratory in Vientiane.

At the survey sites, the following water quality analysis items were carried out using survey equipment supplied by JICA.

(1) Water temperature
(2) Dissolved Oxygen
(3) pH
(4) Electric Conductivity
(5) Turbidity
(6) Chlorine
(7) Color and odor
(8) Total coliform group count

The Table in the following page shows the drinking water quality standards authorized by Nam Saat, and these are compared with the standards of Nap Papa Lao, WHO and Japan. Water samples from existing and available water sources were collected and carefully analyzed in the laboratory. The water quality analysis results for the study sites are shown in the following page. Some of the sites indicate water contamination in ammonium, nitrate, nitrite and coliform count. However, some of these contaminations could have originated from poor sampling practices at the sampling sites. Therefore, during the Pilot Study, the selected future water sources were properly sampled and carefully examined (Refer to the next Chapter on Water Source Development Plan for the result of water quality analyses for the Pilot Study villages).

Table 4-3 Drinking Water Quality Standards

Parameter	Unit	Nam Saat	Nam Papa	WHO	Japan
Physiochemical Parameters (Aesthetic Significance)					
Turbidity	NTU	5	5	5	2
Colour	TCU	5	5	15	
Taste and Odour		Acceptable	Not Offensive	Acceptable	
pH		6.5 - 8.5	6.5 – 8.5	6.5 – 8.5	5.8 - 8.6
Temperature	℃	25 - 35		Acceptable	
Conductivity	μS/cm	1,200			—
Total Dissolved Solids	mg/l	600	1,000	1,000	500
Total Hardness ($CaCO_3$)	mg/l	300	500	500	300
Copper (Cu)	mg/l	1.0	1.0	2.0	1.0
Iron (Fe)	mg/l	0.4	0.3	0.3	0.3
Manganese (Mn)	mg/l	0.5	0.1	0.5	0.05
Chloride (Cl^-)	mg/l		250	250	200
Sodium (Na)	mg/l	250	200	200	200
Sulphate (SO_4^{2-})	mg/l	250	250	200	200
Hydrogen Sulphide (H_2S)	mg/l	0.1		0.05	
Aluminum (Al)	mg/l			0.2	0.2
Zinc (Zn)	mg/l		3.0	3.0	1.0
Residual Chloride	mg/l	0.2−0.5		0.5	>0.1
Health Significant Chemical Parameters					
Antimony (Sb)	mg/l	0.05		0.005	0.002
Arsenic (Ar)	mg/l	0.01	0.05	0.01	0.01
Barium (Ba)	mg/l	0.07		0.7	—
Boron (B)	mg/l	0.3		0.3	0.2
Cadmium (Cd)	mg/l	0.003	0.01	0.003	0.01
Chromium (Cr^{6+})	mg/l	0.05	0.05	0.05	0.05
Cyanide (CN^-)	mg/l	0.07	0.07	0.07	0.01
Fluoride (F^-)	mg/l	1.0	1.0	1.5	0.8
Lead (Pb)	mg/l	0.01	0.05	0.01	0.05
Mercury (Hg)	mg/l	0.001	0.001	0.001	0.0005
Nitrate (NO_3-N)	mg/l	40	10	50	10
Nitrite (NO_2-N)	mg/l	2	1	3	
Selenium (Se)	mg/l	0.01	0.01	0.01	0.01
Bacteriological Parameters					
Faecal Coliform	No./100 ml	0	0	0	0
Total Coliform	No./100 ml	10	0		

NB: NTU=Nephelometric turbidity unit
TCU=Time colour unit

Table 4-4 Water Quality Analysis Results of Existing Sources in Study Target Villages

Province	District	No.	Village Name	Source	pH	Turb. NTU	NH_4-N mg/l	NO_2-N mg/l	NO_3-N mg/l	Cl^- mg/l	SO_4^{2-} mg/l	T-Hardness mg/l $CaCO_3$	Fe mg/l	Mn mg/l	F^- mg/l	Coliform N/100ml
Bokeo	Houayxai	H-1	Poung	Stream	6.9	10	ND	ND	ND	7.4	ND	85	0.03			9
		H-2	Phokham	Stream	7	2	0.04	ND	ND	7.4	ND	42	0.07	ND	ND	13
		H-3	Nam Ngao	Dugwell	6.5		ND	ND	ND		ND			ND	ND	
		H-4	Houai Makkeo	Dugwell	6	11	0.11	0.04	6.3	3.7	ND	36	ND	ND	ND	14
		H-5	Done Phao	Stream	6.2	10	ND	ND	ND	0.7	ND	73	0.05			
		H-6	Nam Deua	Stream	7.2	18	ND	ND	ND	3.7	ND	87	0.05	ND	0.1	6
		H-7	Namma	Stream	7.1	70	0.1	ND	ND	9.6	ND	71	0.24	ND	0.1	0
		H-8	Nampou	Stream	7	1	0.38	ND	1.5	8	33	106	ND	0.2	ND	6
		H-9	May Phattana	Dugwell	7		ND	ND	ND		ND		ND	ND	ND	
		H-10	Phousene	GFS Tap	8	2	0.61	ND	12.5	4	24	92	0.03	0.2	0.1	
		H-11	Bolek	Stream	7	0	0.91	ND	1.7	15	26	105	ND	0.1	0.2	
		H12 to H-16	5 Villages (1 Scheme)	Stream	8	2	0.51	ND	12.7	9	28	72	0.04	0.1	0.3	9
		H-15	Namtoi		7.1		ND	ND	ND	2.2	ND	129	ND			
		H-17 to H-25	9 Villages (1 Scheme)	Stream	7.9	33	0.06	ND	ND	15	ND	102	0.09	0.04		8
				Dugwell	7.4		ND	ND	ND	5.2	ND	89	0.08	ND		
		H-28	Pakhaotay	Stream	8.5	4	ND	ND	ND	19.6						6
		H-29	Thongbia		7.4		ND	ND	ND	5.2	ND	89	0.08	ND		
		H-31	Done Keo	Stream	7.1	5	ND	ND	ND	ND	ND	83	ND			
		H-32	Hat Phouan	Stream	7	5	ND	ND	ND	ND	ND	81	0.03		ND	
		H-33	Nampouktay	Dugwell	6.1		ND	ND	ND	13.2	ND	29	ND	ND	ND	
		H-34	Nampoulkang	Dugwell	6.4	14	ND	ND	1	21.3	8	61	ND	ND	ND	8
		H-35	Done Xay		7	1	0.24	ND	6.6	6	22	110	ND	0.2	ND	8
		H-36	Nam Samoktay		6.2	12	ND	ND	3.8	14.7	ND	47	ND	ND	0.1	9
		H-37	Leang		6.1	12	ND	ND	ND	8.8	ND	18	ND	ND	0.2	11
		H-38	Done Xavanh	Stream	7	1	0.46	ND	ND	6	22	180	0.04	0.1	0.2	10
		H-39	Nam Saen		7.1	7	ND	ND	ND	ND	ND	75	0.04			
	Pha Oudom	P-1 to P-9	9 Villages (1 Scheme)	Stream	7.6	13	ND	ND	ND	13	9	192	0.34	0.08		
					7	2	0.18	ND	ND	1	16	85	ND	ND	0.2	
Luang Namtha	Vieng-phoukha	V-1	Nam Mai	Stream	6	3	0.18	0.09	2	0.6	7	75	0.25	ND	0.2	12
		V-2	Nam Paman	Stream	6.5	8	0.21	ND	1.3	3	2	69	0.03	0.3	ND	
		V-3	Donmay	Stream	7	0	0.41	ND	1.6	3	4	82	ND	0.02	ND	
				Borehole	7	2	0.15	ND	0.6	2	2	200	0.03	ND	ND	
		V-4	Namphae	Spring	6.5	19	0.09	ND	1.1	12	ND	49	0.19	0.05	0.2	
		V-5	Phoulan	Spring	6.6	5	ND	ND	ND	11	ND	98	ND	ND	0.1	5
		V-6	Pangxai	Stream	7.6	7	ND	ND	ND	7.3	ND	164	0.04		ND	
		V-7	Sakon/Layloth	Stream	7.5	1	ND	ND	ND	6.6	ND	130	0.14		ND	
		V-8	Namseua		7.4	9	ND	ND	ND	5	ND					
	Long	L-1	Xiengkok May	Dugwell	5	19	0.63	2	1.8	0.6	7	33	ND	0.1	ND	13
				Stream	6	1	0.1	1	2.5	5	ND	41	ND	ND	0.1	
		L-2	Xiengkok Kao	Dugwell	5.7	7	ND	ND	ND	13		76	ND		ND	
				Stream	6	2	0.1	ND	0.2	0.4	14	58	ND	ND	0.1	1
		L-3	Pang An	Spring	6.4	0	0.1	ND	1.3	0.7	3	54	0.25	ND	0.4	7
				Stream	6.4	4	1.4	0.04	0.9	0.9	ND	51	0.18	ND	0.2	
		L-4	Luang	Stream	7.8	4	ND	ND	ND	80	ND					5
		L-5	Don Savang	Stream	6.5	4	0.71	ND	1.7	1	ND	71	ND	ND	ND	18
		L-6	Nong Kham	Stream	6.5	3	0.75	ND	0.7	2	ND	85	0.07	0.2	0.4	
		L-7	Nam Bak	Spring	8.2	9	ND	ND	ND	100	ND		ND	ND		10
		L-8	Luang Phokhan	Stream	6	3	ND	ND	1	0.8	ND	85	ND	ND	0.3	
				Dugwell	7	0	0.32	0.02	0.6	0.6	2	83	ND	0.4	0.2	
		L-9	Phaya Luang	Stream	7.8	11	ND	ND	ND	3.6	ND	90	0.08	ND	0.2	
		L-10	Sivilay	Stream	6.8	3	1.06	ND	1.1	0.7	ND	96	0.15	ND	0.3	
		L-11	Nam Ma	Stream	7	7	0.32	ND	1.4	3	ND	73	ND	0.2	0.4	22
		L-12	Hoai Mo	Dugwell	7.5	7	2.75	ND	0.8	1.5	ND	111	0.03	0.2	0.8	2
		L-13	Chakhamping		5	11	0.06	ND	1.2	1	65	52	ND	0.2	0.2	104
		L-14	Khok Hin		6	9	ND	ND	1	3	ND	19	ND	0.1	ND	10
		L-15	Tin That	Stream	6.8	7	2.28	0.05	0.7	0.8	2	91	ND	0.03	0.2	28
		L-16	Phatae Kao		6.5	12	0.35	ND	0.7	1	ND	66	0.05	0.2	ND	12
				Spring	7.5	5	0.14	ND	1.4	3	36	69	0.03	0.1	ND	
		L-17	Silimoun		8.9	17	ND	ND	ND	160	ND		0.03	0.2	ND	17
		L-18	Pheo Yae		7	6	ND	ND	0.6	2	12	140	0.03	0.3	ND	8
		L-19	Cha Yi	GFS Tap	6	6	0.58	ND	1.1	2	ND	51	0.06	0.4	ND	
				Stream	7	10	0.19	ND	0.6	1	2	167	ND	0.3	0.3	22
		L-20	Khalung	Spring	6	1	ND	0.05	2.2	1	3	51	0.27	ND	0.1	
				Stream	6.5	6	2.75	ND	1	3	9	94	0.03	0.2	ND	
		L-21	Daen Kang	Dugwell	7.9	2	ND	ND	ND	150	ND					65
		L-22	Namoun	Stream	7	0	0.22	0.09	0.4	1	42	132	0.03	ND	0.3	6
		L-23	Kang	Stream	7	9	0.17	ND	0.8	2	ND	83	ND	0.3	0.3	10
				Dugwell	7	44	0.93	ND	0.6	6	33	126	0.05	0.1	1.3	
		L-24	Paxang	Stream	6	16	1.31	ND	0.2	3	ND	40	0.04	0.3	0.2	83
		L-25	Phataemay	Spring	6	9	2.31	0.07	0.6	3	ND	23	0.04	ND	ND	3

ND: Not detected

CHAPTER 5. DEVELOPMENT PLANS

5.1 Water Source Development Plan

5.1.1 Water Source Options

1) Topographical Zones

Considering the available water resources for water supply in the Study area such as groundwater and surface water, we must take careful attention to the natural environment. Based on the field survey, the topography of the study area can be classified into four zones as listed below. The characteristics of these zones are also shown in the table below.

Table 5-1 Characteristics of Topographical Zones

Parameter	Alluvial Fan Zone	River Terrace Zone	Mountainous Basin Zone	Steep Mountain Zone
Area	Houayxai, Pha Oudom	Long, Viengphoukha	Luang Namtha, Sing	Bokeo, Luang Namtha
Formation	Alluvial and Diluvium deposits consisting of sands, silts, gravel and clay			Sedimentary rocks ranging from Silurian and Devonian periods of Paleozoic era to Triassic and Cretaceous periods of Mesozoic era, and also intrusive rocks of granodiorite and granite of Carboniferous to Permian periods of Paleozoic era
Elevation	350 m to 500 m	550 m to 750 m	520 m to 850 m	900 m to 1,180 m
Available Water Resources	Groundwater			Spring water and rivers

2) Surface Water

Nam Tha River is the main river in the study area, which originates from Luang Namtha Province, flows from northeast to southwest into the Mekong River passing through Bokeo Province. Other rivers in the study area include Nam Ma, Nam Ngam, Nam Ho and Nam Tin rivers which all flow from northeast to southwest terminating into the Mekong River. The water sources possible for use as sources for the target villages are further tributaries of these rivers or springs. In the past, the rivers had stable base flow with abundant quantity and good quality owing to abundant rainfall and protected by deep forests. However, the recent deforestation activities in upstream areas and slash and burn farming

have contributed to the decrease in flow rates of the water resources. The decrease in river base flow in the dry season and increase of turbidity due to topsoil outflow in the rainy season are causing environmental problems in water quality and quantity.

3) Groundwater

Groundwater can be found as unconfined and confined aquifers in the riverbank terraces of Viengphoukha and Long Districts where villages have settled along the river; the inland basins of Luang Namtha, Sing and Pha Oudom Districts; and the Alluvial fan of lowlands of Houayxai District. However, it is reported that the confined groundwater in both Luang Namtha and Bokeo Provinces has problems with water quality and cannot be used as drinking water in some areas. As for unconfined groundwater, it is being drawn from traditional hand dug wells and concrete lined shallow wells having depths of a few meters to 10 m or so with static water levels of a few meters, and water is fetched by hand using buckets. These wells are supplying drinking and domestic water to the villagers in many areas. While the water quality of unconfined groundwater is good and water can be fetched easily, quantity can become a problem in the dry season and also these type of wells are easily contaminated by human sources, and therefore proper construction techniques, sanitary control and careful maintenance are necessary.

5.1.2 Water Intake Options

1) Supply Possibilities

Presently, the existing water sources for villagers in the target area are mainly river water and groundwater through wells as follows.

(1) Traditional hand dug well
(2) Concrete lined shallow well with cover
(3) River and stream water
(4) Protected spring water
(5) Borehole

The possible sources and supply facilities for the villages are presented below.

Table 5-2 Water Source and Supply Possibilities

Priority	Source	Supply Facility	Conditions
1st	Springs and rivers	GFS	Depends on geographic and topographic conditions
2nd	Groundwater	Dug well or borehole with handpump	Limited area dependant on hydrogeological conditions
3rd	Springs and rivers	Protected spring, Infiltration gallery	If groundwater potential is low and GFS is topographically difficult; Inconvenience in fetching water
4th	Rivers	Pumping up to village with motorized pump	More convenience in fetching water than 3rd priority, but high financial and technical requirements for operation and maintenance
5th	Groundwater	Borehole with motorized pump	Suitable for populated villages; High financial and technical requirements for operation and maintenance
6th	Rainwater	Rainwater collection	If no other source is available

2) Intake Facilities

a) GFS Intake

The intake structures for GFS schemes are made of concrete with three components. The stream water first passes through a bed of gravel and sand as a filter unit, and then enters the next tank for adjustment and sedimentation. The water from the second compartment goes through a pipe screened at the inlet which crosses the second compartment with a series of valves and an air release out to the transmission main. There is also a drainage valve to clean out the second tank. This structure assures clean water to be supplied through the tapstands.

b) Handpump

For dug wells and boreholes, handpumps are installed for convenience in pumping up the water. The various handpumps installed for the pilot study are compared in the following table. From the responses given by the villagers, the rope pump Lao-99 seems to be the most favored type among the three types. The reasons given for this response are the comfortability of turning the handle and easiness of repairing.

Table 5-3 Comparison of Handpumps used in Pilot Study

Parameter	Rope Pump Lao-99	Tara	Afridev
Origin	Lao PDR	India	India
Initial Cost	Low	Medium	Medium (higher than Tara)
Handle Operation	Vertical Rotation	Vertical Push-Pull	Lever Action
VLOM Possibility	Very High	High	High
Spare Parts	Easily procured locally	Limited availability in remote areas	Limited availability in remote areas
Gender Consideration	Easily handled by all	Low handle position can strain lower belly muscles for pregnant women, middle-aged women as well as aged women with many delivery experiences	Easily handled by all

c) Other Possibilities

GFS is the most preferred water supply scheme as chosen by the rural population, followed by wells using handpumps. However, if the conditions do not allow for using GFS or handpumps, other methods must be sought. Some alternatives to the above intake facilities are listed below.

Table 5-4 Other Water Supply Alternatives

Situation	Option	Disadvantage
Stream intake point lower than village, and located within reasonable distance	Protected spring	Inconvenience in fetching water due to location of facility
	Pumping up to village with motorized pump	High requirements for operation and maintenance
Borehole drilling in village difficult due to geographical reasons	Dug well outside of village	Inconvenience in fetching water due to distance from village
	Pumping up to village with motorized pump from borehole or dug well outside of village	High requirements for operation and maintenance
Surface water not available and groundwater difficult to develop	Rainwater collection	Requires sufficient annual rainfall, and year round availability is preferable; Requires durable collection structure

5.1.3 Water Source Development

1) Selection of Water Source

The water source to be used for supplying water to the village is determined through community dialogue with the villagers and using the concept of informed choice. The villagers know what sources are available for them to use. If a stream up on the mountain is available, then they most often select this as their source for a GFS scheme. If a village has an existing water supply facility such as a dug well, then they usually want a GFS if possible, but if there is no stream available, they request a borehole. However, for some target villages which chose boreholes, the hydrogeological conditions revealed difficulties for groundwater development in their villages.

Upon selection of the water source by the villagers, survey of the water source is required to determine its potential and appropriateness. For the GFS, topographic surveys using hand levels were made to assess the height difference between the source and the supplying village, and also the distance from the source to the village, as well as the topographical structure of the proposed pipeline route. For groundwater sources, their availability and potential must be surveyed by such methods as geoelectric prospecting.

2) Water Source Confirmation

a) Stream or River

The source of water for the gravity fed system (GFS) is a stream or river up on the mountain. The flow rates of these sources are usually abundant in the rainy season, but sometimes become insufficient in the dry season. The sources of the GFS for the Pilot Study have enough water all year round, except for the source to supply the Pha Oudom scheme.

If the source is insufficient, as is in Pha Oudom, the residents of the village must make all efforts to (1) conserve the forest around the intake so that the source will not be depleted (which means no slash and burn around the intake point), (2) conserve their daily use of water in order for everybody to receive water for a long time, and (3) plan a water fetching time schedule to minimize queuing and to avoid simultaneous tap opening (which can cause problems in water shortage at certain taps).

b) Dug Well

In the past, dug well points were selected using experience and intuition, but many have failed. Therefore for the pilot study, geoelectric prospecting was carried out to scientifically determine the depths of the aquifer and bottom rock layers using electric resistivity measurements. These data were used to make selection of possible well points. Prediction of the depth of the bottom rock layer by geoelectric prospecting greatly increases the success rate of dug wells. Use of this method is highly recommended to improve the chances of a successful dug well.

c) Borehole

Similar to the dug well, geoelectric prospecting is highly recommended but it is even more important for boreholes because of greater uncertainties. In order to increase the chances of a successful drilling, test boring is also advised. Then, after a well is sunk, the groundwater flow must be confirmed by making a pumping test to assure the groundwater potential. Another important factor for a successful well, both borehole and dug well, is to analyze the water for its quality to verify its compliance with drinking water standards.

5.1.4 Water Quality and Quantity

1) Quality

The attached table shows the results of water quality analyzed at the laboratory in Vientiane, which reveal that there are no serious water quality problems for any of the pilot study water sources. However, the groundwater of the boreholes had undesirable odor believed to be caused by biological effects of the geology. Three important parameters for consideration in the assessment of water quality are reviewed below.

Turbidity

The seasonal changes in turbidity of the streams are important indicators to assess the water sources. The turbidity ranged from 3.1 to 29.3 NTU in November 1999, just after the rainy season as was expected. The three samples from (H-17 to H-25) Houayxai 9 villages, (L-15) Tin That and (L-21 and L-12) Daen Kang/Hoai Mo indicated turbidity values above the Nam Saat water quality standard of 5.0 NTU in November 1999. However, for the samples from the next survey in January 2000, the turbidity recovered within the standard, ranging from 0.2 to 3.9 NTU.

Table 5-5 Water Quality Analysis Results of Pilot Study Water Schemes

No.	Village Name	Sampling Date	pH	Turb. NTU	Cond. μ S/cm	NO_2-N mg/l	NO_3-N mg/l	Cl- mg/l	SO_4^{2-} mg/l	T-Hardness mg/l $CaCO_3$	Fe mg/l	Mn mg/l	Cu mg/l	F- mg/l	Pb mg/l	As mg/l	Cr^{6+} mg/l	Cd mg/l	Coliform N/100ml
GFS (Gravity Fed System)																			
H-1	Poung	18-Nov	8.0	3.1	72	<0.02	0.08	3.9	<2.0	72	0.19	0.05	<0.02	0.20	<0.002	<0.005	-	-	15
		11-Dec	7.8	1.6	98	<0.01	<0.10	3.5	<2.0	90	0.08	0.03	<0.10	0.12	<0.002	<0.004	<0.05	-	23
		7-Feb	6.9	1.1	79	<0.01	<0.10	7.0	<2.0	56	<0.03	<0.02	<0.10	0.17	<0.002	0.004	<0.05	0.003	6
		12-Jun				<0.01	0.19	1.5	<2.0	44	<0.03	<0.01	<0.005	0.11	0.007	<0.005	<0.05	<0.002	23
H-7	Namma	14-Jan	7.7	1.3	117	<0.01	0.08	2.9	2.0	105	0.10	<0.02	<0.10	0.19	0.030	<0.004	<0.05	-	8
		8-Feb	7.4	1.3	130	<0.01	<0.10	<1.0	<2.0	91	<0.03	0.03	<0.10	0.20	<0.002	<0.004	<0.05	0.003	20
		12-Jun				<0.01	0.22	<1.0	<2.0	102	0.13	<0.01	<0.10	0.05	0.006	<0.005	<0.05	<0.002	15
H-17 to H-25	Houayxai 9 Villages	18-Nov	7.9	29.3	83	<0.01	0.08	3.5	<2.0	88	0.77	0.06	<0.02	0.30	0.007	<0.005	-	-	8
		13-Jan	7.5	3.9	94	<0.01	0.07	<1.0	3.0	105	0.03	0.02	<0.10	0.19	0.010	<0.004	<0.05	-	80
		24-Feb	7.6	5.0	103	<0.01	0.20	<1.0	<2.0	84	0.12	0.04	<0.10	0.10	0.003	<0.004	<0.05	<0.002	6
		13-Jun				<0.01	0.22	<1.0	<2.0	70	0.23	<0.01	<0.10	0.27	0.010	<0.005	<0.05	0.003	14
H-31	Done Keo	13-Jan	7.4	1.7	68	<0.01	0.12	3.6	<2.0	65	<0.03	<0.02	<0.10	0.10	<0.002	<0.004	<0.05	0.003	9
		23-Feb	7.7	2.6	88	<0.01	0.12	2.2	<2.0	71	<0.03	<0.02	<0.10	0.10	0.004	<0.004	<0.05	<0.002	7
		13-Jun				<0.01	0.27	1.5	<2.0	44	0.08	<0.01	<0.10	0.17	0.020	<0.005	<0.05	<0.002	14
H-32	Hat Phouan	26-Jan	7.7	1.6	55	<0.01	0.17	1.5	<2.0	44	0.12	0.03	<0.10	0.20	0.030	<0.005	<0.05	0.003	5
		23-Feb	7.5	2.3	76	<0.01	<0.10	11.0	<2.0	53	<0.03	<0.02	<0.10	0.10	0.007	<0.004	<0.05	<0.002	20
		11-Jun				<0.01	<0.01	0.7	<2.0	40	0.11	<0.01	<0.10	0.30	0.010	<0.06	<0.05	<0.002	43
P-1 to P-9	Pha Oudom 9 Villages	17-Nov	8.1	4.2	198	<0.01	<0.10	5.0	<2.0	180	0.06	0.04	<0.02	0.32	0.014	<0.005	<0.05	-	3
		11-Jan	7.7	0.5	202	<0.01	0.13	2.2	7.0	172	0.09	<0.02	<0.10	0.10	<0.002	<0.004	<0.05	0.003	9
		16-Feb	7.7	1.5	231	<0.01	<0.01	3.6	15.0	185	<0.03	<0.02	<0.10	0.10	0.008	<0.004	<0.05	<0.002	43
		15-Jun				<0.01	<0.005	<1.0	<2.0	114	0.03	<0.02	<0.10	0.17	0.030	<0.005	<0.05	<0.002	23
V-6	Pangxai	13-Nov	8.2	3.8	91	<0.01	0.07	3.5	<2.0	118	<0.03	<0.03	<0.02	0.62	0.021	<0.05	-	-	20
		9-Jan	7.6	2.9	131	<0.01	0.19	4.4	<2.0	132	0.10	<0.02	<0.10	0.34	<0.002	<0.004	<0.05	-	23
		8-Feb	7.8	1.5	157	<0.01	<0.10	1.5	<2.0	127	<0.03	0.02	<0.10	0.23	<0.002	<0.004	<0.05	<0.002	11
		26-Jun	6.9			<0.01	0.22	<1.0	<2.0	50	<0.03	<0.01	<0.01	0.21	0.010	<0.004	<0.05	<0.002	13
V-8	Namseua	9-Jan	7.2	1.0	45	<0.01	0.15	2.2	<2.0	53	0.20	0.02	<0.10	0.10	0.004	0.004	<0.05	0.003	68
		11-Feb	7.1	2.1	61	<0.01	<0.10	14.0	<2.0	42	0.03	<0.02	<0.10	0.10	0.020	<0.004	<0.05	<0.002	43
		27-Jun	7.0			<0.01	0.15	<1.0	<2.0	21	0.08	<0.01	<0.01	0.10	0.020	<0.004	<0.05	<0.002	43
L1 & L-2	Xiengkok Mai / Xiengkok Kao	10-Nov	7.6	3.6	63	<0.01	<0.05	4.3	<2.0	46	0.09	0.03	<0.02	0.30	0.019	<0.005	-	-	3
		13-Dec	7.2	1.0	65	<0.01	<0.10	3.7	<2.0	76	<0.03	<0.02	<0.10	0.10	<0.002	<0.004	<0.05	<0.002	49
		9-Feb	7.4	0.8	84	<0.01	<0.10	2.9	4.0	44	0.05	<0.02	<0.10	0.11	<0.002	<0.004	<0.05	<0.002	12
		25-Jun	7.1			<0.01	0.18	<1.0	<2.0	44	0.05	<0.01	<0.10	0.15	0.008	<0.005	0.005	<0.002	33
L-4	Luang	11-Nov	7.6	2.8	88	<0.01	0.27	1.4	<2.0	74	0.05	<0.02	<0.02	0.21	<0.002	<0.005	-	-	5
		8-Jan	7.5	0.6	96	<0.01	0.13	2.9	3.0	74	0.06	0.02	<0.10	0.58	0.030	0.006	<0.05	0.002	7
		18-Feb	7.5	5.5	119	0.05	<0.10	7.3	<2.0	90	<0.03	<0.02	<0.10	0.10	0.005	<0.004	<0.05	<0.002	23
		24-Jun	7.0			0.02	0.17	0.7	<2.0	53	0.34	0.10	<0.10	0.15	0.045	0.005	<0.05	0.002	43
L-13	Chakhamping	11-Nov	7.3	7.8	61	<0.01	0.21	3.5	<2.0	60	<0.03	0.02	<0.02	0.14	0.004	<0.005	-	-	10
		8-Jan	7.4	1.4	76	<0.01	<0.10	1.4	<2.0	53	0.40	0.02	<0.10	0.10	<0.002	<0.004	<0.05	-	17
		18-Feb	7.4	3.0	94	<0.01	<0.10	7.4	<2.0	55	<0.03	<0.02	<0.10	0.10	0.008	<0.004	<0.05	0.004	43
		24-Jun	6.4			<0.01	0.20	<1.0	<2.0	32	<0.03	<0.01	<0.10	0.10	0.010	<0.005	<0.05	<0.002	23
L-15	Tin That	11-Nov	7.8	16.7	107	<0.01	0.15	2.8	<2.0	104	0.08	0.07	<0.02	0.25	<0.002	<0.005	-	-	3
		19-Jan	7.4	0.2	103	<0.01	0.10	2.9	<2.0	90	0.04	0.02	<0.10	0.10	0.010	<0.005	<0.05	0.003	5
		9-Feb	7.5	0.8	135	<0.01	<0.10	<1.0	<2.0	92	0.03	<0.02	<0.10	0.12	<0.002	<0.004	<0.05	0.003	16
		24-Jun	7.0			<0.01	0.13	<1.0	<2.0	71	0.04	<0.01	<0.10	0.12	0.009	<0.005	<0.05	<0.002	23
L-21 & L-12	Daen Kang / Hoai Mo	11-Nov	7.9	11.6	113	<0.01	0.09	8.5	<2.0	114	<0.03	0.06	<0.02	0.33	0.012	<0.005	-	-	2
		18-Jan	7.5	0.2	132	<0.01	0.10	3.7	<2.0	126	<0.03	<0.02	<0.10	0.10	0.030	<0.005	<0.05	<0.002	2
		10-Feb	7.8	1.8	174	<0.01	<0.10	<1.0	<2.0	124	0.10	<0.02	<0.10	0.20	<0.002	<0.004	<0.05	<0.002	10
		24-Jun	7.1			<0.01	0.21	<1.0	<2.0	59	0.41	0.02	<0.10	0.20	<0.002	<0.005	<0.05	0.004	43
Dug Well and Borehole																			
H-3	Nam Ngao	#1 1-Mar	6.1	0.3	170	<0.01	10.00	1.6	2.4	64	<0.03	<0.02	<0.02	0.10	<0.002	<0.001	0.01	<0.001	7
		#1 11-Jun				0.20	4.90	8.1	<2.0	72	<0.03	<0.02	<0.10	0.41	0.004	<0.005	<0.05	<0.002	0
		#2 1-Mar	6.3	50.0	248	0.08	26.00	14.0	12.0	88	0.70	<0.02	0.02	0.10	<0.002	<0.001	<0.05	<0.001	6
		#2 11-Jun				<0.01	7.10	11.2	<2.0	118	<0.03	0.02	<0.10	0.24	0.005	<0.005	<0.05	<0.002	23
H-9	May Phattana	1-Mar	7.1	50.0	657	<0.01	0.40	1.2	145.0	325	0.09	<0.02	0.02	0.20	0.010	<0.001	<0.05	<0.001	16
		12-Jun				<0.01	0.21	<1.0	99.0	264	<0.03	0.01	<0.10	0.42	0.003	<0.005	<0.05	0.004	0
H-37	Leang	1-Mar	7.1	10.0	560	<0.01	0.40	6.0	186.0	258	1.10	<0.02	0.02	0.20	<0.002	<0.001	<0.05	<0.001	16
		12-Jun				<0.01	0.22	8.8	106.0	214	0.05	0.20	<0.10	0.10	0.0008	<0.005	<0.05	<0.002	0
Drinking Water Quality Standards																			
Nam Saat		6.5 - 8.5	5	1,200	2	40		250	300	0.40	0.50	1.0	1.0	0.01	0.01	0.05	0.003	10	
Nam Papa		6.5 - 8.5	5		1	10	250	250	500	0.30	0.10	1.0	1.0	0.05	0.05	0.05	0.010	0	
WHO		6.5 - 8.5	5		3	50	250	200	500	0.30	0.50	2.0	1.5	0.01	0.01	0.05	0.003	0	
Japan		5.8 - 8.6	2		10		200	200	300	0.30	0.05	1.0	0.8	0.05	0.01	0.05	0.010	0	

Iron

Only one source from (H-17 to H-25) Houayxai 9 villages indicated an iron content beyond the Nam Saat water quality standard of 0.4 mg/l in November 1999. However, in the sample of the next survey in January 2000, the iron content recovered within the standard from 0.77 mg/l to 0.03 mg/l.

Coliform Group

Coliform group counts indicates the extent of organic contamination due to bacteria in the water source. In the samples of two sources from (V-6) Pangxai and (L-13) Chakhamping, the coliform group counts were found slightly beyond the standard ranging from 11 to 23 MPN/100ml and 10 to 17 MPN/100ml, respectively. On the other hand, samples from other sites indicated that the coliform group count after the rainy season was low due to the large river discharge as compared with other periods. Further, the number of coliform increased in the dry season due to the decrease in the discharge and increase in human activities surrounding the water source. The present situation concerning water contamination is not so serious, but tap water in the villages should be boiled before drinking.

2) Quantity

The flow rates of water sources for the pilot study are listed in Table 5-6. Excluding the source for the 9 villages in Pha Oudom, the flow rates of sources for GFS which are streams or rivers are sufficient to supply the requirements of the pilot villages. Most of the potential sources for GFS in the target area have enough flow all year round.

The consumption rates as measured from readings on the water meter are also shown in Table 5-6. The water is used for drinking, cooking, bathing, washing clothes and dishes, as well as for gardens. Although the consumption rates vary between villages according to their use pattern, the average consumption rate of the pilot villages is about 38 lit/cap/day.

The pilot study dug wells and boreholes using handpumps are yielding sufficient quantity of water to the villagers. However, some villagers complained that they were able to pump water only a few hours during some days in the dry season due to lowering of the water level, but recovered the next day. This requires deepening of the well. The groundwater potential of the study area is difficult to determine because of the lack of sufficient data, since only two boreholes were drilled for the pilot study. However, the potentials of the two pilot boreholes as determined from pumping test results are shown in Table 5-7.

Table 5-6 Water Quantity Measurements of Pilot Study Water Schemes

Code No.	Village Name	Population (2000)	Flow Rate in April-99 (lit/sec)	Flow Rate (lit/sec) GFS (June-00) Intake	Flow Rate (lit/sec) GFS (June-00) Tap	Flow Rate (lit/sec) Well (June-00)	Cumulative Sum of Consumption (m^3) (July-00)	Cumulative Sum of Consumption (m^3) (Nov-00)	Consumption Rate (lit/cap/day)
Houayxai District									
H-1	Poung	553	2.50	2.50	0.25		1,451	14,274	85
H-3	Nam Ngao	217				0.33			
H-7	Namma	352	1.80	1.40	0.22		794	4,730	63
H-9	May Phattana	133				0.22			
H-17	Maynignom	106			0.33			263	32
H-18	Thongsengchan	675			-			1,546	20
H-19	Xiengnam	300			-			606	34
H-20	Nongneun	227			0.11			786	49
H-21	Nale	278	7.50	10.00	0.16		1,170	970	25
H-22	Chomchouk	369			-			1,322	24
H-23	Paksang	212			0.50			1,218	63
H-24	Mayphoukha	443			0.50			2,227	41
H-25	Namhotay	644			0.70			1,642	25
H-31	Done Keo	181	1.20	2.50	0.70		1,312	2,399	51
H-32	Hat Phouan	150	2.50	2.50	1.00		-	4,606	86
H-37	Leang	241				0.20			
Pha Oudom District									
P-1	Phiengkham	475			0.68			930	8
P-2	Thinkeoneua	312			0.21			1,264	13
P-3	Thinkeokang	300			0.33			1,570	20
P-4	Thinkeotay	276			0.33			1,404	22
P-5	Phaoudom	783	1.75	1.67	0.33		-	2,156	10
P-6	Nathong	285			0.36			940	12
P-7	Phonexay	400			0.33			2,482	21
P-8	Somsavang	377			0.36			1,902	15
P-9	Sonexay	301			0.33			1,221	22
Viengphouka District									
V-6	Pangxai	159	0.25	0.63	0.19		-	521	16
V-8	Nam Seua	368	0.17	0.20	0.20		-	2,322	24
Long District									
L-1	Xiengkok May	236	2.40	-	0.32		2,352	6,567	66
L-2	Xiengkok Kao	305			-		-	5,280	48
L-4	Luang	293	7.00	-	-		1,492	4,066	88
L-13	Chakhamping	84	5.50	-	0.15		827	918	29
L-15	Tin That	362	3.13	4.00	0.40		1,446	6,789	79
L-21	Daen Kang	325	9.00	10.00	0.60		1,095	6,179	80
L-12	Hoai Mo	72			0.60		-	101	5
								Average Consumption Rate	38

Table 5-7 Groundwater Potential of Pilot Boreholes

Village Name	Ave. Aquifer Depth	Static Water Level (m)	Pumping Water Level (m)	Drawdown (m)	Pumping Rate (lit/min)	Specific Capacity (lit/min/m)	Potential (m^3/day)
May Phattana	Below 17.5 m	1.5	10.5	9.0	15.0	1.67	24.0
Leang	Below 10.0 m	7.5	42.0	34.5	7.0	0.20	2.9

The above table shows that the groundwater potential of the surveyed aquifer is between 2.9 and 24.0 m^3/day. The potential of the target area should be determined from the specific capacity with respect to the allowable drawdown, but the actual potential must be evaluated in terms of both quantity as well as quality. Therefore, it is concluded that the possibility for groundwater development of the Houayxai area is very low. (Refer to the Data Book for details on well construction of the pilot study wells.)

5.1.5 Water Source Evaluation

The water sources used for each of the pilot study villages are evaluated in the table shown in the following page.

The water supply schemes are functioning very well with only minor problems. Upon inspection of the water meters of GFS schemes, quantities used in the last three months or so reveal high frequencies of their usage. Most villages are satisfied with the supply, but the borehole villages have a problem with water quality where the water has an undesirable odor. Therefore, the difficulty in groundwater development was witnessed and indicates that future planning of groundwater sources requires careful consideration.

On the other hand, if alternatives such as the GFS and wells using handpumps are not possible, then other technology must be selected. These include, protected spring, rainwater collection, and use of motorized pumps. The technical aspects of protected spring and rainwater collection do not need explanation, as they are very simple methods. However, using motorized pumps requires careful consideration on their selection. Motorized pumps can be driven by electrical power or generators. For most of the rural areas, power lines are not available, and therefore, some type of generator must be considered. The most popular type is the generator using diesel as fuel. For the remote areas, procuring fuel may be difficult due to limited supply as well as economic reasons of the poor villagers. The use of unconventional power such as wind or solar can solve this problem if their conditions in sufficiency of wind speed and insolation are met. Operation and maintenance costs for wind and solar pumps are very low, but their initial costs are higher than conventional fuels, and especially solar equipment can be very high.

Table 5-8 Water Source Evaluation Table

No.	Pilot Village Name	Water Source	Intake Facility	Discharge and Water Quality		Maintenance of Source	Comment
				Dry Season	Rainy Season		
GFS Schemes							
H-1	Poung	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (somewhat turbid)	Intake cleaning and periodic inspection of supply pipe	
H-7	Namma	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (turbid)	Good O&M organization. Inspection done 3 times/mon/6pers. In rainy season,. Inspect everyday by 3 persons	
H-17 to H-25	Houayxai 9 Villages	Due to no other alternative source, used one source to supply 9 villages sharing 1 storage tank.	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (somewhat turbid)	Distribution of water from storage tank causing dispute. Need stronger inter-village management. Need cooperative cleaning and periodic inspection by a unified committee of 9 village. Fee collection on volumetric basis can resolve feeling of unfairness.	Flow differences between villages as well as tapstands are causing feeling of unfairness to collapse solidarity.
H-31	Done Keo	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice	Intake cleaning and periodic inspection of supply pipe. Need drainage manage	
H-32	Hat Phouan	Chosen source was appropriate	Function properly	Quantity and quality suffice	Quantity and quality suffice	Intake cleaning and periodic inspection of supply pipe	
P-1 to P-9	Pha Oudom 9 Villages	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity somewhat insufficient. Quality good	Quantity and quality suffice (turbid)	Intake cleaning and periodic inspection of supply pipe. Good management of system and water allocation	
V-6	Pangxai	Chosen source was appropriate	Function properly	Quantity and quality suffice	Quantity and quality suffice	Intake cleaning and periodic inspection of supply pipe	
V-8	Namseua	Chosen source was appropriate	Function properly	Quantity and quality suffice	Quantity and quality suffice	Intake cleaning and periodic inspection of supply pipe	
L-1& L-2	Xiengkok Mai / Xiengkok Kao	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (somewhat turbid)	Intake cleaning and periodic inspection of supply pipe	
L-4	Luang	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (turbid)	Intake cleaning and periodic inspection of supply pipe	
L-13	Chakhamping	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (somewhat turbid)	Intake cleaning and periodic inspection of supply pipe	
L-15	Tin That	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (turbid)	Intake cleaning and periodic inspection of supply pipe	
L-21 & L-12	Daen Kang / Hoai Mo	Chosen source was appropriate	Pipe clogged due to flooding in rainy season	Quantity and quality suffice	Quantity and quality suffice (turbid)	Intake cleaning and periodic inspection of supply pipe	
Dug Well and Borehole							
H-3	Nam Ngao #1	Well depth: 8m SWL: 6.6m	Rope Pump Lao-99 installed	Quantity sufficient. Water turbid just after construction, but became clear after a few months	Quantity and quality suffice	Area around well is cleaned	Since village originally requested GFS, participation was low at beginning, but gradually increased
	Nam Ngao #2	Well depth: 9m SWL: 6.4m	Tara handpump installed		Quantity and quality suffice	Area around well is cleaned	
H-9	May Phattana	Well depth:47m SWL: 1.5m	Tara handpump installed	Quantity sufficient for handpump. Quality-wise, water has undesirable odor causing villagers to use for other than drinking		Area around well is cleaned	
H-37	Leang	Well depth:60m SWL: 7.5m	Afridev handpump installed	Quantity sufficient for handpump. Quality-wise, water has undesirable odor causing villagers to use for other than drinking		Area around well is cleaned	

5.2 Water Supply and Sanitation Plan

5.2.1 Water Supply and Sanitation Options

1) Water Supply

Through this Study, the selection of future water sources was carried out by following the consensus of the villagers based on the concept of Informed Choice as stipulated in the Sector Strategy that has been developed by Nam Saat with support from local authorities, WB WSP-EAP and UNICEF. As a result, the GFS or gravity fed system is the water supply system chosen by most of the rural population in the study target villages. The source for the GFS is a stream or spring water, and the water is allowed to flow naturally to the villages through pipelines using the force of gravity. The water supply systems chosen by the villagers are listed below in order of preference.

(1) GFS : Gravity Fed System
(2) Borehole
(3) Protected shallow well or dug well
(4) Spring protection
(5) Rain water collection

Based on the results of the village survey of the target sites, the GFS is the most popular type with almost 83% of the villages wanting this type. Since many of the study sites are located in the mountainous area, the streams and springs to be used as sources for the GFS have good quality and are stable in quantity. Therefore since these water sources are environmentally sound and in consideration of operation and maintenance of the GFS by the villagers, the GFS can be considered as appropriate technology for these villages.

On the other hand, some villages selected boreholes (10%) and dug wells (5%). Technically, dug wells present no problems in quality and quantity if properly constructed and maintained. Development of boreholes requires highly technical surveys and judgment due to restrictions in hydrogeology, water quality and other factors. For example, some villages in Viengphoukha District chose borehole as their preferred water supply system, but these villages are located on mountaintops which can cause difficulties in pumping up the groundwater.

2) Sanitation

During the village field survey, in addition to the selection of water supply facilities, latrines as a means of sanitation were also selected through the

consensus of the villagers using the concept of Informed Choice. As a result, the pour flush bowl single pit latrine is the sanitation system chosen by the majority of the target rural population. The pour flush type latrine is water dependant and must have a sufficient supply of water to function effectively. The latrines chosen by the villagers are listed below in order of preference.

(1) Pour flush bowl single pit latrine
(2) Ventilated improved single pit (VIP) latrine
(3) Cover latrine
(4) Conventional pit latrine
(5) Septic tank toilet

Based on the results of the village survey of the 81 target sites, the pour flush type latrine is the most popular type with about 88% of the villages wanting this type. Although sufficient water supply is a prerequisite for this type of latrine, the use of water to wash down fecal matter is a very efficient method in consideration of sanitation. Furthermore, in consideration of operation and maintenance of this type of latrine by the villagers, the pour flush latrine can be considered as appropriate technology for these villages.

On the other hand, one village selected the ventilated improved single pit (VIP) latrine, while others (11%) said they do not want latrines. For the VIP latrine, once the underground pit is filled, the latrine has to be relocated. The villages that replied not needing latrines are those that already have some latrines constructed by other donor organizations or through the support of the government, or they are not conscious towards sanitation.

5.2.2 Design Parameters

1) Considerations

When considering a GFS scheme, the following factors need to be confirmed during the water source survey.

(1) Flow rate of source:	The flow must be sufficient to cover the design supply rate all year round.
(2) Water quality:	The water quality must be suitable for drinking during all seasons.
(3) Distance to source:	The source must be within transportable distance to the target village.
(4) Location of source:	There must be enough height difference to supply water by gravity to the target village.

If a water source which can satisfy all of the above factors is found, then GFS can be considered as one of the choices for the village to select. If, on the other hand, one of the above conditions cannot be met, then the GFS might present some problems and other supply alternatives need to be considered.

Due to the peculiar characteristic of the GFS scheme, appropriateness in scale is important to make full use of its characteristic. That is, the system should be sustainable in terms of operation and maintenance by the villagers living in remote, rural areas. If this is not possible, then the GFS scheme may need to be reconsidered.

Basically, one source should supply one village. However, if a suitable source is not available for each village and groundwater development is difficult, the necessity to supply a number of villages with one source will have to be considered. In this case, the following considerations are essential to assure sustainability in both financial and managerial terms.

(1) Are the preliminary preparation period and construction period sufficient in consideration of the facilities scale?
(2) Are the actual needs of each village confirmed (does each village really want a GFS)?
(3) Upon making agreement with each village carefully considering their economic situation and ethnic differences, is it possible to create an organization for independent operation and maintenance?
(4) Is a fair distribution of benefits possible in relation to water fees collected and contributions in materials, labor and cash from each village?
(5) When a problem arises in operation and maintenance of the facilities, can the WATSAN committee conduct appropriate intervention and solve the problem?

For multi-village supply with one source, although cost-effectiveness of the system can be an advantage, the other inevitable problems will most likely overweigh this advantage. Whereas the pipeline network and valve operation for a GFS should be simple, when a number of villages has to be supplied from one source, they become more complicated to increase the number of troubles in the system. Management of the system will also become more complicated where disputes can occur between villages, and so a strong solidarity is required with a trusted leader who can have control over all the villages concerned.

2) Design Criteria

Upon discussions between the Lao side and the Study team, the following design standards were adopted for the pilot study.

- Population growth rate: 2.9%
- Target year: 15 years
- Unit supply rate
  - For water scheme only: 45 lit/cap/day
  - For water scheme + latrine: 45 - 50 lit/cap/day

Although these unit supply rates have given satisfactory results in facilities design, future development plans for water supply should consider special water needs due to the existence of schools, clinics, temples and other public facilities. For some of the pilot study villages, the following unit supply rates including special water need rates were used in the design with satisfactory results. This implies that these unit rates can be used to give reliable design supply rates.

Table 5-9 Design Criteria for Unit Supply Rates

Condition		Unit Supply Rate	
Design Factor	Water Scheme Only	45 lit/cap/day	
	Water Scheme and Latrine	45 - 50 lit/cap/day	
Primary School		Per student	10 lit/day
Secondary School		Per student	15 lit/day
Dispensary or Clinic		Per clinic	500 lit/day
Temple or Public Office		Per temple or office	500 lit/day

The above criteria can be used to formulate basic designs, but for future development plans, detailed surveys should be made to reconfirm the criteria. To formulate an optimum water supply, the implementation design should be flexible to consider modified criteria which reflect upon the actual conditions of the target village.

Here, an example will be given on calculating the design water supply rate. The daily water supply hours will be divided into three periods as 3 hours in the morning, 4 hours during noontime and 3 hours in the evening. This can be apportioned as 30% for morning, 40% for noon and 30% for evening as the supply ratios for a day. The design supply rate is calculated by multiplying the design population to the unit supply rate, but here, an additional demand for special water needs will be added in accordance with the number of public facilities in the village. On the other hand, the intake yield is calculated by multiplying the

daily yield as measured during the water source survey to the total daily supply hours of 14 hours. Since the intake yield is less than the design supply rate, the shortage should be insured by a storage tank to be filled during hours when the system is not used such as during the night. The capacity of the storage tank can be determined by using the difference between the yield and design supply rate. Also, if the topography reveals a long and steep downhill, then a break pressure tank may be required to reduce the hydrostatic pressure in the flow which can build up along the way.

Table 5-10 Calculation Example of Design Water Supply Rate

Population: 500 persons, One primary school (50 students), One temple Intake yield: 20 lit/min (Surveyed in 2000)				
Design Year:	2015 (15 years)	Supplied Population	=500×1.54	=770 persons
Pop. Growth Rate	2.9%	Design Supply Rate	=45×770+1,000	=35,650 lit/day
Unit Supply Rate	45 lit/cap/day	Daily Intake Yield	=20×60×14	=16,800 lit/day
Add. Demand	1,000 lit/day	Storage Tank Capacity	=16,800−35.650	<0 ⇒ 20 m^3

Water Supply Hours			Ratio	Design Supply Rate	Intake Yield
Morning	5:00 – 8:00	3 hours	30%	10,695 lit/day	12,600 lit/day
Noon	8:00 – 16:00	4 hours	40%	14,260 lit/day	16,800 lit/day
Evening	16:00 – 19:00	3 hours	30%	10,695 lit/day	12,600 lit/day
Total		14 hours	100%	35,650 lit/day	42,000 lit/day

The design criteria adopted by Nam Saat concerning the number of facilities for various water schemes are listed below. However, the number of tapstands needs to be determined also by considering the geographical layout of the village.

Table 5-11 Design Criteria for Number of Facilities

Facility Unit	Design Criteria
Tap for GFS	80 – 120 persons
Dug Well or Borehole	150 – 200 persons
Latrine	1 household or family

5.2.3 Facilities Plan

1) Facilities Design for GFS

Facilities' designing for GFS is based on the social survey, water source survey, topographic survey and other village surveys conducted at an earlier stage. Engineers from Provincial and District Nam Saat with support from Nam Saat central take the initiative to prepare the GFS design report. This design report is composed of the following items.

Table 5-12 Design Report Composition for GFS Scheme

Contents of GFS Design Report	Description
1. General Information of Village	Population structure, number of households, public facilities, etc.
2. Village Interior and Exterior Map	Roads inside and outside of village, houses, public facilities, land use, etc.
3. Calculation Table of Design Supply Rate	Calculations of unit supply rate, supply hours, intake yield, design supply rate, etc.
4. Plan of Pipeline Route	Plan drawn from topographic data
5. Cross Section of Pipeline Route	Cross-section drawn from topographic data
6. Topographic Data of Pipeline Route	Data taken from simple topographic survey
7. List of Quantities of Materials and Equipment	List of materials and equipment required for facilities construction and their quantities
8. Construction Cost Estimation	Materials cost, transportation cost, etc.
9. Construction Schedule	Bar chart of required days for construction from commencement to completion
10. Facilities Drawing	Drawings of intake facility, storage tank, tapstand, pipe laying, etc.

To facilitate the designing procedures for Provincial and District Nam Saat engineers and the confirmation work by Nam Saat central, the "GFS standard design format" can be effectively used. Of course, when a characteristic of the village or a special consideration on the GFS scheme requires deviation from the format, any needed modifications should be made.

Through the community dialogue, preparations should be made for village committee organization and construction planning, followed by the construction works. However during GFS construction works, modifications such as pipeline route alterations, pipe material replacements and pipe joint quantity changes are inevitable, and therefore the GFS design report must be revised into a GFS completion report to be used as reference for operation and maintenance of the facilities.

Unexpected problems due to various causes arise during GFS construction works which necessitate changes in the original design. Since construction machineries are not used for GFS construction and laborers from the village including women are trenching the pipe laying routes, areas difficult to trench such as hard rock formations can be encountered which will require altering the route or replacing the pipe material to iron for laying on the ground. Furthermore, even under appropriate supervision, during the period when the laborers are becoming familiar with their work, the still inexperienced villagers who are mostly farmers can damage tools and pipe materials.

If modifications are required during construction work for GFS, the supervisor must reconfirm the design in consideration of technical matters such as head loss in the pipe and pressure at the tap. The flow of facilities designing for GFS is depicted in the following figure.

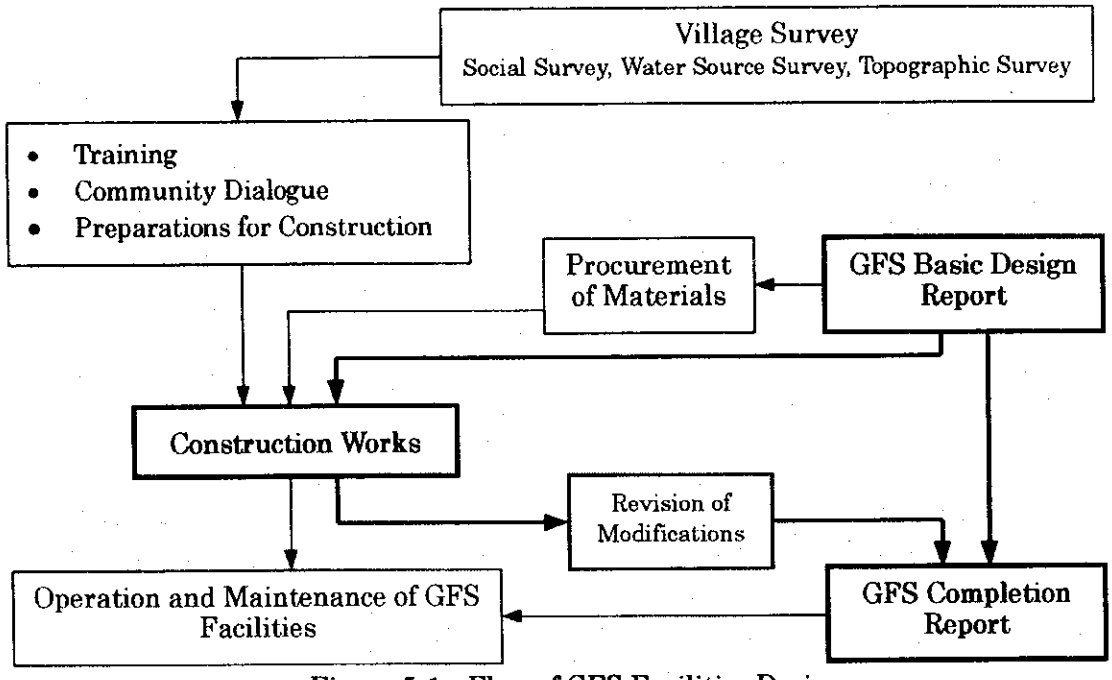


Figure 5-1 Flow of GFS Facilities Design

Due to the implicated modifications required for GFS, planning an accurate budget is difficult during the basic design stage. Other than uncertainties related to natural conditions, the transportation costs of materials to remote villages are also dubious, and therefore, consideration of contingencies may be necessary when making cost estimations.

For facilities design of GFS, it is important to realize that the facilities are to be constructed and maintained by villagers who are mostly farmers living in remote areas. This means that the specifications should include facilities which are easy to construct, durable and simple to repair. Therefore, the facilities need to be designed in accordance with results of discussions with villagers, selection by the villagers and agreement with the villagers concerning the materials, specifications, construction methods and other relevant factors.

a) Standard Materials

The materials required for GFS can be divided into materials contributed by the village and those procured by other sources. For selection of the latter materials, the following factors should be considered.

Considerations for Materials Selection
• Are they suitable for use by the villagers? • Are they effortless to install, simple to construct, and easy to repair? • Can they withstand seasonal changes and different natural conditions? • Can they be easily managed during operation and maintenance, as well as during stock inventory? • Can remote villages easily procure spare parts? • Can they be conveniently procured with the maintenance budget from collected water fees? Is it inexpensive?

The adopted standard materials for pipes, taps, water meters and others should consider the special characteristic of the GFS and also receive the understanding of the villagers.

Pipe Material • Main pipe materials are PVC, HDPE and GI*, but in consideration that the villagers are going to do the trenching, the HDPE pipes, which are easier to work with due to their flexibility, will be adopted. • HDPE pipes manufactured in Laos and Thailand are available, and their qualities are similar. • To promote local industries, locally made Lao products are desirable, but due to long production periods necessary for local products, procurement within a required period may be difficult. Efforts should be made to procure both local and imported products in accordance with the required quantity and construction schedule.
Tap Type • The most popular tap is the lever type manufactured in Thailand, and another type with a propeller handle is also available, but is relatively more expensive. • The lever type tap is easily damaged but inexpensive, and is easily procured even in the remote areas. • The villagers should make the choice as to which type they prefer.
Water Meter • With the objective of appropriate fee collection, water meters are installed in the tapstand as standard. • All available water meters are imported. • Similar types made by differnt manufacturers are available, but to avoid problems in operation and maintenance, the meter type in one village should be unified. • In consideration of effective operation and maintenance, meters can be installed at the intake and storage tank. • Especially for a multi-village scheme using one water source, to manage the water distribution to each supply area, installation of meters in each area is recommended.

*PVC: polyvinyl chloride, HDPE: high density polyethelene, GI: galvanized iron

b) Standard Facilities

The main facilities of the GFS are intake, transmission main, storage tank, supply line and tapstand. Although the construction works are supervised and controlled by Provincial and District Nam Saat officers, in consideration of the fact that the actual construction is done by the villagers themselves, the following specifications for facilities shall be the standards.

Intake Facility

- Reinforced concrete structure having sufficient durability to withstand stream yield increases and water level rising in the rainy season. For this durability, the reinforcement bar shall be over ϕ 10 mm, and the outer wall thickness shall be more than 125 mm.
- A structure which can prevent the inflow of silt, sand, gravel, leaves and other debris. The main standard measures to deter stream water inflow are as follows, but they should be adopted in accordance with seasonal fluctuations and surrounding conditions of the intake point.
  - □ Raise the wall higher than the stream water level during the rainy season,
  - □ Relocate the intake to a point where the stream cannot flow over the intake.
  - □ Install a screen capable of preventing silt and other particles from flowing into the transmission main even when the sedimentation compartment has been agitated.
- Appropriate shape and sufficient depth of foundation to withstand the water pressure during the rainy season

Transmission Main

- HDPE pipes shall be used for laying underground and GI pipes for laying on the ground.
- Air vents and drainage valves shall be installed inside valve boxes at required locations along the pipeline route in accordance with the topography.
- If the transmission distance is very long traveling several km, then drainage valves inside valve boxes shall be installed at a minimum rate of one for every 1 km.

Storage Tank

- Reinforced concrete structure using reinforcement bars of over ϕ 10 mm.
- For tanks of capacity less than 12 m^3, the outer wall and floor thicknesses shall be more than 150 mm. For capacity more than 12 m^3, the outer wall thickness, >200 mm, and floor thickness, >250 mm.
- Roofs of reinforced concrete, and of wooden frame with corrugated galvanized steel sheets are being built. However, the wood frame with steel sheet type roof, being the most familiar with the villagers, shall be the standard.
- All exposed piping around the tank, including the inflow pipe, outflow pipe, overflow pipe and drainpipe, shall be located in one area and enclosed in a concrete box having a hinged steel cover with a lock.
- If necessary for effect management, operation and maintenance of the system, gate valves can be installed in both inflow and outflow pipes.
- Especially in the case of one water source supplying multi-villages, and multiple outflow pipes are installed for each supply area, a gate valve shall be installed for each supply pipe.
- Since the storage tank is usually located on mountains and in forests, tall grass and weeds can grow thickly around the tank to interfere with operation and maintenance. So, the area around the tank shall be spread with pebbles and gravel.

Supply Pipeline

- HDPE pipes shall be standard.
- If necessary for effective operation and maintenance, gate valves inside valve boxes should be installed for each supply area.

Communal Tapstand

- Usually, reinforcement bars are not used in tapstand structures, but since many cracks and broken pieces were seen in the concrete floor and drainage, the structure shall use reinforcement bars of over ϕ 6 mm as standard.
- The installation of soakaways located more than 3 m away from the concrete floor is standard. However, other drainage methods are acceptable in accordance with the surrounding area and possibility of sanitary connection to existing drainage ways.
- The valve box containing a gate valve and a water meter shall have a drainage hole, and covered with a hinged steel cover having a lock.

c) Standard Works

Similar to selection of materials and facilities specifications for GFS, the construction method of GFS also needs consideration due to its special characteristic. Especially, the following standards for construction works and their applications concerning pipeline trenching and ground tamping need careful attention

Trench Depth for Pipeline • Trench depth for pipe laying shall be 800 mm below the ground level. • Since the labor force for trenching is the villagers which include women, the trenching depths tend to be shallow, and therefore, floods during the rainy season can wash away the ground to unearth the laid pipeline. This lesson must be learned when trenching and appropriate measure must be taken.
Pipe Laying Location • When underground laying the transmission main along rivers, the route shall be selected so that it will not be influenced by changes in river pattern in the rainy season. • Increased water during the rainy season can scrape off the river banks to change the river width, and the pipeline laid along the river can become exposed and damaged by rolling gravel and falling trees. Therefore, pipeline routing shall sufficiently confirm the surrounding situation.
Ground Tamping • Before construction of storage tanks and tapstands, the work site shall be leveled and tamped sufficiently. • If leveling and tamping are inadequate and construction of the tapstand is proceeded, the ground area around the concrete floor can be washed away by rainwater and expose the foundation to tilt the tapstand. • Considering that the ground level for communal tapstands must be higher than the soakaway, and that leveling and tamping will lower the ground, the tapstand must be sited at a location having sufficiently higher ground level than the surrounding area.

2) Facilities Design for Wells

Design reports are also required for dug wells and boreholes. The composition of design reports for wells is shown below.

Table 5-13 Design Report Composition for Wells

Contents of Design Report	Description
1. General Information of Village	Population structure, number of households, public facilities, etc.
2. List of Quantities of Materials and Equipment	List of materials and equipment required for facilities construction and their quantities
3. Construction Cost Estimation	Materials cost, transportation cost, etc.
4. Facilities Drawing	Drawings of well cross section, handpump installation, etc.

Other than the specifications required for drilling the wells, specifications for conducting geoelectric prospecting and pumping tests are also important. Table 5-14 shows an example of requirements for drilling, geophysical surveys, tests and analyses required for construction of boreholes and dug wells.

Table 5-14 Example of Requirements for Well Drilling

Parameter		Borehole	Dug Well
Drilling Specifications		ϕ 6" × 50 m	ϕ 1m × 10m
Geoelectric Prospecting	Number of Points	5 points/well	3 points/well
	Method	Wenner	Wenner
	Depth	100 m	12 m
Pumping Test	Step Drawdown Test	5 Steps	5 Steps
	Continuous Test	24 Hours	24 Hours
	Recovery Test	12 Hours	12 Hours
Water Quality Analysis		Drinking Water Standard Items	

During the whole process, technology transfer on drilling and construction procedures as listed below should be given to Provincial and District level personnel in order for them to supervise similar works in the future.

Table 5-15 Items for Technology Transfer on Well Construction Practices

Borehole	Dug Well
• Boring • Well logging • Screen and casing installation • Gravel packing • Well cleaning • Pumping test • Water quality analysis • Water level measurement • Wellhead construction • Hand pump installation	• Digging • Concrete lining installation • Disinfection • Water quality analysis • Water level measurement • Wellhead construction • Hand pump installation

Considerations and measures against problems required for well construction, using the problems encountered during the drilling works of the pilot villages as example, are tabulated in Table 5-16.

3) Facilities Design for Sanitation Facilities

One of the characteristics of this Study is that not only water supply facilities were implemented, but latrines were also constructed as means to improve the sanitation environment. The impacts of this significant coupling together of water and sanitation are summarized below.

- Low villagers' awareness towards sanitation before the pilot study: At the beginning stage, the villagers had low awareness on sanitation. Some concerned persons were even against the construction of latrines.
- Behavioral change towards sanitation: As a result of sanitation education, hygiene promotion and installation of latrines, the villagers' became more aware of the importance of sanitation, which also penetrated to surrounding villages which were observing the changes.

Table 5-16 Considerations for Borehole and Dugwell Construction Works

Activity	Issue	Description	Consideration	Measure
Planning	Selection of water point (for the case of May Phatthana)	Due to dry hole in the village, borehole was drilled across the main traffic road.	• Possibility for traffic accidents	Need village rule to avoid traffic accidents, especially for children
Operation	Hole collapsing	Drilling period prolonged due to hole collapsing	• Methodology for appropriate action • Strategy to avoid hole collapsing • Strategy to keep schedule	Appropriate action for maintaining schedule
	Machine trouble	Drilling period is extending due to waiting for repair	• Methodology for appropriate action, • Strategy to repair promptly • Strategy to keep schedule	Appropriate action for maintaining schedule
	Delay in schedule	Whole scheduling delayed	• Analyzing reason for delay	Alternative plan to keep schedule
Managing	Insufficient intervention in drilling work	Nam Saat is not managing drilling progress well	• Strategy for supervising work • Experience with objective to be supervised.	Appropriate intervention should be made with the contractor in view of scheduling and completion design.
	Digging depth	How to justify depth of dug well	• Definition of appropriate depth	Approval when reaching the maximized depth. It should be defined in the contract
Community participation	Low community participation for dug well digging and construction	Low community participation for digging and construction due to misunderstanding by all parties involved (Nam Saat, JICA Study Team, contractor, villagers)	• Coordination among all parties (Nam Saat, JICA Study Team, contractor, villagers) before starting construction and also during construction	Proper community participation with proper coordination
	Low community participation for borehole drilling and construction	Borehole drilling does not require much community involvement through whole process, so not enough activity to keep villagers' interest in view of community participation	• Strategy to maximize community participation throughout the work	Continuously motivate villagers to be involved.

- A step towards success in sanitation practice: The construction of latrines as pilot study acted as a model case for sanitation promotion. The sanitation education was effective to bring interest to the community. These 2 phenomena gave multiple effects to promote behavior change.

The contents of the design reports required for latrines are listed below.

Table 5-17 Design Report Composition for Latrines

	Contents of Design Report	Description
1.	General Information of Village	Population structure, number of households, public facilities, etc.
2.	List of Quantities of Materials and Equipment	List of materials and equipment required for facilities construction and their quantities
3.	Construction Cost Estimation	Materials cost, transportation cost, etc.
4.	Facilities Drawing	Drawings of underground pit cross section, superstructure configuration, pit ring, pit cover, etc.

The materials required for construction of latrines, other than the latrine bowl, are mostly procurable by the villagers, and latrines can be constructed easily by the villagers. The villagers can easily build the superstructure housing from materials such as bamboo, wood, rattan, asbestos, concrete blocks and any other locally available materials. If the basic design is observed, then the construction materials and shape can be decided by the villagers, but advise should be given on the following points.

- The latrine should be located away from cooking areas
- The latrine should be located in a place having enough ventilation
- The slope of the floor around the bowl should be finished to allow enough drainage

The above points can maintain sanitary conditions around the latrine. Sanitary latrines become naturally necessary as frequency of use increases, which can heighten motivation for maintenance. Also, sanitary latrines can help to promote sanitation practices to surrounding villages as well. Therefore, with simple technical guidance on construction and maintenance, villagers can easily constructed their own latrines, and if the villagers become sufficiently aware of the importance and necessity of latrines, then sanitation facilities can become a part of daily village life

The following lessons learned from the pilot study on the effects of sanitation facilities can be applied to future planning.

- For villages receiving both water and sanitation facilities, the two facilities gave multiple effects to improve the sanitary environment and raise the satisfaction of the villagers.

- For villages which received only water facilities, their desire for sanitation facilities became evident after the construction. This phenomenon shows the importance of using latrine construction as a model case.

4) Cost Estimation of Materials

Unit costs of materials should be standardized by making a "cost estimation format". The US Dollars or Thai Baht should be adopted for collecting cost estimation data because of the instability of the Kip due to serious inflation. Unit costs for procurement of materials should be surveyed in the project area as well as Vientiane Municipality, considering the possible advantage in accessibility and lower transportation cost due to the location of the project villages.

When Nam Saat estimates a project cost, they review the following points with respect to the materials supplier and forwarder when considering the unit costs.

(1) The capacity to supply required quantities of materials for the construction works in accordance with the construction schedule
(2) The capacity to insure coverage against damage to materials during transport or delay in delivery

5) Constructed Facilities

The water supply and sanitation facilities constructed through villagers' participation during the pilot study and pilot study extension are listed in the Table 5-18. Out of the 81 study target villages, a total of 50[1] villages were implemented as pilot studies with 21 GFS schemes, 2 dug wells and 2 boreholes, and 24 villages received pour flush type latrines.

5.2.4 Organization for Construction Works

Since the construction works of GFS is actually conducted by the villagers, the organization of the construction works must consider the community characteristics and nature of the villagers. Some villages have high availability of construction materials, while other villages cannot procure any materials; some villages have many skilled workers such as masons and carpenters, and other villages which consist mainly of farmers have very few skilled workers available.

[1] The total number of villages actually targeted for the two pilot studies was 51 villages, but during the implementation, a request was made to cancel one village, L-11 Nam Ma in Long District of Luang Namtha Province, due to its resettlement. Therefore the total number is 50 villages

Table 5-18 Facilities Implemented through the Pilot Studies

Pilot Study				Pilot Study Extension			
No.	Village Name	Water Scheme	Latrine	No.	Village Name	Water Scheme	Latrine
Bokeo Province							
Houayxai District							
H-1	Poung	GFS	Pour Flush	H-2	Phokham	GFS/1 Scheme 2 Villages	Pour Flush
H-3	Nam Ngao	Dug Well		H-4	Hoai Makeo		Pour Flush
H-7	Namma	GFS	Pour Flush	H-5	Done Phao	GFS	
H-9	May Phatthana	Borehole		H-8	Namphou	GFS	Pour Flush
H-17	Maynignom	GFS 1 Scheme 9 Villages	Pour Flush	H-26	Phibounthong	Dug Well	
H-18	Thongsengchan			H-27	Houakhoua	GFS 1 Scheme 4 Villages	Pour Flush
H-19	Xiengnam			H-28	Pakhaotay		
H-20	Nongneun			H-29	Thongbia		
H-21	Nale		Pour Flush	H-30	Viengmay		Pour Flush
H-22	Chomchouk						
H-23	Paksang		Pour Flush				
H-24	Maypoukha		Pour Flush				
H-25	Namhotay		Pour Flush				
H-31	Done Keo	GFS	Pour Flush				
H-32	Hat Phouan	GFS					
H-37	Leang	Borehole					
Pha Oudom District							
P-1	Phiengkham	GFS 1 Scheme 9 Villages					
P-2	Thinkeoneua						
P-3	Thinkeokang						
P-4	Thinkeotay						
P-5	Phaoudom						
P-6	Nathong						
P-7	Phonexay		Pour Flush				
P-8	Somsavang						
P-9	Sonexay						
Luang Namtha Province							
Viengphoukha District							
V-6	Pangxai	GFS	Pour Flush	V-1	Nam Mai	GFS	Pour Flush
V-8	Nam Seua	GFS					
Long District							
L-1	Xiengkok May	GFS/1 Scheme 2 Villages	Pour Flush	L-6	Nong Kham	GFS	Pour Flush
L-2	Xiengkok Kao		Pour Flush	L-7	Nam Bak	GFS 1 Scheme 4 Villages	Pour Flush
L-4	Luang	GFS		L-8	Luang Phokham		Pour Flush
L-13	Chakhamping	GFS		L-9	Phaya Luang		Pour Flush
L-15	Tinthat	GFS		L-14	Khok Hin		Pour Flush
L-21	Daen Kang	GFS/1 Scheme 2 Villages		L-23	Kang	GFS	Pour Flush
L-12	Hoai Mo			L-11	Nam Ma	Cancelled*	
Total	34 Villages	16 Schemes (13 GFS) (1 Dug Well) (2 Borehole)	12 Latrine Villages	Total	16 Villages (1 Cancelled)	9 Schemes (8 GFS) (1 Dug Well	12 Latrine Villages
TOTAL	**50 Villages**		**25 Water Schemes (21 GFS, 2, Dug Well, 2 Borehole)**			**24 Latrine Villages (Pour Flush Latrine)**	

N.B.: *Due to resettlement of this village, a request was made to cancel this village.

These differences in characteristics and nature of each village create differences in attitude towards acceptance of the construction works, which means that the supervision and control by Provincial and District Nam Saat staff require flexibility to cope with the different requirements.

For the villages having low availability of materials and only a few skilled workers, basic technical assistance in construction is inevitable, and elementary explanations on GFS including work demonstrations are needed. Therefore, for these villages, enough time must be anticipated in the scheduling. Furthermore, the manning assignments must also consider this situation by increasing the number of staff from all levels for supervision and coordination of these villages.

For the villages having understanding and experience in similar work also need attention. These villages may not have enough understanding as needed or they may be thinking easily about the construction, where in this case, the village is most of the time very loose about accepting the construction work. If their understanding on GFS is low, they might make requests such as additional tapstands, bigger diameter pipes and frequent changes in siting of facilities. If this is the situation, the supervisor in charge should not give in easily to accepting the additions and changes, but rather make explanations on the design particulars until they clearly understand the situation.

When forming the organization for construction works, the actual conditions and characteristics of the village must be considered. Explanations should be made on the contributions required from the village and details of the construction materials to be delivered to the village, and adjustments need to be made on the amount of contributions possible, required timing of these contributions and delivery schedule of construction materials. Also, the construction schedule details as well as assignment schedule for supervisors, coordinators and patrol staff must be prepared.

As participation is the key word to the construction works, the contributions in labor, local materials and cash from the village are very important. Furthermore, well managed collaboration between the villagers and the supervisors will greatly contribute to the smooth and effective progress of the construction works.