# **Chapter 3 Pilot Models Construction**

## 3.1 Purposes of Pilot Models

Two pilot systems were constructed in the communes under typical different social situation in the Central Highlands. One is poverty commune (K3-1) and the other is minority-dominated commune (G2). The main purpose of the pilot models in K3-1 and G2 is to assess the feasibility and sustainability of the piped water supply systems with regard to the following issues, and to feed the results of the pilot models back to the feasibility study:

- financial sustainability,
- local management skills,
- monitoring of house connection rate and water charge collection,
- effectiveness of IEC, and
- local construction skills.

## (1) Financial sustainability

In K3-1, the majority of the population is the ethnic minority people and the economic conditions are generally poor, and the financial sustainability of the piped supply systems has been unclear. The project cannot achieve its goal without financial sustainability.

#### (2) Local management skills

On the other hand, the communities in G2 have had an issue between the two major ethnic groups (the Kinh and Gia Rai). The people's committee has been expected to solve the issue by themselves to ensure the harmonious management of the water supply system.

#### (3) House connection rate, water charges collection and IEC

Water charges collection from users of house connections to obtain estimated revenues is the most important for the sustainable O/M. To achieve successful O/M, effective IEC activities are essential for the promotion of safe and clean water in both communes. IEC activities have been carried out prior to the construction of the water supply facilities, and their effectiveness needs to be checked and reviewed.

#### (4) Local construction skills

Piped supply systems are still not common in the rural areas in Vietnam. The level and reliability of the construction contractors need to be technically evaluated to ensure quality of the construction works and materials to be basically procured from the local markets considering the availability of spare parts. The skill to keep the construction schedule and to prepare the design drawings to meet the satisfying construction is also one of the important key factors.

## 3.2 Background Information

Background information includes the target population, ethnicity, economic conditions, present water supply, health, groundwater potential, water quality, future water demands in each target area.

## 3.2.1 Dak Ui Commune (K3-1)

#### (1) General Background

It takes one and half hours by car from the provincial capital, Kon Tum city. The target area is located along a minor dirt (not asphalt) road, which is a turnoff at Dak Ha from the national road No. 14.

The target area (K3-1) includes 5 villages, i.e. nos. 1A, 1B, 5B, 6, and 7, with the total population of about 2,164 (412 households). The biggest village is village No. 7 with a population of 1,044, followed by villages 1B (361), 1A (355), 5B (275), and 6 (129).

The target area is inhabited by various ethnic minority people. Xe Dang and Xo Dra people live in villages 1A, 1B, 5B, and 6, and a few Roman households also live in village No. 7. The Kinh people dwell in villages 1B, 5B, 6, and 7.

The poverty ratio, 33 %, is reported only for the commune level, although the specific data for K3-1 is unavailable.

There are public buildings in K3-1, i.e. CPC, a secondary school, and the commune health center in village 1B, and primary schools in village 1A and 7.

#### (2) Existing Water Supply

Most of the existing water supply is in the form of shallow dug wells, and many people still believe that spring water is clean and drinkable.

There are 2 bamboo piped systems where spring water gravitates to villages Nos. 5B and 7. Maintenance of the bamboo systems is of local responsibility, and both Kinh and ethnic minority people have managed the systems very successfully. The inside of the bamboo pipes has been reinforced by plastic pipes self-sustainably contributed by the local users of the existing systems.

According to the social survey, 49% of the respondents were reportedly unsatisfied with the quantity of water in the dry season, and only 7% were unsatisfied with the quality of the existing water supply. Urgency and necessity of development of groundwater is therefore very potential in the target area.

#### (3) Piped System

The study team has explored a well with a safety yield of 259  $m^3$ /day near the commune health center. The depth of the well is only 38 m with a screen 28 m in length. The water taken from the well has high contents of iron (3.49 mg/l) and manganese (0.12 mg/l), and water treatment by aeration and filtration is necessary.

The estimated water demands (maximum daily demands) are 27.5 m<sup>3</sup>/day in 2001, 59.7 m<sup>3</sup>/day in 2005, 224.3 m<sup>3</sup>/day in 2010, and 322.6 m<sup>3</sup>/day in 2020. One more well with the same capacity as the explored well will be necessary to meet the water demand in 2020.

Alternative 2a is recommended for the system in K3-1. Water is pumped from the drilled well to a treatment plant on the hill in village No. 7 from where the water runs to a ground level reservoir. The target area will be supplied from the proposed reservoir.

## **3.2.2** Nhon Hoa Commune (G2)

#### (4) General Background

It takes about one hour by car from the provincial capital, Pleiku city. The target area is part of the G2 system and located along and off the national road No. 14 from Pleiku to Buon Ma Thout.

The target area of the pilot model covers villages Hoa An, Hoa Phu, Plei Lao, and Plei Kia, with the total population of 1,150 (200 households). Village Plei Kia has a population of 744, and Hoa An has 406.

Most of the villagers (98%) in Hoa An is the Kinh, while 90% of the residents are the Gia Rai people in Plei Kia. The poverty ratio of village Hoa An is relatively low (19%), whilst that of Plei Kia is as high as 40%.

Most importantly, this commune had a dispute on the land acquisition. However, the People's Committee and PCERWASS solved the issue with the private land on whose land the well for the pilot model was drilled.

#### (5) Existing Water Supply

Most of the people use a dug well as their water source in the target area. Especially, in the Kinh dominated Hoa An village every household owns dug well.

According to the social survey, 23% of the respondents were unsatisfied with the quantity of water in the dry season, and 13% were unsatisfied with the quality of the existing water supply.

#### (6) Piped System

The study team has drilled a deep well with a yield of 173 m3/d. The drilled deep well is 110 m long with a screen 34 m in length. The water has a somewhat high content of manganese.

The estimated water demands (maximum daily demands) for the G2 system (not only for the pilot area) are 132.5 m<sup>3</sup>/day in 2001, 289.2 m<sup>3</sup>/day in 2005, 1096.2 m<sup>3</sup>/day in 2010, and 1603.2 m<sup>3</sup>/day in 2020. At least one more well with the same capacity as the explored well will be necessary to meet the water demand in 2005, 5 more by 2010, and 2 more by 2020.

Alternative 2a is recommended for the system in G2. From the deep well the water is pumped out to an elevated tower from where the water gravitates to the distribution network. The pilot model is conventionally postpond to install reservoir for limited construction time schedule. The water supply facilities are located anywhere near the well while the elevated tower is located at the highest point near the people's committee.

# 3.3 Overall Progress of Pilot Model

#### 3.3.1 General

The pilot model plants in Dak Ui commune (K3-1) and Nhon Hoa commune (G2) were constructed by the end of January 2002. The selected local contractor carried out the construction works of the pilot model plants under the contract agreed between the JICA study team and the contractor on 31<sup>st</sup> October 2001. The construction period took 3 months starting at the beginning of November 2001.

The monitoring of the actual and realistic operation and maintenance activities by the users will be continuing after the completion of model plants for about 3 months from February to April 2002. The actual schedule of the construction works is presented in Figure 3.1.

Items Dak Ui (K3-1) Nhon Hoa (G2) A. Water resource 1. Permissible yield of JICA's deep well 3.0 l/sec 2.0 l/sec 2. Altitude of JICA's deep well El 687 m El 420 m 3. Elevation of reservoir tank El 750 m El 426 m B Water demand 1. Number of villages 5 2. Number of households 412 200 1,150 3. Number of population, 2001 2,164 4. Maximum hourly demand, 2001 2.0 m3/h 1.1 m3/h 5. Maximum daily demand, 2001 20.0 m3/d 11.0 m3/d 6. Maximum hourly demand, 2020 26.0 m3/h 13.3 m3/h 7. Maximum daily demand, 2020 238.0 m3/day 122.0 m3/day 8. Minimum pressure at tapping point 3.0 m

The basic parameters for the construction works are as follows:

## 3.3.2 Construction Works

The scope of the construction works of the pilot models are summarized as follows.

- Design of water supply facilities
- Land clearing
- Installation of submersible pumps with appurtenant
- Installation of electric panels and its protection
- Connection of electric power lines to public power lines
- Construction of well heads
- Installation of raw-water pipelines
- Construction of provisional reservoirs
- Installation of distribution pipelines
- Construction of public taps
- Water pressure tests
- Disinfection

#### (1) Water Intake

The profiles of the wells explored by the JICA study team in K3-1 and G2 in 2001 are as follows:

Description	K3-1	G2
Well diameter	150 mm	150 mm
Well depth (reamed)	38 m	110 m
Dynamic water level	18 m	61 m
Permissible yield	3 1/s	3 l/s
Ground elevation (m)	685	421

The deep well head was constructed to meet the water demand for the year 2020. The well head consists of a pressure gauge, gate valve, water meters, non-return valve and all necessary couplings and fittings. A protective housing was constructed. The following type of submersible pumps was installed in K3-1 and G2 systems respectively.

	Description	K3-1	G2
	Туре	Calpeda submersible pump, Italy	Calpeda submersible pump, Italy
de	Model	4SD 10/17N N 021525	4SD 10/17
Pump	Performance	H max. 114 m, Q min. 1.5 m3/h H min. 35 m, Q max. 12 m3/h	H max. 114 m, Q min. 1.5 m3/h H min. 35 m, Q max. 12 m3/h
	Туре	Franklin Electric, Germany	Franklin Electric, Germany
Motor	Model	3 kW, 3-Phase, 380 V	3 kW, 3-Phase, 380 V

#### (2) Power Supply

The power required for the operation of submersible pumps and lightning is supplied from national grid. The line connection and installation of control panels have been completed in K3-1 and G2.

#### (3) Raw Water Mains

The raw water main laid 60 cm below the ground transports the water from the wellhead to the reservoir. The raw water pipe is made from Galvanized Iron (GI) and is of dimension 100 mm (K3-1- Dak Ui and G2-Nhon Hoa).

#### (4) **Distribution Lines**

The distribution pipes were designed and constructed for the maximum hourly demand in year 2020. The distribution pipes are High Dense Poly-ethylene (HDPE) for secondary and small pipelines and Poli-vinyl Chlorine (PVC) for the main pipelines. The distribution pipe lengths and diameters are shown in the following:

Pipe Material		K3-1	G2			
	Dia.	Length (m)	Dia.	Length (m)		
	(mm)		(mm)			
PVC (for mains)	100	600	140	460		
PVC (for mains)	-	-	100	1,435		
HDPE (for secondary pipes)	75	500	-	-		
HDPE (for secondary pipes)	63	1,600	63	665		
HDPE (for secondary pipes)	50	3,200	50	1,500		
HDPE (for secondary pipes)	32	4,500	32	800		

## (5) Iron Treatment Plant

A treatment plant (aeration and slow sand filtration) was constructed at the hill top of the K3-1 system to reduce iron from 3.49 mg/l to less than 0.5 mg/l (the Vietnamese standard). No treatment plant was constructed for the G2 system.

#### (6) Storage Reservoirs

The storage reservoirs with a capacity of 5  $\text{m}^3$  of a temporary nature was constructed in order to ensure supply during the pilot period. The prefabricated temporary reservoir and elevated tank 6 m high were constructed in G2. The temporary reservoirs in G2 will later be replaced by permanent concrete reservoirs, when the actual implementation is started.

In K3-1 the concrete reservoir equipped with the iron removal plant was constructed.

## (7) Public Taps

The number of public taps constructed was 50 in K3-1 and 4 in G2 respectively. Two shower rooms are equipped with each public tap in K3-1 considering the local customs.

## (8) Pressure Testing and Disinfection

In K3-1 system, the pressure testing at every 300 m in length and at 1.5 times of the design pressure was carried out from  $29^{\text{th}}$  December of 2001 to  $11^{\text{th}}$  January of 2002 in the presence of PCERWASS and the JICA study team. In K3-1 system, the pressure test was also carried out from  $1^{\text{st}}$  to  $7^{\text{th}}$  of January 2002.

Following the pressure testing, the disinfection was carried out in the G2 and K3-1 system subjecting to all the relevant parts of the pipelines with a 50-mg/l solution for 24 hours. After disinfecting the system the residual chlorine content was reduced below 1 mg/l.

#### (9) Preliminary Design and Actual Construction

The following table shows major parts of technical design change or modification during the construction period of the 2 model plants compared with the preliminary design of the study team.

Syst	Work Item			K3-1	
em		Content	Original	Actual	Reason
	Public tap	Quantity	45 sets	50 sets	Request from CPC and villagers
	Distribution pipe	Material, spec.	PE D75 and D50	HDPE D75 and D50	Stronger than PE
K3-1	Distribution pipe	Material, spec.	PE D65	HDPE D63	Stronger than PE and local availability
	Distribution pipe	Material, spec	PE D25	HDPE D32	Stronger than PE and local availability
	Iron treatment plant	Item	none	Aeration & slow sand	Remove iron contents
	Distribution pipe, PVC	Material, spec	D150 mm	D140 mm	Local availability
	Distri. pipe, PVC D100	Material, quantity	500 m	1,435 m	Base on the hydraulic calculation
G2	Distri. pipe	Material, spec. & Q`ty	PE D65 x 1,600 m	HDPE D63 x 665 m	Stronger than PE, local availability & hydraulic calculation
	Distri. pipe	Material, spec.	PE D50	HDPE D50	Stronger than PE & local availability
	Distri. pipe	Material, spec.	PE D40	HDPE D50	Local availability & hydraulic calculation

# 3.3.3 Water Tariff and Financial Sustainability

The water tariffs were preliminary set by the study team consulting with CPC/TPC. The basic concepts in December 2001 are as follows:

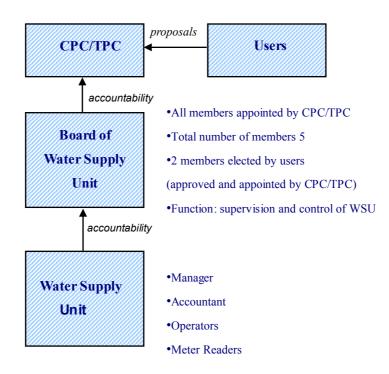
System	Estimated users	Average water use (lpcd)	water use sales		Total annual revenue (MVND/y)	Estimated annual expenditure (MVND/y)	Annual balance (MVND/y)	
K3-1	2164: 25% HC	35 for HC	38	2000	27.5	26.6	0.97MVND	
	and PT 75%	15 for PT						
G2	1150: 50% HC	35 for HC	26	1600	15.1	15.0	-0.14MVND	
	and 50% PT	15 for PT						

HC: house connection

PT: public tap

While the calculated annual balance for the K3-1 system is positive, that for the G2 system is negative. In order to meet the balance between the revenue and expenditure including the re-investment cost, the rate of house connections should be increased for the G2 system. Unless the 50 public taps are properly managed and water tariffs are collected by the local people in K3-1, the water supply systems will fall in deficit.

The present house connections of the K3-1 and G2 systems are reportedly 2 and 26, respectively. The calculations for the estimated water tariffs will become 2000 VND/m3 for K3-1, and 3000 VND/m3 at these house connection levels.



The study team has been strongly requesting to WSUs and PCERWASS for the necessity of more house connections to maintain sustainable management. IEC activities are most important to achieve the target number of house connections. The monitoring of the management of WSU will be continued for the reliable economic evaluation.

# 3.3.4 Water Supply Management Unit

After the discussions with CERWASS Hanoi and CPC, the Water Supply Unit (WSU) was established for the management of the water supply facilities during the construction stage.

The job positions and their duties were decided in the presence of JICA study team at the pilot model construction stage as follows.

## Water Supply Unit of K3-1

Board of WSU: by the selection from users (2 persons from users) and 3 from CPC

- Manager	Half day work only
- Accountant	Half day work only
- Operator	Full time work
- Inspector	Half day work only

## Water Supply Unit of G2

Board of WSU: by the selection from users (1 person from each village) and CPC

- Manager	Sometime work without salary
- Accountant	Half day work
- Operator	Full time work
- Inspector	Half day work

Transfer of technology and know-how of O/M to the WSU staff was carried out by the contractor and the JICA study team. The O/M manual and monitoring forms are provided in Appendix 8-9 in Supporting Report-B. The periodical water quality check by using portable kits was introduced to the operator of each WSU.

# 3.3.5 On-going IEC Activities

As the importance of IEC has been explained, the IEC activities are committed by Gia Lai PCERWASS in K3-1 and G2.

The following personnel who can speak both the Kinh and the ethnic minority languages are engaged in IEC:

K3-1: Doctors and nurses in the health center

G2: Former vice-chairman of CPC

Necessary information to be distributed as follows:

1) the <u>objectives</u> of the piped supply system,

2) the master plan drawings,

3) the implementation schedule,

4) the results of the water quality analysis,

5) the benefits of safe and clean water,

6) the costs for house connections and the water tariff,

7) how to reduce the cost for the management of the water supply system

8) how to keep the environment clean, and

9) the responsibilities of the local people.

#### 3.4 Percentage of House Connections

The most crucial issue is how to involve more users to the piped network through house connections. The willingness to pay in the social survey is relatively on the positive side.

As a result of IEC activities in the 2 pilot model areas, the number of house connections have been increased, which will raise the revenue level. The cost for IEC promoters are necessary and recommended to be supported by the Vietnam government. It is strongly recommended for PCERWASS to be involved in more IEC activities.

There are two (2) households which already had a house connections on 29 January 2002in K3-1 system. The installation of 5 additional public taps was requested to the study team from CPC because the target area is mostly composed of poor and very poor minority households. Some of the houses are willing to connect to the piped system in K3-1 system, but it was not yet achieved at the end of Jan. 2002, but three households were connected by the end of May 2002.

There are twenty-six (26) households which already had a house connections on 29 January 2002 (out of 138 houses ; 19%), and reached to 38 house holds at the end of May 2002 in G2 system (27%). The planned coverage for the house connections is 70%. According to the social survey and interviews in the model areas, high willingness for the house connections was reported and designed as many as 100 house connections. More intensive IEC activities are imperative in G2.

The capacity building of PCERWASS with regard to financial sustainability, O/M, and IEC is urgent. Regular training at CERWASS Hanoi for PCERWASS, and horizontal training between PCERWASS for IEC and technical issues are recommended.

## 3.5 Local Construction Skills and Materials

In Vietnam, a numbers of construction companies exist as listed below:

- 1) General construction companies locating Hanoi and Ho Chi Minh------ 9 companies
- 2) Middle sized construction companies in Da Nan, Nya Tran and Da Rat cities—7 companies
- 3) Construction companies for water supply system in the target provinces which have the experience of the similar projects:

- Construction Enterprise for Water Supply (Buon Ma Thout city)
- Tan Viet Groundwater construction company (Buon Ma Thout city)
- Thien Trung construction company (Buon Ma Thout city)
- Gia Lai State Enterprise in Mechanical Services (Pleiku)
- Subdivision No. 709 (Pleiku)
- Gia Lai Construction and Electric Assembly Company (Pleiku)

The pilot model plants by the local contractor, Gia Lai Construction and Electric Assembly Company (in Pleiku City, Gia Lai Province). The following table summarizes an evaluation of the local contractor in the course of construction supervision of the pilot models construction from November 2001 to December 2001:

Evaluation items	Evaluation
Understanding of contract	Still needs experience
Cost proposal	On-time, acceptable
Document preparation	Speedy, acceptable but needs English skill-up
Construction material preparation	Speedy and acceptable
Worker organization skill	Speedy and acceptable
Construction schedule	Followed the target schedule, acceptable
Understanding of progress meeting	Clearly understood
Quality control	Understand, but needs more attention at site

It is assessed that simple system for rural water supply could be constructed by the local contractors. Almost all of the construction materials for the rural water supply facilities are available in the local markets of Vietnam, except the submersible pump motors and control panels. Water meters are also available from Assembly Company in line with the licensed production of a qualified French Company. Popular water meters for house connection are made in China and made in India. The both meters were installed in G2 and K3-1 systems.

# 3.6 Necessary Monitoring Items

Necessary documents for monitoring items are in Appendix 8-1. The monitoring will be continued by WSU with the help of PCERWASS. The main items are listed below.

## **Daily operation records**

- Pump operation time, production water volume, and meter reading, water loss, conventional water quality test etc. (Form-c1)
- Maintenance records (Form-c2)
- List of summarized pump operation and water production (Form-c3)

## Monthly records

- Monthly report for new user registrations and remarkable O/M topics
- Records of every user (water meter reading)
- Records of water charge collections
- Account records (revenues and expenditures)
- Diseases and number of patients

# 3.7 Results of the Monitoring of O&M

# 3.7.1 Purpose and Methodology

A follow-up mission to collect the management and operation experience from the pilot models in Dak Ui (K3-1) and Nhon Hoa (G2) was undertaken by Mr. Pham Anh Dung (CERWASS) and the Study Team Member (Mr. Hannu Vikamn) in the period of May 04-08 May 2002. The mission collected records and documents from the two Water Supply Units (WSUs) operating the respective schemes, interviewed the managers and staff of the WSUs as well as customers, and visited sites, including pumping stations, treatment plant (in K3-1), public taps and private connections. The operation data was summarised in Table 3.1 for K3-1 system and Table 3.2 for G2 system in daily basis.

# 3.7.2 Progress and Status

Both pilot models had been taken into operation by the end of January 2002. Along with official handing-over a water quality kit and a set of manuals, model reports, records and documents were distributed to the WSUs.

The institutional capacity of both WSUs needs further building. G2 has managed to operate and maintain the system and collect revenues.

The problem is exacerbated by the status of PCERWASS of Kon Tum. The experience and capacity of PCERWASS is not up to the level of its counterpart in Gia Lai. Furthermore, PCERWASS of Gia Lai was involved in the implementation

of the pilot model Dak Ui, which has probably resulted in some confusion and misinterpretation of its responsibilities by PCERWASS of Kon Tum. The mission tried to clarify the situation and requested Kon Tum PCERWASS to closely follow-up and support the WSU and the People's Committee in Dak Ui.

The total number of house connections in G2 is 38 by May 08. There also three public taps at schools and a "public" tap at the market managed and operated by a vendor. The estimated number of beneficiaries, i.e., people using water from the scheme in G2 (excluding customers of the vendor) is about 170.

As shown Table 3.1 and Table 3.2, both schemes have been operated more or less on a daily basis with some interruptions particularly in K3-1. Interviewed customers reported to have benefited from almost uninterrupted service in both communes. Interruptions in K3-1 were explained to have resulted from power failures (one power failure occurred during a site visit) and few interruptions in G2 from installation of new customer connections.

Since the beginning, the total pumping in K3-1 until May 07 has been about 4,500 m<sup>3</sup>. Meters have been read twice. Based on very limited and partly questionable data from the end of March, "sold" water (so far unbilled) or rather metered water use was about 930 m<sup>3</sup> against the total pumping of about 1700 m<sup>3</sup>. This suggests that non-revenue water is some 45%. Obviously the most significant single reason for high losses is substantial overflow from the treatment plant, due to long pumping periods. By the arrangement of communication tools, there is no overflowing since June 2002.

The total pumping from the beginning until May 08 in G2 has been about 1,800 m<sup>3</sup>. WSU has maintained quite reliable monthly records. According to these records, the water use between January 27 and April 30 totalled 1,355 m<sup>3</sup> while the metered water use in the same period was 1,182 m<sup>3</sup>. Consequently, the non-revenue water is 13%.

The tariff in G2 is VND 2,000 per m<sup>3</sup> and it is said to be VND 1,500 per m<sup>3</sup> in K3-1. The tariff in G2 could provide sustainable financial status if the number of house connections and the volume of sold water increased closer to the capacity of the system. The tariff in K3-1 and its water sales are almost equal to the original estimate for the firast year due to high water consumption volume, though the house connection number is limited. IEC activities are important to increase the house connection.

According to the water analysis reports the water quality in both schemes is incompliance with the Vietnamese standards and international water quality standards. However, users in G2 have complained about water quality. Although nitrite was traced in the sample in an unknown amount at the beginning of the operation, repeated sampling and analysis managed by PCERWASS showed that no nitrite was traced. After boiling a small volume of white/greyish sedimentation can be observed at the bottom of vessels. It is possible and even likely that the problem is mainly aesthetic and does not involve any risks. The most probable cause is calcium. However, the mission took samples to be analysed in Buon Ma Thuot, Hanoi and Tokyo. The result is shown in Data Book "Water Quality". The water quality in G2 as perceived by the customers is restricts the interest of existing customers to use water and potential new customers to register. The results have confirmed that the water quality in G2, on the basis of the analysed parameters; i) does not constitute any risk for human health, ii) is in compliance with Vietnamese water quality standards (Standard 5050 of MOH) as well as international standards and guidelines (WHO, EU, EPA of USA, etc), and iii) is not affected by high iron concentrations of any substances that could explain the white/greyish sedimentation. Similar problems are often caused by high hardness, but analysed hardness (about 50 mg/l) and concentration of calcium (about 5 mg/l) in G2 are not much to explain the cause of sedimentation. It is very likely that the problem is mainly aesthetic and does not involve any risks.

The mission did not observe any wastage of water by users. For example, there were no taps of public water points left opened. In K3-1, some civil works of public water points have been partly damaged.

#### Issues

The issues in G2 include water quality in G2, lack of potential customers along pipelines (designed to serve minority population), manual pump operation (resulting in overflows) and pending action on establishment of rules, proper accounting, and more detailed data base on customers.

There are more issues in K3-1. The most serious are related to low level of system management.

There is rubbish (leaves and small branches from nearby trees) in filter basin of the treatment plant. The WSU constructed the cover after collecting the necessary money by the beginning of June 2002. Manual pump operation in K3-1 is not convenient due to the location of treatment plant far and high from the pumping station. Yet, the percentage of water losses and long-time pumping suggest that there is an urgent need to improve cost-consciousness of WSU. JICA Study Team donated the set of transceivers recently (June 2002) to WSU of K3-1 system for communication tool between the reservoir tank (iron removal treatment) and pump station.

The time for information, education and communication (IEC) has been far too short to achieve perfect results. For example, customers of K3-1 said that the water quality is very good. Yet, some of them (even teachers) preferred to drink water from shallow wells, due to the taste that they were used to (saying that the piped water "did not taste sweet"). Further IEC is definitely needed. It will take time whereas the capacity building of WSUs is a more urgent matter.

# 3.8 Lessons Learned

# 3.8.1 Institutional Aspects

Some of the communes selected for the Study, Dak Ui (K3-1) among them, have been generously supported by the Government of Vietnam through free or highly subsidized investments and services.

It is obvious that in a situation where extensive capacity building and mental reform is still required at the provincial level it is impossible to expect that the district level could have substantial role in supporting communes, WSUs and users. It will take time – probably several years – before the Units of Agriculture and Rural Development in the district will be upgraded and prepared to play the role suggested in the NRWSS.

## 3.8.2 Financial Aspects

The tariff of VND 2,000/ $m^3$  in G2 can be sufficient for financial sustainability even for the financing of re-investment in longer term. The number of house connections is still less than half of the estimated average of the first year in G2. The tariff of VND 1,500/ $m^3$  in K3-1 is enough for salary, electric charge payment and small size of repairs. Excessive pumping, very low number of metered house connections and extremely low start in billing and collection make the situation even worse, and the sustainability is at risk. The short period of operation of the pilot models does not provide for meaningful lessons. However, the laissez-faire management style of K3-1 WSU (No contracts, no formation of user groups) does not give an encouraging signal.

## 3.8.3 Technical Aspects

One of the most serious technical problems is the vulnerability of power supply. The unreliability of power supply is an external factor. Its impacts can be reduced by taking its impacts into account in the design of the water supply schemes.

Experience from the first few months of operation shows that pumps can be operated manually reasonably well (in G2). On the other hand, operation practice in K3-1 has ignored wastage of water and energy, even though the volume of the reservoir in K3-1 is manifold and should allow more accurate optimization of pumping than in G2.

It is vital that the WSU is able to make connections and repair broken pipelines.

Month	Date	Time (min)	F(s)	F (e)	F(m³)	Power (s)	Power (e)	ower (KWh)	F (m <sup>3</sup> /d) Day	F(m³/h)	E (KVVh/m³)	Time (s)	Time (e)
	26	710	1685	1793	108	251	292	41	Tue	9.1	0.38	6.30	18.20
	27	595	1793	1889	96	663	667	4	Wed	9.7	0.04	7.20	17.15
	28	650	1889	1819	-70	624	711	87	Thu	-6.5	-1.24	7.25	18.15
	29	0	1819	1819	0			0	Fri	0.0	#DIV/0!	No	power
	30	0	1819	1819	0			0	Sat	0.0	#DIV/0!	No	power
	31	615	1930	2020	90	729	772	43	Sun	8.8	0.48	8.05	18.20
Apr	1	660	2020	2124	104	772	791	19	Mon	9.5	0.18	7.00	18.00
	2	680	2124	2202	78	213	242	29	Tue	6.9	0.37	8.05	18.25
	3	715	2202	2324	122	281	294	13	Wed	10.2	0.11	6.20	18.15
	4	320	2324	2367	43	195	134	-61	Thu	8.1	-1.42	12.25	17.45
	5	665	2367	2422	55	934	952	18	Fri	5.0	0.33	7.15	18.20
	6	740	2422	2554	132	919	959	40	Sat	10.7	0.30	7.10	19.30
	7	0	2554	2554	0			0	Sun	0.0	#DIV/0!		power
	8	715	2554	2636	82	102	102	0	Mon	6.9	0.00	6.25	18.30
	9	0	2636	2636	0			0	Tue	0.0	#DIV/0!	No	power
	10	745	2636	2729	93	102	113	11	Wed	7.5	0.12	6.00	18.25
	11	660	2729	2801	72	111	114	3	Thu	6.5	0.04	7.15	18.15
	12	405	2801	2863	62	114	116	2	Fri	9.2	0.03	7.35	14.20
	13	450	2863	2928	65	116	119	3	Sat	8.7	0.05	7.45	15.15
	14	550	2928	3014	86	119	124	5	Sun	9.4	0.06	7.30	17.00
	15	670	3014	3123	109	124	129	5	Mon	9.8	0.05	7.20	18.30
	16	n.a.	3123	3123	0	129	132	3	Ti	0.0	#DI∨/0!	6.30	n.a.
	17	365	3123	3183	60	132	152	20	Wed	9.9	0.33	7.15	13.20
	18	0	3183	3183	0			0	Thu	0.0	#DIV/0!	No	power
	19	710	3183	3349	166	135	139	4	Fri	14.0	0.02	7.55	19.45
	20	310	3349	3396	47	139	142	3	Sat	9.1	0.06	6.50	12.00
	21	530	3396	3474	78	142	145	3	Sun	8.8	0.04	7.15	16.15
	22	0	3474	3474	0			0	Mon	0.0	#DI∨/0!	No	power
	23	605	3474	3558	84	145	149	4	Tue	8.3	0.05	7.00	17.15
	24	580	3558	3639	81	149	153	4	Wed	8.4	0.05	6.30	16.10
	25	705	3639	3724	85	153	157	4	Thu	7.2	0.05	6.30	18.15
	26	510	3724	3787	63	157	160	3	Fri	7.4	0.05	6.15	14.45
	27	710	3787	3793	6	160	164	4	Sat	0.5	0.67	7.25	17.15
	28	710	3793	3883	90	164	168	4	Sun	7.6	0.04	7.25	17.15
	29	0	3883	3883	0			0	Mon	0.0	#DIV/0!		power
	30	465	3883	3966	83	168	171	3	Tue	10.7	0.04	8.00	15.45
May	1	450	3966	4040	74	171	174	3	Wed	9.9	0.04	8.00	15.30
	2	495	4040	4087	47	174	177	3	Thu	5.7	0.06	8.45	17.00
	3	0	4087	4087	0			0	Fri	0.0	#DIV/0!		power
	4	630	4087	4156	69	177	182	5	Sat	6.6	0.07	6.00	15.00
	5	1480	4156	4367	211	182	187	5	Sun	8.6	0.02	7.20	18.00
	6	740	4367	4476	109	187	1020	833	Mon	8.8	7.64	6.00	18.20

## Table 3.1 Daily operation record

Month	Date	Time (min)	F (s)		F (m³)	Power (s)		ower (kWh)			F(m <sup>3</sup> /h)	E (KWh/m³)	Time (s)	Time (e)
Jan	27	25	270	273	3	150	152	2	3	Sun	7.2	0.67	13.00	13.25
	28	45	273	278	5	152	155	3			6.7	0.60	6.10	6.55
		25	278	280	2	155	155	0	- 7	Mon	4.8	0.00	11.40	11.65
	29	30	280	285	5	155	158	3	5	Tue	10.0	0.60	6.40	6.70
	30	30	285	289	4	158	160	2			8.0	0.50	12.15	12.45
		35	289	294	5	160	163	3	9	Wed	8.6	0.60	17.15	17.50
	31	30	294	298	4	163	165	2			8.0	0.50	6.00	6.30
		40	298	303	5	165	168	3	9	Thu	7.5	0.60	16.10	16.50
Feb	1	40	303	308	5	168	171	3			7.5	0.60	14.30	14.70
		35	308	312	4	171	173	2	9	Fri	6.9	0.50	18.00	18.35
	2	30	312	316	4	173	175	2			8.0	0.50	6.00	6.30
		25	316	318	2	175	175	0	6	Sat	4.8	0.00	13.00	13.25
	3	45	318	323	5	175	178	3			6.7	0.60	9.45	9.90
		35	323	328	5	178	181	3	10	Sun	8.6	0.60	17.40	17.75
	4	30	328	332	4	181	183	2			8.0	0.50	9.10	9.40
		35	332	336	4	183	185	2	8	Mon	6.9	0.50	14.15	14.50
	5	60	336	340	4	185	187	2	_		4.0	0.50	8.30	8.90
		30	340	347	7	187	191	4	11	Tue	14.0	0.57	10.30	10.60
	6	30	347	352	5	191	194	3	5	Wed	10.0	0.60	17.00	17.30
	7	55	352	362	10	194	198	4	· ·		10.9	0.40	9.00	9.55
		30	362	366	4	194	199	1	14	Thu	8.0	0.40	15.00	15.30
	8	50	366	372	6	199	202	3	17	ma	7.2	0.50	8.00	8.50
	0	35	372	377	5	202	202	3	11	Fri	8.6	0.60	17.00	17.35
	9	35	377	382	5	202	203	3	5	Sat	8.6	0.60	10.00	10.35
	10	50	382	388	6	203	200	6	6	Sai	7.2	1.00	6.00	6.50
	11	45	388	394	6	200		4	0	Sun				
				400			218		40	Man	8.0	0.67	6.50	6.95
	42	55 30	394 400	400	6	218	222	4	12	Mon	6.5	0.67	16.00	16.55
	12				4	222	224		40	<b>T</b>	8.0	0.50	10.00	10.30
	10	50	404	410	6	224	228	4	10	Tue	7.2	0.67	16.00	16.50
	13	50	410	416	6	228	234	6	40	104-1	7.2	1.00	7.00	7.50
		50	416	422	6	234	237	3	12	Wed	7.2	0.50	13.00	13.50
	14	50	422	428	6	237	240	3			7.2	0.50	8.00	8.50
		30	428	432	4	240	241	1	10	Thu	8.0	0.25	16.15	16.45
	15	30	432	436	4	241	242	1			8.0	0.25	7.15	7.45
		40	436	442	6	242	244	2	10	Fri	9.0	0.33	14.10	14.50
	16	40	449	455	6	244	246	2	6	Sat	9.0	0.33	7.10	7.50
	17	55	455	462	7	246	249	3	-		7.6	0.43	6.00	6.55
		55	462	469	7	249	252	3	14	Sun	7.6	0.43	13.00	13.55
	18	40	469	475	6	452	454	2	6	Mon	9.0	0.33	8.10	8.50
	19	40	482	489	7	454	456	2	-		10.5	0.29	8.30	8.70
		25	489	493	4	457	457	ō	11	Tue	9.6	0.00	13.15	13.40
	20	45	493	498	5	457	458	1			6.7	0.20	7.45	7.90
	20	40 60	498	505	7	457	461	3			7.0	0.43	13.00	13.60
		35	505	510	5	450	462	1	17	Wed	8.6	0.40	17.00	17.35
	21	60	510	516	6	461	464	2		*****	6.0	0.33	7.00	7.60
	- 21	60	516	522	6	462	464	3	12	Thu	6.0	0.50	14.00	14.60
	22	30	510	522	4	464	467		12	mu	8.0	0.50	7.00	7.30
	- 22				4	467	460	1	0	Eri		0.25	14.00	14.35
		35	526	531					9	Fri	8.6			
	23	60 25	531	538	7	469	473	4	40	C-4	7.0	0.57	6.00	6.60
		35	538	541	3	473	473	0	10	Sat	5.1	0.00	12.00	12.35
	24	40	541	546	5	473	476	3		0	7.5	0.60	7.10	7.50
		50	546	552	6	476	477	1	11	Sun	7.2	0.17	13.40	13.90
	25	30	552	556	4	477	478	1	4	Mon	8.0	0.25	10.00	10.30
	26	45	556	561	5	478	480	2	5	Tue	6.7	0.40	16.30	16.75
	27	30	561	565	4	480	481	1			8.0	0.25	6.30	6.60
		40	565	570	5	481	483	2	9	Wed	7.5	0.40	11.00	11.40
	28	65	570	578	8	483	487	4	8	Thu	7.4	0.50	6.00	6.65

## Table 3.2(1/4) Daily operation record of G2

Mar			F (s)	. (0)	F(m <sup>-3</sup> )	Power (s)	FOWER (E)	Power (kWh) F	i (in 7u	j Day	F(m <sup>3</sup> /h)	E (KWh/m <sup>3</sup> )	Time (s)	Time (e)
	1	45	578	582	4			0			5.3	0.00	8.30	8.75
(		50	582	588	6			0	10	Fri	7.2	0.00	14.30	14.80
	2	50	588	593	5			0			6.0	0.00	9.00	9.50
		50	593	599	6			0	11	Sat	7.2	0.00	17.00	17.50
	3	50	599	605	6			0			7.2	0.00	8.00	8.50
		50	605	612	7			0	13	Sun	8.4	0.00	15.30	15.80
	4	0	612	612	0			0	0	Mon	0.0	0.00		ower
	5	370	612	633	21			Ő		mon	3.4	0.00	7.00	13.10
		110	633	638	5			0 0	26	Tue	2.7	0.00	18.00	19.50
	6	80	638	644	6			0	20	Tuc	4.5	0.00	8.00	8.80
			644						40	\0/eed				
		70		651	7			0	13	Wed	6.0	0.00	15.00	15.70
	7	80	651	661	10			0	40	T1	7.5	0.00	6.00	6.80
		100	661	669	8			0	18	Thu	4.8	0.00	15.10	16.50
	8	60	669	675	6			0			6.0	0.00	7.00	7.60
L		40	675	670	-5			0			-7.5	0.00	13.00	13.40
		80	670	676	6			0	7	Fri	4.5	0.00	18.00	18.80
	9	80	676	683	7			0			5.3	0.00	7.10	7.90
		85	683	690	7			0	14	Sat	4.9	0.00	14.00	14.85
	10	75	690	696	6			0			4.8	0.00	8.00	8.75
		40	696	700	4			0	10	Sun	6.0	0.00	13.30	13.70
	11	50	700	706	6			0	6	Mon	7.2	0.00	12.00	12.50
	12	50	706	712	6			0	6	Tue	7.2	0.00	6.00	6.50
	13	50	712	718	6			0			7.2	0.00	6.30	6.80
		40	718	723	5			0	11	Wed	7.5	0.00	13.00	13.40
	14	50	723	729	6			Ō	6	Thu	7.2	0.00	6.30	6.80
	15	90	729	737	8			0	· ·	11104	5.3	0.00	7.10	8.40
	13	40	737	742	5			0	13	Fri	7.5	0.00	18.10	18.50
	40								15	FI				
	16	50	742	748	6			0	40	0.4	7.2	0.00	7.30	7.80
		60	748	754	6			0	12	Sat	6.0	0.00	13.00	13.60
	17	80	754	764	10			0		-	7.5	0.00	6.00	6.80
		25	764	767	3			0	13	Sun	7.2	0.00	14.00	14.25
	18	40	767	773	6			0			9.0	0.00	8.30	8.70
		40	773	778	5			0	11	Mon	7.5	0.00	14.10	14.50
	19	50	778	784	6			0			7.2	0.00	6.00	6.50
		30	784	788	4			0			8.0	0.00	11.00	11.30
		70	788	796	8			0	18	Tue	6.9	0.00	16.00	16.70
	20	65	796	805	9			0			8.3	0.00	6.00	6.65
		30	805	809	4			0	13	Wed	8.0	0.00	11.00	11.30
	21	45	809	816	7			0			9.3	0.00	6.00	6.45
		40	816	822	6			0	13	Thu	9.0	0.00	13.00	13.40
	22	40	822	828	6			0			9.0	0.00	6.00	6.40
		35	828	833	5			0			8.6	0.00	11.00	11.35
		30	833	837	4			ů O	15	Fri	8.0	0.00	15.00	15.30
	23	55	837	844	7			0			7.6	0.00	6.00	6.55
		60	844	850	6			0	13	Sat	6.0	0.00	18.00	18.60
	24	120	850	861	11			0	10	Joa	5.5	0.00	7.00	9.00
	24	30	861	864	3			0			6.0	0.00	15.00	15.30
				_					47	Sup				
		30	864	867	3			0	17	Sun	6.0	0.00	17.00	17.30
	25	35	867	872	5			0	40		8.6	0.00	8.00	8.35
$\vdash$		40	872	877	5			0	10	Mon	7.5	0.00	15.00	15.40
	26	40	877	883	6			0		-	9.0	0.00	6.00	6.40
		55	883	890	7			0	13	Tue	7.6	0.00	14.15	14.70
	27	60	890	896	6			0	6	Wed	6.0	0.00	6.00	6.60
	28	40	896	901	5			0			7.5	0.00	6.00	6.40
		60	901	909	8			0	13	Thu	8.0	0.00	11.00	11.60
	29	40	909	914	5			0			7.5	0.00	6.00	6.40
		40	914	919	5			0	10	Fri	7.5	0.00	11.00	11.40
	30	105	919	928	9			0	-		5.1	0.00	6.00	7.05
		60	928	936	8			0	17	Sat	8.0	0.00	11.00	11.60
	31	120	936	945	9			0			4.5	0.00	8.00	10.00
		120	945	957	12			0		-	7.2	0.00	9.20	11.00
		30	957	961	4			0	25	Sun	8.0	0.00	15.30	15.60

## Table 3.2(2/4) Daily operation record of G2

Month	Date	Time (min)	F (s)		F (m³)	Power (s)	Power (e)	<sup>v</sup> ower (kWh)			F(m³/h)	E (KWh/m³)	Time (s)	Time (e)
Apr	1	n.a.	961	973	12			0	12	Mon	#VALUE!	0.00	11.20	n.a
	2	90	973	983	10			0			6.7	0.00	8.30	10.00
		60	983	990	7			0			7.0	0.00	13.00	13.60
		80	990	1000	10			0			7.5	0.00	6.00	6.80
		60	1000	1008	8			0	35	Tue	8.0	0.00	11.00	11.60
	3	55	1008	1015	7			0			7.6	0.00	6.00	6.55
		95	1015	1024	9			0			5.7	0.00	10.00	10.95
		60	1024	1032	8			0	24	Wed	8.0	0.00	17.00	17.60
	4	55	1032	1039	7			0			7.6	0.00	6.00	6.55
		65	1039	1048	9			0			8.3	0.00	11.00	11.65
		n.a.	1048	1051	3			0	19	Thu	#VALUE!	0.00	n.a.	n.a
	5	115	1051	1066	15			0			7.8	0.00	9.50	11.45
		50	1066	1074	8			0	23	Fri	9.6	0.00	3.00	3.50
	6	110	1074	1085	11			0			6.0	0.00	6.15	8.05
		90	1085	1094	9			0	20	Sat	6.0	0.00	13.10	14.40
	7	90	1094	1105	11			0			7.3	0.00	6.00	6.90
		40	1105	1110	5			0			7.5	0.00	12.00	12.40
		40	1110	1115	5			0	21	Sun	7.5	0.00	16.10	16.50
	8	125	1115	1132	17			0			8.2	0.00	6.00	8.05
		90	1132	1145	13			Ő	30	Mon	8.7	0.00	11.00	11.90
	9	0			0			0 0	13	Tue	#DIV/0!	#DIV/0!		
	10	60	1145	1153	8			0			8.0	0.00	6.00	6.60
	- 10	60	1153	1161	8			0			8.0	0.00	11.00	11.60
		30	1161	1165	4			0	20	Wed	8.0	0.00	14.00	14.30
	11	90	1165	1177	12			0	20	* YCu	8.0	0.00	6.00	6.90
		90	1177	1188				0	23	Thu	7.3	0.00	11.00	
	40				11			0	23	Thu				11.90
	12	95	1188	1199	11				7	E.	6.9	0.00	6.00	6.9
	40	130	1199	1215	16			0	27	Fri	7.4	0.00	13.00	15.10
	13	80	1215	1225	10			0			7.5	0.00	7.10	7.90
		130	1225	1237	12			0	22	Sat	5.5	0.00	13.00	15.10
	14	110	1237	1252	15			0		-	8.2	0.00	7.10	9.00
		180	1252	1268	16			0	31	Sun	5.3	0.00	17.00	20.00
	15	60	1268	1275	7			0			7.0	0.00	9.00	9.60
		140	1275	1279	4			0	11	Mon	1.7	0.00	17.30	18.50
	16	65	1279	1286	7			0			6.5	0.00	7.15	7.8
		60	1286	1292	6			0			6.0	0.00	13.00	13.6
		40	1292	1296	4			0	17	Tue	6.0	0.00	15.00	15.4
	17	60	1296	1312	16			0			16.0	0.00	8.00	8.6
		40	1312	1316	4			0	20	Wed	6.0	0.00	12.30	12.70
	18	135	1316	1326	10			0			4.4	0.00	8.00	10.15
		60	1326	1335	9			0	19	Thu	9.0	0.00	14.00	14.60
	19	140	1335	1345	10			0			4.3	0.00	8.00	10.20
		100	1345	1351	6			0			3.6	0.00	15.00	16.4
		50	1351	1355	4			0	20	Fri	4.8	0.00	18.00	18.50
	20	150	1355	1368	13			0			5.2	0.00	8.00	10.30
		60	1368	1376	8			0			8.0	0.00	14.00	14.6
		45	1376	1380	4			0	25	Sat	5.3	0.00	18.00	18.4
	21	150	1380	1392	12			0		-	4.8	0.00	8.00	10.3
		60	1392	1399	7			Ő			7.0	0.00	14.00	14.6
		50	1399	1404	5			Ő	24	Sun	6.0	0.00	19.00	19.5
	22	75	1404	1414	10			0			8.0	0.00	7.30	8.4
		75	1414	1422	8			Ő			6.4	0.00	11.00	11.7
		40	1422	1429	7			0	25	Mon	10.5	0.00	17.40	17.8
	23	40 70	1429	1438	9			0	23	MOL		0.00	7.00	7.7
	23	60	1429	1450				0			7.7	0.00	12.00	12.6
					12				27	Tue	12.0			
		60	1450	1456	6			0	27	Tue	6.0	0.00	19.00	19.6
	24	80	1456	1470	14			0			10.5	0.00	7.30	8.5
		30	1470	1480	10			0		1.4.1.1	20.0	0.00	12.00	12.3
		60	1480	1487	7			0	31	Wed	7.0	0.00	18.00	18.6
	25	90	1487	1500	13			0		_	8.7	0.00	8.30	10.00
		120	1500	1510	10			0	23	Thu	5.0	0.00	17.00	19.0
	26	80	1510	1519	9			0			6.8	0.00	7.00	7.8
		100	1519	1530	11			0	20	Fri	6.6	0.00	13.00	14.4

## Table 3.2(3/4) Daily operation record of G2

Month	Date	Time (min)	F (s)	F (e)	F (m <sup>3</sup> )	Power (s)	Power (e)	ower (kWh)	F (m <sup>3</sup> /d)	) Day	F (m <sup>3</sup> /h)	E (kWh/m³)	Time (s)	Time (e)
	27	70	1530	1538	8			0			6.9	0.00	7.30	8.40
		50	1538	1543	5			0			6.0	0.00	13.00	13.50
		40	1543	1548	5			0	18	Sat	7.5	0.00	18.10	18.50
	28	80	1548	1558	10			0			7.5	0.00	7.00	7.80
		60	1558	1563	5			0			5.0	0.00	13.00	13.60
		60	1563	1568	5			0	20	Sun	5.0	0.00	18.00	18.60
	29	80	1568	1578	10			0			7.5	0.00	7.30	8.50
		40	1578	1588	10			0	20	Mon	15.0	0.00	16.00	16.40
	30	90	1588	1597	9			0			6.0	0.00	6.00	6.90
		120	1597	1608	11			0	20	Tue	5.5	0.00	18.00	20.00
May	1	70	1608	1615	7			0			6.0	0.00	6.20	6.90
		60	1615	1620	5			0			5.0	0.00	14.00	14.60
		70	1620	1627	7			0	19	Wed	6.0	0.00	18.00	18.70
	2	75	1627	1635	8			0			6.4	0.00	7.00	7.75
		75	1635	1642	7			0			5.6	0.00	15.00	15.75
		60	1642	1648	6			0	21	Thu	6.0	0.00	19.00	19.60
	3	80	1648	1658	10			0			7.5	0.00	7.30	8.50
		65	1658	1667	9			0	19	Fri	8.3	0.00	15.25	15.90
	4	65	1667	1672	5			0			4.6	0.00	8.10	8.75
		75	1672	1679	7			0			5.6	0.00	13.30	14.45
		80	1679	1685	6			0	18	Sat	4.5	0.00	18.20	19.40
	5	90	1685	1695	10			0			6.7	0.00	7.30	9.00
		70	1695	1701	6			0			5.1	0.00	14.30	15.40
		60	1701	1705	4			0	20	Sun	4.0	0.00	18.00	18.60
	6	120	1705	1717	12			0			6.0	0.00	8.00	10.00
		110	1717	1726	9			0			4.9	0.00	14.00	15.50
		60	1726	1730	4			0	25	Mon	4.0	0.00	18.00	18.60
	7	80	1730	1738	8			0			6.0	0.00	7.30	8.50
		50	1738	1747	9			0			10.8	0.00	14.10	14.60
		100	1747	1755	8			0			4.8	0.00	17.20	18.40

## Table 3.2(4/4) Daily operation record of G2

#### Figure 3.1 Schedule of Model Plants Construction in Dak Ui (K3-1) and Nhon Hoa (G2) Communes

		1	1			2 0 0 1 2 0 0 2
	Activities / Construction Items / Work Items	Unit	Q`ty	Aug.	Sept.	Oct. Nov. Dec. Jan. Feb. Mar. Apr. May
			1		1 2 3 4	1 2 3 4 1 1 2 3 4 1 2 3 4 1 1 1 2 3 4 1 1 1 2 3 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
Α	Pre-construction activities					
	a) Preparation of Candidate Subcontractor's List	LS	1			Legends
	b) Selection of Candidate Subcontractors	LS	1			Site survey : wet season
	c) Preparation of Sub-Contarct Agreement and Terms of Reference (TOR)	LS	1			1st step design and drawings
	d) Approval of JICA for Sub-Contract Agreement and TOR	LS	1			Priced bill of quantities
	e) Review & Acknowledgement by CERWASS for Sub-Contract and TOR	LS	1			Others, required
	<li>f) Distribution of TOR to Candidate Sub-Contractors</li>	LS	1			
	g) Preparation of Proposals by the Candidate Sub-Contractors	LS	1			8th October 2001
	h) Closing Date of Submission of Proposals	LS	1			
	i) Assessment of Proposals / Recommendation to JICA	LS	1			
	j) JICA's Concurrence and Approval	LS	1			
	k) Conclusion of Sub-Contract Agreement	LS	1			
В	Construction	1				
	B1 Survey and design, K3-1 and G2					
	1) Topographic survey	LS	1			
	2) 2nd step design	LS	1			
	B2 Mobilization, Demobilization and Procurement, K3-1 and G2					
	1) Mobilization / Demobilization					
	2) Procurement of pump, pipes, fittings and others					
	B3 K3-1 Dak Ui Commune (No. 1A, 1B, 5B, 6 and 7, Peak demand : 2.0 m3/h)		1			
	1) Well head arrangements	LS	1			
	2) Raw water pump, furnishing and installation					
	- Submersible pump, 1.0 l/s x 70 m	no.	1			
	- Control panel, motor protection, motor cable of 100 m	no.	1			
	3) Power supply from national grid	LS	1			
	<ol> <li>Storage reservoir, 5 m3 tank, valves, bends &amp; others</li> </ol>	LS	1			
	5) Raw water main, furnishing and installation					
	- GI materials, 100 mm dia.	lin.m	1,400			
	- Sector valves, 100 mm dia	no.	2	1		
	- Valve chambers, bends 90 degrees, each	no.	2			
	6) Distribution pipes, furnishing and installation					
	- Clearing of piperoute	sq.m	12,000			
	- PVC w/valves, 100 mm dia.	lin.m	600			
	- PE w/valves, 90 mm dia.	lin.m	500			
	- PE w/valves, 65 mm dia.	lin.m	1,600			
	- PE w/valves, 50 mm dia.	lin.m	3,200			
	- Valve chambers	no.	12			
	- bends and tees	LS	1			
	7) Small distribution pipes and valves	LS	1	T		
	8) Public taps, type 3, w/meter	no.	45			
	9) Pressure testing	LS	1			
	10) Disinfection	LS	1			
	B4 G2 Nhon Hoa Commune (Plei Kia & Hoa An Villeges, Peak demand : 1.1 m3/h)					
	1) Well head arrangements	LS	1			
	2) Raw water pump, furnishing and installation					
	- Submersible pump, 1.0 l/s x 70 m	no.	1			
	- Control panel, Motor protection, motor cable of 200 m	LS	1			
	3) Power supply from national grid	LS	1	-		<del>┆╶┫╍╎╍╏╺╎╺<b>╞═╡</b>╶╎╶╏╍┨╍╢╍╢╸┨╶╣╶╎╴╎╴┨╶┥╼┨╍╢╍╢╸╢╺╢╵╿╵╵╵</del>
	4) Storage reservoir, 5 m3 tank, valves, bends & others	LS	1			┼ <del>╏╷╎╎┝╪╡</del> ╎╎╎╎╴ <del>╞╪╡</del>
	5) Raw water main, furnishing and installation		+	-		┼╍╊╍┼╍╉╌┼╌┼╌╎╌┨╍╁╍┨╍╫╌┫╌╎╴┥╴╎╴┫╌┼╼╋╍┼╍┨╾╎╴┫╴╎╴
	- Clearing piproute	sq.m	1,000	-		┼╌╂╌┼╌┨╌┽╌┠═╡╌┼╶┨╌┽╌┨╌╢╌┨╶╢╴╢╴╢╴╢╴╢╴╢╴╢╴╢╴╢╴╢
	- GI materials, 100 mm dia.	lin.m	500			<del>╷╻╷╷╷╷╷╷╷┍╪╪╪╡</del> ╻╻╻╴╴╴╴╴╴╴╴
	- Sector valves, 100 mm dia	no.	2			<del>┊╶┨┈╎╌╽╶╎╶╿┝<b>╪╒╪╤╡</b>┥┨╶┨╶╿╶╿╶╿╶╿╶╿╶╿╶╿╶╿</del>
	- Valve chambers, bends 90 degrees each	no.	2			┼╂┼┼╂┼╎┝╪╪╪╧┥╂┼╏┼╎┼╏┼┼┼╎╎
	6) Transmission pipes w/valves, bends and tees		1 7.000			┼╂┽┿╋╌┫┊╴╏╴╎╴╏╺╋╌┫╌┥╼┫╴╏╴╎╴╏╴┨╺╋╌┥╸┥╴┥╴
	- Clearing of pipe route	sq.m	7,000			<del>╎┨┽┽┽┿┫╎┨┝╪╪</del> ╋┼╂┿╉┨┨┊╎╎╎╎╎┨┼╋┽┥┥╿╵
	- PVC, 150 mm dia., furnishing and installation	lin.m	600			┼┼┼┼┼┼╎┼╞╪╪╪╤╡┼╏╎╎┼╎╢┼╢╎╢╎╎
	- PE, 100 mm dia., furnishing and installation	lin.m	500			┼╌╂╌┼╌┦╌┼╌┼╌┼ <del>╞╪╪╪╤╡</del> ╌┨╶╢╌╢╴╢╌╢╌╢╌╢╌╢╌╢╌╢╌╢╌╢
	- PE, 65 mm dia., furnishing and installation	lin.m				┼╍┠╍┼╍┨╌┼╌┼╌┼ <del>╞╹╪╍╪╍╡</del> ╍╉╌┨╌╎╌┠╌┼╍┨╌┼╌╢╌┼╌╢╌┼╌╢╴┼╶╢
	- PE, 50 mm dia., furnishing and installation	lin.m	1,500			┼ <del>╏╎┥┥┥┥┥┥┥┥┝<b>╞╪╪╤┥</b>┥┥┥┥┥┥┥┥┥┥┥┥┥┥┥</del>
	- PE 40 mm dia., funishing and installation	lin.m	1,500			┼╍╊╍┼╍╊╍┼╌╂╌╎╌╎╴╊╍╪╍╋╍╉╌┨╴┼╌╎╴┠╶╎╍╊╍┼╍╄╍┼╍┠╸┼╌┠╶┼╌
	7) Distribution pipes		3,000			┽╍╊╍┿╍╋╍┿╍╉╌┿╌╂╌┝╌┼╼╉╍╋╍╋╍╋╍╋╌╋╌┿╌┾╍╋╍┿╍╋╍┿╍╋╍┿╼╋╍┿╌╋╌┿╌
	Clearing of piperoute     PE w/whyse bands 25 mm dia furnishing and installation	sq.m	3,000			┼╂┽┽╋┽┫╴╴┍┓╴╴╴╸╸
	PE w/valves, bends 25 mm dia., furnishing and installation	lin.m		· · · · · ·	+++	┼╍╁╍┼╍╁╶┼╶┼╶┼╴┼╴ <b>╞╍╪╍╪╍╕</b> ╍╉╶╏╴╎╴╎╴┠╶╎╼╂╍┼╍╂╍╎╸┨╴╎╴╿
	8) Public taps, type 3, w/meter	no.	4			┼╍┟╍┟╍┨╌┼╌┼╌┦╌┨┍╋╤╤┫╍┨╶┨╌╎╌┨╌╎╌┨╌┼╌┨╌┼╌┨╌┼╌┨╴┼╴┦╴┼
	9) Pressure testing	LS	+ 1			<u>┼╂┼┼┼┼┼┼┼┼┼╊╇╋┼╏┼┼┼┼┼┼┼┼┼┼┼</u> ┼┼
	10) Disinfection	LS	1			┼╍╆╍┼╍╉╶┼╌┼╌┽╌╉╼╉╍╋┲╋╸╋╌┼╌┼╌┨╌┽╼╋╍┼╸╇╶┼╴┼
С	Operation and Maintenance of Model Plants and Its Monitoring		·	_		┼╉┽┼┼┽┩╎┨╎╎╏┥┥┓╸
	C1 K3-1 Dak Ui Commune	LS	1			<u>│</u>
	C2 G2 Nhon Hoa Commune	LS	1	-		•••••••••••••••••••••••••••••••••••••••
D	Intermediate Assessment of Model Plant					┼╼╋╾┽╾╋╼┽╾╉╌┽╌╉╌┽╼╋╌╋╼╋╼╋╴╋╴┽╴┥╴╋╴┥╸╋╸┥╸
	D1 K3-1 Dak Ui Commune	LS	1	-		┼╍┟╍┼╍┼╍┼╌┼╌┼╌┼╌┼╍┼╍┝┍╧╧╧╧╧╧╧╧╧╧╧╧╧╧
l	D2 G2 Nhon Hoa Commune	LS	1			

# Chapter 4 Cost Estimation and Implementation Plan

# 4.1 Project Cost

## 4.1.1 Conditions and Assumptions for Cost Estimate

The construction cost for the selected 21 priority systems has been estimated under the following conditions and assumptions:

- 1) The price level is the year 2001
- 2) Exchange rate is US\$ 1.0 = VND = 15,000 = JY 120.0
- 3) The estimates were reviewed on a financial basis with the cost composition and conditions as given in the Table 4.1.

Project Cost item	Parameters	No.
Direct construction cost	Unit cost or lump sum basis	А
VAT (Value Added Tax)	10 % of A	В
Construction cost	A+B	С
Land acquisition and compensation cost		D
Engineering services expenses	15 % of C	Е
Base cost	C+D+E	F
Physical contingency	10 % of F	G
Project cost	F+G	Н
Price contingency	10 % of H	Ι
Total investment cost		H+I

4) The unit costs applied for the cost estimates are tabulated in Table 4.2.

No.	Construction Items		Unit Cost	FC Pc	ortion	LC Portion	
			(US\$)	(US\$)	(%)	US\$	(%)
1	Deep well	well	40,000	20,000	50	20,000	50
2	Submersible pump	set	6,000	5,000	83	1,000	17
3	Well head arrangement	head	1,900	500	26	1,400	74
4	Control panel	panel	2,200	2,000	91	200	9
5	Power supply	station	4,300	0	0	4,300	100
6	Well head house	m2	180	0	0	180	100
7	Reservoir, ground 50 m3	m3	107	0	0	107	100
8	Treatment plant						
	Aeration & reaction basin	m3	400	0	0	400	100
	Rapid sand filter	m2	2,000	0	0	2,000	100
	Roughing & slow sand filter	m2	1,500	0	0	1,500	100
9	Booster pump station	m3/hr	518	300	58	220	42
10	Chlorinator	item	4,400	2,200	50	2,200	50
11	Raw water lines, GI 100 mm	m	16	0	0	16	100
	included fittings, tests & all other works						
12	Distribution lines including fittings,						
	tests & all other works						
	PVC 100 mm	m	16.0	0	0	16.0	100
	PVC 150-200 mm	m	17.0	0	0	17.0	100
	HDPE 25-65 mm	m	6.0	0	0	6.0	100
	HDPE 75-125 mm	m	9.5	0	0	9.5	100
13	Public taps	tap	500	0	0	500	100

Table 4.2 Unit Cost for Major Items with Foreign and Local Currency Portion

Foreign and Local currency portions are categorized as following a) and b). The project cost was expressed by US\$.

- a) Local currency portion
- Labor costs
- Locally available materials, facilities and equipment
- Inland transportation cost for materials to be imported
- Value added tax (VAT)
- Land acquisition and compensation costs
- Local portion of engineering services expenses
- Contingencies for local portion
- b) Foreign currency portion
- Cost of materials, facilities and equipment to be imported
- Foreign portion of engineering services expenses
- Contingencies for foreign portion
- 5) The direct construction cost was estimated by multiplying work quantity and unit construction cost in principle. The work quantity was estimated based on

the system layout, outline dimensions and proposed capacities of the facilities for the priority systems of each commune. The cost for capacity building, IEC, O&M activities and other soft components are estimated by man-month basis for human resource input ant tools required for these activities. It shall be prepared by Vietnamese side.

- 6) The unit costs in Table 4.1 was determined with referring the published current cost standards in 3 provinces of Kon Tum, Gia Lai and Dac Lac, international market price of construction materials and facilities, cost proposals for the construction of 2 pilot model plants at K3-1 and G2 communes, and other data obtained during the study period. The unit costs presented in this study are to be reviewed in future.
- 7) The power required for the rural water supply system is by connecting system to the existing power line of national grid. The cost comparison between the generator driven system and the existing power lone is shown in Appendix 5.
- 8) A 10 % of construction cost was added as for the value added tax (VAT) following to the Vietnamese regulation.
- 9) Land acquisition and compensation costs were itemized in the format sheet of cost estimate. No cost was accounted it as the government owned land.
- 10) Engineering service expenses assume at 15 % of construction cost for the survey, investigation, and design and construction supervision for respective scheme.
- 11) A 10 % of base cost was counted for the physical contingency considering present maturity of the project and for unforeseeable site conditions, etc.
- 12) Price contingency was itemized in the format sheet of cost estimate. No cost was accounted on an assumption that project will be implemented in an early stage.

Project costs were further subdivided in the next section of 3.1.2 "Construction Cost".

#### **4.1.2** Construction Cost

The construction cost of the 21 systems has been estimated at US\$ 13.7 million or equivalent VND 205.5 billion. Its foreign currency and local currency portion are 13 % and 87 %, respectively, excluding procurement for drilling equipment. Table 4.3 shows summary for 21 systems in phase 1 by four steps to the year 2010.

Phasing	ing Implementation Period		Cost excluding procurement of equipment (US\$ million
_		System	including VAT)
Step 1	2002-2004	5	5.1
Step 2	2004-2006	5	3.0
Step 3	2006-2008	4	1.8
Step 4	2008-2010	7	3.8
	Total	21	13.7

Table 4.3 Cost for the 21 Systems by 4-step Implementation

The step-wised project cost is tabulated in Table 4.4 with the implementation mode of four cases of step 1, step 2 step 3 and step 4.

#### Table 4.4 Alternative Cost Study by Phasing Implementation in Phase1

(Alternative1:Four steps implementation)

Serial No. System No.		Name of	Construction Cost	Base Cost	Project Cost (US\$) *3					
			Commune	(US\$)*1	(US\$)*2	1st step	2nd step	3rd step	4th step	step 1 to 4
						5-system	5-system	4-system	7-system	21-system
						2002-2004	2004-2006	2006-2008	2008-2010	2002-2010
		Kon Tum		2,140,805	2,461,926	561,334	581,175	259,908	1,305,702	2,708,119
1	1	K1-1	Bo Y	875,885	1,007,268				1,107,995	1,107,995
2	2	K2-1	Dak Su	156,290	179,734				197,707	197,707
3	3	K2-3	Dak Su	443,742	510,303	561,334				561,334
4	4	K3-1	Dak Ui	205,461	236,280			259,908		259,908
5	5	K4-1	Dak Hring	459,427	528,341		581,175			581,175
		Gia Lai		3,392,611	3,901,503	2,098,521	1,205,832	699,827	287,473	4,291,653
6	1	G1	Kong Tang	607,639	698,785		768,663			768,663
7	2	G2	Nhon Hoa	1,064,964	1,224,709	1,347,179				1,347,179
8	3	G3-1	Chu Ty	593,946	683,038	751,342				751,342
9	4	G4-1	Thang Hung	345,588	397,426		437,169			437,169
10	5	G5-1	Ngia Hoa	340,560	391,644			430,808		430,808
11	6	G6-1	Ia Rsiom	212,663	244,562			269,019		269,019
12	7	G7-1	Kong Yang	227,251	261,339				287,473	287,473
		Dac Lac		4,515,889	5,193,272	1,982,864	1,153,380	688,513	1,887,841	5,712,598
13	1	D1	Krong Nang	640,632	736,727	810,399				810,399
14	2	D2	Ea Drang	926,850	1,065,878	1,172,465				1,172,465
15	3	D3-1	Krong Buk	337,039	387,595		426,354			426,354
16	4	D3-2	Krong Buk	321,530	369,760				406,735	406,735
17	5	D4-1	Ea Drong	544,279	625,921			688,513		688,513
18	6	D4-2	Ea Drong	246,098	283,013				311,314	311,314
19	7	D5-1	Ea Wer	566,628	651,622				716,784	716,784
20	8	D6	Kien Duc	574,724	660,933		727,026			727,026
21	9	D7	Krong Kmar	358,109	411,825				453,008	453,008
		Total		10,049,305	11,556,701	4,642,719	2,940,387	1,648,248	3,481,016	12,712,370
		VAT (10 %)				361,792	191,721	176,239	275,179	1,004,931
		Total				5,004,511	3,132,108	1,824,487	3,756,195	13,717,301

US\$	1.0=VND	15,000.0=JY	120.0

Notes \*1 Construction cost

\*2 Base cost = Construction cost + Land acquisition cost + Engineering services cost (15% of construction cost)

\*3 Project cost = Base cost + Physical contingency (10 % of base cost), excluding price contingency

Table also shows summary cost for 21 systems in phase1 divided into foreign and local currency portions.

Soria	ıl No.	Syatem No.	Name of Commune	FC <1	LC <2	Total <3	Total Equivalent <3	
Serial NO.		System No.	Name of Commune	(US\$)	(US\$)	(US\$)	(1,000 VND)	
		Kon Tum		384,633	2,323,485	2,708,118	40,621,772	
1	1	K1-1	Bo Y	255,043	852,952	1,107,995	16,619,918	
2	2	K2-1	Dak Su	9,708	187,999	197,707	2,965,603	
3	3	K2-3	Dak Su	99,457	461,877	561,334	8,420,004	
4	4	K3-1	Dak Ui	9,708	250,201	259,908	3,898,622	
5	5	K4-1	Dak Hring	10,719	570,456	581,175	8,717,624	
		Gia Lai		504,580	3,787,073	4,291,653	64,374,794	
6	1	G1	Kong Tang	59,635	709,028	768,663	11,529,950	
7	2	G2	Nhon Hoa	238,308	1,108,871	1,347,179	20,207,692	
8	3	G3-1	Chu Ty	62,229	689,112	751,342	11,270,125	
9	4	G4-1	Thang Hung	55,591	381,578	437,169	6,557,532	
10	5	G5-1	Ngia Hoa	52,386	378,422	430,808	6,462,126	
11	6	G6-1	Ia Rsiom	21,916	247,102	269,019	4,035,280	
12	7	G7-1	Kong Yang	14,515	272,958	287,473	4,312,088	
		Dac Lac		817,870	4,894,729	5,712,600	85,688,994	
13	1	D1	Krong Nang	106,815	703,584	810,399	12,155,992	
14	2	D2	Ea Drang	203,055	969,410	1,172,465	17,586,979	
15	3	D3-1	Krong Buk	63,603	362,752	426,354	6,395,315	
16	4	D3-2	Krong Buk	46,301	360,435	406,735	6,101,032	
17	5	D4-1	Ea Drong	93,843	594,669	688,513	10,327,694	
18	6	D4-2	Ea Drong	40,196	271,118	311,314	4,669,710	
19	7	D5-1	Ea Wer	96,743	620,041	716,784	10,751,766	
20	8	D6	Kien Duc	106,381	620,644	727,026	10,905,388	
21	9	D7	Krong Kmar	60,932	392,076	453,008	6,795,118	
		Total		1,707,084	11,005,286	12,712,371	190,685,559	
		(%)		13	87			

Table 4.5 Summary of Project Cost Divided FC and LC in Phase 1(to 2010)

<1 FC: Foreign Currency Portion

<2 LC: Local Currency portion

<3 excluding value added tax

The estimated cost for respective system and summary of procurement cost of drilling and other ancillary equipment are in Appendix 6 and Appendix 7.

In case of alternative implementation method by the three phasing, the cost for three steps and two steps implementation will be at once as shown an example below Table 4.6 and 3.7.

Phasing	Implementation Period	No. of System	Cost excluding procurement of equipment (US\$ million including VAT)
Step 1	2002-2005	10	8.1
Step 2	2004-2006	4	1.8
Step 3	2006-2008	7	3.8
	Total	21	13.7

Phasing	Implementation Period	No. of System	Cost excluding procurement of equipment (US\$ million including VAT)				
1 <sup>st</sup> step	2002-2006	14	9.9				
2 <sup>nd</sup> step 2005-2007		7	3.8				
	Total	21	13.7				

Table 4.7 Cost for the 21 Systems by 2-step Implementation

## 4.1.3 Cost for Soft Components

The soft components will be required for the cost of the human resources input by the Vietnamese side and other source on the following major scope and activities. The salary for local promoter of IEC and hygiene activities is estimated at approximately VND 100,000/month/promtor. A few foreign donor's specialist may be necessary to confirm or to check the performance of soft components. Necessary man powers are as following:

- IEC promotion (Vietnamese side)
- Capacity building for the agencies concerned (Donors & Vietnamese side)
- O&M training (Vietnamese side)
- Preparation of O&M manuals (Donors)
- Other soft components (Vietnamese side)

As described in Chapter 5 "Guideline for information, education and communication (IEC) and Hygiene Promotion", the soft components are responsible by Vietnamese side. A few human resources to support IEC etc, may be supported by donors, volunteers, and NGOs. The IEC campaign will be employed locally due to local language issue to communicate with ethnic minorities by using the budget of Vietnamese side. Detail of the work is mentioned in Chapter 5.

**Table 4.8 Soft Components** 

Cost Item	Unit	Quantity
Input men-month	M/M	396
Minor equipment and tools	-	LS

# 4.1.4 **Procurement for Equipment**

The procurement of A) well drilling and ancillary equipment, B) equipment for solar and generator driven pumping system and C) supporting vehicles is

recommended. The cost was estimated at US\$ 2.76 million and US\$ 0.25 million, respectively. The item of equipment is;

## A) Drilling equipment

- Water well drilling equipment
- High pressure air compressor
- Miscellaneous ancillary equipment
- Air lift equipment
- Supporting equipment
- Mobile workshop equipment
- Spare parts

## B) Equipment for solar and generator driven pumping system

- Solar
- Generator
- **C)** Supporting Vehicles
- Four (4) sets of 4WD car for IEC activities

# 4.1.5 Total Project Cost excluding the Soft Components

The project cost in phase 1 (2002-2010) was estimated at around US16.5 millions US\$ for the 21 systems with exception of the soft components.

#### **Table 4.9 Summary of Project Cost**

Item No.	Project Cost Component	Cost (US\$ million)
1	Construction Costs	13.70
2	Procurement of equipment	3.017

## 4.2 Implementation Plan

## 4.2.1 Introduction

This chapter outlines an implementation plan for a number of schemes for the rural water supply. The framework was planned to cover eight years period up to the year 2010 to meet the NRWSS strategy. The following shows basic principles to formulate the implementation plan for the 21 prioritized schemes:

- To implement the schemes meeting to the NRWSS implementation strategy.
- To give high priority with sustainability rather than speed of implementation.
- To implement soft components and construction in parallel.
- No sizable front load investment.
- Due consideration of the balance between development and environment.

## 4.2.2 Development Schemes

#### (1) Methodology of Implementation

The 21 selected priority systems was reviewed by reflecting the lessons learned from monitoring results of the 2 pilot model plants (constructed at G2 and K3-1 communes).

The review result conducts a probable implementation order. It was tentatively arranged with the four groups of implementation priority.

- GroupA : Immediately implementation, when donor or the Vietnamese government's budget is ready
- GroupB: stage 2 implementation after the Group A was successfully completed
- GroupC : stage 3 implementation after the Group B
- GroupD : stage 4 implementation after the Group C

#### (2) Implementation Priority

An implementation priority of Groups A, B, C and D in order is presented with physical information in Table 4.10 after careful interpretation of the selected 21 systems from the viewpoints of project sustainability.

Ser		Province/	Name of Commune/Town	Grouping for	Water Source / numbers of drilling well & construction of intake till 2010		
No	5.	System No. Kon Tum	Commune/Town	Implementation	construction of in		
1	1	Kon Tum K1-1	ΒοΥ	D	Groundwater	7	
-	-			2	0.0	,	
2	2	K2-1	Dak Su	D	Groundwater	0	
3	3	K2-3	Dak Su	A	River water	0	
4	4	K3-1	Dak Ui	С	Groundwater	0	
5	5	K4-1	Dak Hring	В	Groundwater	1 intake	
		Gia Lai					
6	1	G1	Kong Tang	В	Groundwater	1	
7	2	G2	Nhon Hoa	Α	Groundwater	6	
8	3	G3-1	Chu Ty	Α	Groundwater	1	
9	4	G4-1	Thang Hung	В	Groundwater	1	
10	5	G5-1	Ngia Hoa	С	Groundwater	1	
11	6	G6-1	Ia rsiom	С	Groundwater	0	
12	7	G7-1	Kong Yang	D	Groundwater	0	
		Dac Lac					
13	1	D1	Krong Nang	Α	Groundwater	2	
14	2	D2	Ea Drang	Α	Existing boreholes	6	
15	3	D3-1	Krong Buk	В	Groundwater	1	
16	4	D3-2	Krong Buk	D	Not drilled yet	1	
17	5	D4-1	Ea Drong	С	Groundwater	2	
18	6	D4-2	Ea Drong	D	Not drilled yet	1	
19	7	D5-1	Ea Wer	D	Groundwater	2	
20	8	D6	Kien Duc	В	Existing boreholes	3	
21	9	D7	Krong Kmar	D	Groundwater	1	

**Table 4.10 Grouping for Implementation Priority** 

#### (3) Scope of Works

The scope of works required for implementation is as follows:

- Capacity building for rural and national level (donors)
- IEC, training for O&M and other in the site (Vietnamese side)
- Field survey and investigation, and basic and detailed design including preparation of tender document (donors)
- Procurement of construction materials and necessary equipment (donors)
- Construction supervision (donors)

# 4.2.3 Implementation Schedule

The phasing implementation for the 21 systems is recommended taking into consideration of sustainability of projects as shown in Table 4.11.

Step	Implementation period	Group	Kon Tum	Gia Lai	Dac Lac
1	2002-2004	А	K2-3	G2, G3-1	D1, D2
2	2004-2006	В	K4-1	G1, G4-1	D3-1, D6
3	2006-2008	С	K3-1	G5-1, G6-1	D4-1
4	2008-2010	D	K1-1, K2-1	G7-1	D3-2, D4-2, D5-1, D7

Table 4.11 Phasing Plan of Implementation for 21 Systems

# 4.3 Mode of Implementation

It is necessary to consider many factors and elements to introduce the mode of implementation to realize the project.

## 4.3.1 Soft Components

The soft components of capacity building, IEC, organization of WSU, training of O&M are crucial prior to construction the project. This is the matter of the precondition for the project.

The activities of capacity building of PCERWASS, IEC and establishment of WSU, training of O&M for WSU and other are important for sustainable projects. The soft components should be conducted and carried out mainly by Vietnamese side as a task, when a foreign grant aid is requested.

The necessary items of soft component are presented in this supporting report-B, Chapter 5. A human resource input plan for soft component composed of the following staff to implement.

## **Overall Management Team (Mainly by Vietnamese side, partly by Donors)**

- Team Leader
- Capacity building specialist
- Administrator

Provincial and Commune Team (Vietnamese side)

- Capacity building specialist
- IEC specialist
- O&M specialist

## 4.3.2 Construction

To implement construction, an international consultant team will carry out the survey, plan, design and supervision of the proposed systems involving local consultant team. The following type of human resource will be required to input on these engineering services.

#### **Design stage**

- Team leader
- Hydro-geologist
- Design engineer
- Cost estimator
- Specification writer
- CAD operator

## **Construction stage**

- Team leader
- Supervisor as piping specialist
- Supervisor as treatment plant specialist
- Surveyor

During the design stage the established water supply units (WSU) will be involved. Operators from the WSU will be engaged for supervision during construction of systems by the contribution of about 2 months for each system (WSU). CPC/TPC and/or the users (WSU) have the responsible to support their salaries for about 2 months. Considerable plans for the construction of the systems are listed below.

- Alternative 1: Contract system with Vietnamese contractor
- Alternative 2: Contract system with local constructor
- Alternative 3: CERWASS force account system
- Alternative 4: Users themselves
- Alternative 5: NGO's / Grass roots

Table 4.12 shows an evaluation for the construction and technical capability for each alternative plan.

Descriptions	Constructor, Vietnamese	Constructor, abroad	CERWASS force account	WSU/ Users	NGO
Alternative	1	2	3	4	5
Deepwell construction	0	0	Δ	Х	Х
Raw water main	0	0	Δ	Х	Δ
Booster pump	0	0	Δ	Х	Δ
Treatment plant	Δ	0	Δ	Х	Х
Reservoir	0	0	0	Δ	Δ
Distribution	0	0	0	Δ	Δ
House connection	0	0	0	Δ	0
Public taps	0	0	0	0	0

 Table 4.12 Evaluation of Facilities Construction Capability by Alternative

 Implementation Method

Notes O: possible  $\Delta$ : difficult X: impossible

The lessons learned from JICA exploratory test well drilling, and construction of the two pilot models at K3-1 and G2 communes, it is judged that Vietnamese contractor is possible to construct systems. Therefore, alternative 1 or 2 will be selected to implement the project. It is recommended to select the alternative 1 and 2. The technical and financial viewpoints are as following.

 Table 4.13 Technical and Financial Soundness of Alternatives 1 and 2

Alternative	Source	Technical Aspects		Financial Aspect
		Quality	Schedule	Cost performance
1	Contractor, Vietnamese	Δ	Δ	0
2	Contractor, abroad	0	0	Δ

Notes O: advantage  $\Delta$ : disadvantage

Alternative 1 may be recommendable with the conditions of the following counter measures to solve the disadvantages:

- Guidance engineer/s from consultant will have to be involved for 1) technical instruction of drilling operation for procured machine, and 2) strengthening of technology for construction of water treatment plant, deep well and other facilities to ensure the quality.
- Down the Hole (DTH) driven rotary machine shall be used for the drilling to save the construction time schedule.

## 4.3.3 Implementation Schedule

It was recommended that the phase 1 scheme be implemented until the year 2010 in accordance with the NRWSS. Three alternatives implementation plans are prepared in this study. Tentative implementation schedule of the 21 systems are shown in Figure 4.1 by four steps. Table 4.14 shows its summary.

Step	Commune/Town	Implementation schedule			
		Soft components	Construction		
1	K2-3, G2, G3-1, D1, D2	2003-2004	2002-2004		
2	K4-1, G1, G4-1, D3-1, D6	2003-2006	2004-2006		
3	K3-1, G5-1, G6-1, D4-1	2003-2008	2006-2008		
4	K1-1, K2-1, G7-1, D3-2, D4-2, D5-1, D7	2003-2010	2008-2010		

 Table 4.14 Summary of Implementation Schedule

Step	Descriptions	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
		NRWSS Tar			e 1 (till 201	0)					
	Master Plan										
	Feasibility Study										
	Financial Arrangement			1st step		2nd step		3rd step		4th step	
	Selection of consultant									1	
	Field survey and Investigation		-	Þ						$\vdash$	
	Basic Design										
	Tender Design										
	Tender and Contract										
	Procurememnt of Equipment			design, tende	r & procurem	ent					
	Implementation										
1st	Structural Measures(5-system	, K2-3, G3-	1, G2, D1,	D2)							
	Soft component										
	- Capacity building										
	- IEC										
	- O&M activities										
2nd	Structural Measures (5-system	n, K4-1, G1	, G4-1, D3	1, D6)							
	Soft component										
	- Capacity building										
	- IEC										
	- O&M activities										
3rd	Structural Measures(4-system	, K3-1, G5-	1, G6-1, D	4-1)							
	Soft component										
	- Capacity building										
	- IEC										
	- O&M activities										/
4th	Structural Measures (7-system	n, K1-1, K2	-1, G7-1, D	3-2, D4-2,	D5-1, D7)						
	Soft component										
	- Capacity building										
	- IEC										
	- O&M activities										

#### Table 4.15 Construction Schedule Plan

# 4.3.4 Funding / Finance

The NRWSS stated that international assistance should be fully utilized. Donor may be fund for construction portion of rural water supply projects.

In principal, soft components should be well-off with self support by Vietnamese side. A donor may support it in some extents within his capacity. The following scenarios may be envisaged.

Firstly at the Central government level: MARD/CERWASS will explain and report to MPI for the project's urgency and necessity with satisfaction data regarding sustainability of projects. Then, MPI will request to foreign donors to implement it. Secondly, at provincial and commune level: PCERWASS will coordinate well for IEC, establishment of WSU, and necessary budget arrangement for soft component.

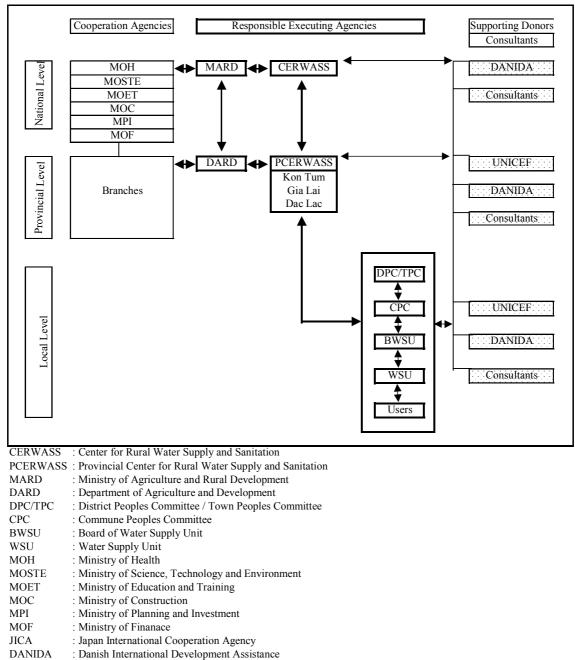
There are two kinds of financial preparation types. One is the Vietnamese government plans, including budgetary arrangements for IEC, HRD, technology guidance and investment costs for the projects. Two is by grant aid or loan funds from foreign countries based on the request from Vietnamese government.

The followings are considerable financial source for the implementation.

- Loan of Vietnamese national budget
- Grant of Vietnamese national budget
- Donor's grant aid
- Foreign countries' project type loan
- Combination of donor's grant aid and Vietnamese national budget

# 4.3.5 Organization for Implementation

Tentative plan of the Organization for implementation is shown below Figure 4.1.



UNICEF : United Nations Children's Fund

# Figure 4.1 Organization Structure Plan for Implementation of Rural Water Supply Project in the Central Highlands

# Chapter 5 Operation and Management

# 5.1 Organization of Operation and Maintenance

## 5.1.1 Principles

The operation and maintenance of the water supply facilities in the project will be organized along the following principles, based on the NRWSS and the lessons learnt from rural water supply in other countries:

- organization of operation and management arrangements of the facilities prior to construction of facilities (could not be fully applied in the pilot schemes due to time constraints),
- integration of the responsibilities for implementation, management and operation and maintenance, including major rehabilitation, extension and reinvestment,
- □ retaining at least the majority of the ownership of the system with the commune or users,
- relative autonomy of the O&M organization, meaning its ability to operate with minimum control from any governmental body, but with necessary oversight and regulation,
- a business-like approach, meaning the water supply operator, although public, operates just as if it was a private business, in terms of its efficient system of billing and collecting revenues, financial self-sustainability, planning and budgeting, and treatment of the users of its services as true users, and
- provision of services related to O&M of the schemes by the private sector, to the extent reasonable and possible.

# 5.1.2 Organization of O&M

The NRWSS recommends that users (communes) decide how they wish to organize O&M. However, as rural piped schemes are a novelty in most project communes, an organizational model has been developed as a basis for discussion in communes. The model is based on the above principles, lessons learned from Vietnam and other countries, and extensive discussions with stakeholders ranging from

CERWASS and PCERWASS to commune leaders and user representatives. This model is considered realistic at this stage of development in the Central Highlands.

#### **Proposed Organizations**

For the O&M of the facilities implemented in the pilot models, following organizations are proposed.

- □ **Board of Water Supply Unit** will be established under CPC/TPC for piped water supply.
- □ This organization will be materialized through representation of users in the Board of the WSU.
- □ Water Supply Unit (WSU) will be established under the Board of Water Supply Unit.
- □ **Representation of the users** will be included in the management structure of the WSU.

The chart of the organizations for piped water supply is shown in the following figure.

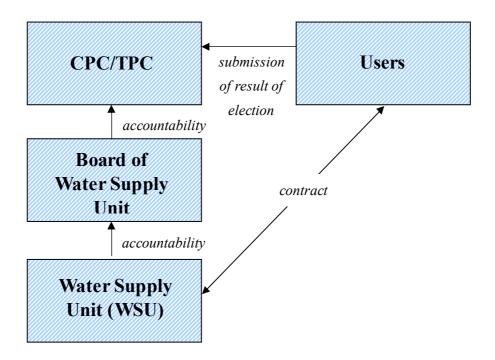


Figure 5.1 Organization for piped water supply

#### **Board of Water Supply Unit Scheme**

The purpose of the Board is to have a rigid and responsible body to supervise the WSU. The Board of WSU will be established based on following procedures;

- The Board comprises of five members appointed by the People's Committee of the commune or town for a two years period,
- □ At least two of the five members of the Board should be elected by the users as their representatives. This election could take place for instance in an annual meeting of registered users of the WSU,
- □ The chairperson of the Board, on behalf of the Board, is accountable to the PC,
- □ The People's Committee appoints the members of the Board and adopts the tariff and other relevant decisions of the Board, and
- □ The Board convenes meetings according to the schedule decided by them, however at least once a month.

#### WSU

In order to achieve sufficient autonomy and separate the accounts of the WSU, it should have a staff of its own. The WSU will be established based on following procedures;

- □ Board appoints the Manager of the WSU,
- Board appoints other staff members of the WSU on the basis of the proposal of the Manager, and
- □ It is estimated that the proposed piped schemes will have the following staff;
- manager,
- accountant,
- pump operator/treatment plant operator,
- network inspector/ meter readers, and
- water charge collectors.

## **Duties and Responsibilities of CPC/TPC**

Functions and duties of CPC/TPC on this O&M model shall be includes followings;

- PC is in charge of resolving problems on sabotage, damaging the safety of the water supply system, and enforcing the measures against the violators of the general regulations and other relevant rules and misconduct of the staff of the WSU and the members of the Board,
- PC provides support to the Board and the WSU in their duties, especially in training, and
- □ If PC refuses to adopt the new tariffs decided by the Board and accepted by the representatives of the users in the Board, PC should reimburse the WSU losses incurred due, or related to, the PC's decision of not adopting the required tariff.

## **Functions of Board of WSU**

The main duties of the Board are to **monitor and supervise the financial and technical performance** of the WSU, and to **approve the annual plans** and **decide upon the water tariff** and other payments and fines related to water supply services provided by the WSU.

## **D** Responsibilities

Responsibilities of Board for WSU shall be includes followings;

- decisions on the salaries and possible performance incentives of the Manager and other staff members of the WSU,
- decision of the general regulation of the WSU and the conditions of contracts between the users and the WSU,
- decisions on protection of the water source and the water supply system,
- approval of annual (financial) plans proposed by the WSU, (if the Board is not satisfied with the WSU's proposal, it requests WSU to submit a new plan that takes into account the guidance provided by the Board), and
- decisions on water tariff, connection fees, meter rents, reconnection fees, fines etc.

## **Duties**

Duties of Board of WSU shall be includes followings;

- close and timely monitoring of the balance of costs and revenues against the financial plan and taking measures to ensure the sustainability in the case of possible deficit (either by reducing costs or increasing revenues),
- monitoring of the efficiency and performance of the WSU,
- provision of transparent information of the performance and accounts of the WSU to PC and users,
- promotion of water use in collaboration of health and educational authorities and mass organizations,
- settlement of disputes between the users and the WSU,
- reporting to PC and submission of tariff decisions and other decisions to PC for adoption, and
- support to the WSU in the enforcement of the General Regulations and requesting support from relevant authorities if necessary.

#### **Functions of WSU**

Duties and responsibilities of each staff on the WSU shall be includes followings.

- □ Manager
- The manager will have the overall responsibility of the utility and he/she will be accountable for his work to the Board.
- Consequently, the duties of the manager would include planning and budgeting, monitoring of the performance of the utility, reporting, personnel management, liaison with relevant stakeholders, user relations, material management, contract management and supervision and control of his/her staff.

#### **G** Accountant

• The duties of the accountant are self-explanatory. In addition to accounting the accountant will also be responsible for preparing monthly water bills, based on the data provided by network inspectors, and maintaining user ledgers.

## **D** Pump operator/Treatment plant operator

• The main tasks of the pump/treatment plant operator are the operation and control of well pumps, including recording flow, pressure and power use

measurements in the operation record of the intake, general control of the volume and quality of inflow and outflow at the treatment plant.

- The operator is, in the first place, responsible for the water quality, and in general for the technical performance, operational and financial efficiency of the plant, reporting about the purchase needs (chemicals, spare parts, etc.) to the manager, and technical condition and housekeeping at the plant.
- The operator would also be the recommended person to be responsible for the sanitary inspection of the well/intake facilities and their cleaning when necessary.

## **D** Network inspector/meter reader

- The main tasks of the network inspector cover the overall network operation including general monitoring of the performance of distribution, based on readings of the master meters and user meters, observation of any irregularities (pressure, power consumption, etc.), detection of potential leaks and illegal connections, consequent repair, and installation, possible disconnection and reconnection of house connections.
- When the number of users in on the increase, the network inspector's main duty is the provision of house connections. The installation work can be outsourced to a contractor but the inspector has to assume the responsibility for quality control.
- The network inspector is, in the first place, responsible for the supply of water to the users in adequate quantity and with adequate pressure, and in general for the technical performance, operational and financial efficiency of the wells and distribution system (paying particular attention on minimizing the unaccounted-for water) and their technical condition.
- In this aspect, s/he will be responsible for the implementation of the maintenance plan in the network, including public water points, testing of water quality in the system, reporting about the purchase needs (pipes, fittings, etc.) to the manager.
- The network inspector/meter reader shall be carry out monthly reading of user meters, distribution of water bills.
- The network inspector/meter reader reports the readings to the accountant

#### □ Water charge collector

- The main tasks of water charge collector are to collect the water charge based on the bill prepared by the accountant, and to inspect the functioning and condition of the meter as well as its seal.
- The water charge collector receives the bills from the accountant.
- He/she is accountable for his/her work and the collected payments to the manager. He/she also reports about his/her work and any observed irregularities to the manager.

## Staffing of WSU

The salaries of WSU staff are paid from the revenues collected from the users. In the initial period of the water supply system operation, some staff members may not be paid at all if they perform their duties as an additional task associated with their previous duties.

As a general principle the manager and the Board should ensure that for each activity of the WSU there are always at least two staff members who are familiar with this activity. This means that although there have to be clear responsibilities with one person having the responsibility for the task there is a need to develop overlapping skills. This will ensure uninterrupted operation and performance if a staff member is temporarily or permanently out of service.

Proposed staffing scheme of WSU includes followings.

## □ Manager/Accountant

It is assumed that there would be one manager and one accountant in every WSU. It is assumed that as long as the number of connections is less than 750 the manager can work on a half-time basis. In larger schemes there would be a full-time manager. Respectively, an accountant is assumed to be able to work on a half-time basis in schemes serving less than 1,000 connections.

## **D** Pump/treatment plant operators

The number of pump/treatment plant operators depends on the type of treatment, the number of hours of operation per day and the volume of the treated water

reservoir. Because pump operation has been designed to be manual, the pump operator needs to be available during the pumping hours,

It is assumed that there will be one full-time pump operator in each scheme but s/he can assume other responsibilities as well. For example, it is assumed the pump operator could manage to assume the responsibility for simple water treatment. It is estimated that initially water treatment can be undertaken in one eight-hour shift (until 2005) but, as the water use increases, plant operators will work in two shifts (2006-2009) and three shifts (tentatively since 2010).

#### **D** Network inspector/meter reader

It is estimated that generally one network inspector/meter reader will work in one shift except in large systems with a network exceeding 40 km and/or the number of connections exceeding 2,000. Thereafter, there would be two network inspector/meter reader. It is estimated that each meter reader can manage 300 connections, including meter reading. The number of meter readers will vary, consequently, from one half time reader of the smallest scheme in until 2005 to 11.5 readers of the largest scheme in 2020. The number of meter readers have been estimated at the accuracy of 0.5 full time worker.

The estimated staffing needs of each scheme in the years 2005, 2010 and 2020 are shown in the following Table 5.1;

Commune	N	/lanage	er	Ac	counta	nnt		p/treat it oper			ork ins ter rea			ter cha ollecto	8
	2005	2010	2020	2005	2010	2020	2005	2010	2020	2005	2010	2020	2005	2010	2020
K1 Bo Y	1/2	1/2	1	1/2	1/2	1	1	3	3	1	1	1	1	11/2	31/2
K2-1 Dak Su	0	0	0	0	0	0	1	3	3	1	1	1	0	0	1
K2-3 Dak Su	1/2	1/2	1/2	1/2	1/2	1/2	1	3	3	1	1	1	1/2	1	2
K3 Dak Ui	1/2	1/2	1/2	1/2	1/2	1/2	1	3	3	1	1	1	1/2	1	2
K4 Dak Hring	1/2	1/2	1	1/2	1/2	1/2	1	3	3	1	1	1	1	1	21/2
G1 Kong Tang	1/2	1/2	1	1/2	1/2	1	1	3	3	2	2	2	11/2	2	5
G2 Nhon Hoa	1/2	1	1	1/2	1	1	1	3	3	2	2	2	21/2	31/2	71/2
G3 Chu Ty	1/2	1	1	1/2	1/2	1	1	3	3	1/2	1/2	1	2	3	7
G4 Thang Hung	1/2	1/2	1	1/2	1/2	1	1	3	3	1	1	1	1	11/2	31/2
G5 Nghia Hoa	1/2	1/2	1	1/2	1/2	1/2	1	3	3	1	1	1	1	1	21/2
G6 Ia Rsion	1/2	1/2	1	1/2	1/2	1/2	1	3	3	1	1	1	1	11/2	31/2
G7 Kong Yang	1/2	1/2	1/2	1/2	1/2	1/2	1	3	3	1	1	1	1/2	1/2	11/2
D1 Krong Nang	1	1	1	1/2	1	1	1	3	3	1	1	2	21/2	4	81/2
D2 Ea Drang	1	1	1	1	1	1	1	3	3	1	1	2	31/2	51/2	111/2
D3-1 Krong Puk	1/2	1/2	1	1/2	1/2	1	1	3	3	1	1	1	11/2	21/2	5
D3-2 Krong Puk	0	0	0	0	0	0	1	3	3	1	1	1	1	11/2	3
D4-1 Ea Drong	1/2	1/2	1	1/2	1/2	1	1	3	3	1	1	1	11/2	21/2	51/2
D4-1 Ea Drong	0	0	0	0	0	0	1	3	3	1	1	1	1/2	1	2
D5 Ea Wer	1/2	1/2	1	1/2	$\frac{1}{2}$	1	1	3	3	1	1	1	11/2	2	4
D6 Kien Duc	1/2	1	1	1/2	1/2	1	1	3	3	1	1	1	2	3	6½
D7 Krong Kmar	1/2	1/2	1	1/2	1/2	1	1	3	3	1	1	1	11/2	21/2	5

Table 5.1Staffing Requirements

For the meaningful financial management of the utility it is extremely important to apply cost/profit center accounting even if this requires additional work in comparison or in addition to the administrative accounting practiced by organizations accountable to CPC/TPC. The accountant should have appropriate education and preferably some relevant experience,

#### Recommendations

It is recommended to use a performance agreement between the owner (represented by the Board). Typically the performance agreement defines the general obligations of the key players, tariff policy, conditions of services including remedies in the event of non-payment, qualitative and quantitative performance criteria, and the frequency and modalities in the provision of information.

In discussions with stakeholders a possibility to make use of user committees (e.g., WATSAN committees) instead of a Board was raised. However, experience suggests that such committees are not so suitable to assume responsibility for full

piped schemes and it would probably be quite complicated if possible at all to hand over the ownership and responsibility from PCs to such committees.

There are more also radical models in use especially in the Mekong Delta, where the O&M has often been organized applying a joint stock company model. This model has certain advantages:

- it would allow mobilization of private capital from users or other investors,
- it would eliminate possible aggressive drainage of revenues from the commune,
- and it would facilitate necessary autonomy of the organization of O&M in a transparent way.

On the other hand this model has not been legalized in Vietnam so far and it is not supported by CERWASS.

Master Plan introduced another option, also based on Vietnamese experience, of combining the responsibility for the O&M of water supply with power supply. This model did not seem to be popular, mainly because power suppliers are normally district level organizations whereas water supply should be organized "at the lowest appropriate level". It seems that even where these functions have been combined in the past, e.g., in Chu Ty Town (G3), they have been recently separated. Consequently, this is not considered a realistic option any longer.

It is also possible to outsource some functions to be undertaken by external personnel. That would call for careful definition of duties and performance standards, indicators and monitoring mechanisms and transparent competitive bidding. It is recommended, therefore, that if WSU or Boards wish to consider outsourcing, CERWASS and PCERWASS assist them in developing procedures and criteria to protect the public and the users' interests.

# 5.1.3 Guideline for Operation and Maintenance

Prior to and during the second field work period guidelines for operation and maintenance were developed. **Model documentation** was developed and designed especially to help the establishment and mobilization of WSUs and the Boards in the two pilot communes and to support them to develop working modalities. This model documentation includes *General Regulations of Services* and an *Application* 

for a Connection to Piped Water Supply (Appendix 8), a Contract for Water Supply between the user and the WSU (Appendix 9) and a form for Daily Operations Record (Appendix 10). These documents can be revised and further developed on the basis of experience from the two pilot schemes to be applied in other project schemes.

The *General Regulations* define the mission statement, service area and organization of the WSU, the rights and responsibilities of the users, the WSU, the Board and the People's Committee, the responsibilities of the staff of the WSU, and implications of the violations of the regulations.

The *Application for a Connection to Piped Water Supply* and the *Contract for Water Supply* are based on the *General Regulations* and they define the rights and responsibilities of the contracting parties and conditions of the contract.

The *Daily Operations Record* provides a format for collection and recording of the most necessary technical data.

The comprehensive O&M guidelines will need to be prepared at the time of implementation of each scheme. The operating instructions will include all the **manuals** provided by the suppliers of the pumps, switchboards and other installations. As the schemes are based on manual pump operation, the pump operators need hands-on training on the spot in order to be able to develop pumping patterns for their respective schemes. The pump operators need to apply an iterative method, learning from their experience, to optimize pumping to supply sufficiently water 24 hours a day and simultaneously avoiding overflows at the reservoir and consequent waste of water, energy and possibly chemicals.

According to the role based on the NRWSS, PCERWASS will focus on supporting and facilitating functions. They include initial capacity building of the utility staff, the Board, DPC/TPC and users, development and distribution of model procedures, contracts, ledgers, guidelines, etc., maintaining lists of suppliers and service providers, facilitation of cross-fertilization and learning from others' experience: successes as well as failures. PCERWASS could also support the utilities in performance evaluation and, in association with this, maintain benchmarking data bases.

It is unlikely that small water utilities would be able to have spare or stand-by pumps. PCERWASS could possibly have a couple of spare pumps to be borrowed or leased by utilities in the case of emergency as long as there is a healthy market and, consequently, private enterprise who can provide emergency service.

In the course of time at least some of the supporting functions of PCERWASS will be decentralized to the districts (Units for Agriculture and Rural Development), at the pace of their increased capacity. It is anticipated that by the time of the completion of the schemes under this pilot model, at least in some of the project districts UARD could possess capacity to provide advisory services to rural water utilities, although their role is likely to be more vital in smaller scale water supply applying lower cost technologies and directly owned and managed by users or user groups.

Guidelines, model procedures etc. that are widely applicable in the country, will be developed by CERWASS or jointly between CERWASS and at least some PCERWASS and possibly some advanced utilities, in order to incorporate hands-on experience. CERWASS could also take the leading role in the development of performance indicators and benchmarking.

Repair of pumps and electric appliances as well as meter testing and calibration are functions, in which small rural utilities are likely to rely on services provided by private (or state-owned) companies. The availability of spare parts and prompt repair of pumps and other equipment should be one major criterion in the selection of technology. For meter testing and calibration a realistic alternative seems to be signing a contract with an urban water utility in the center of the province or in another major town at a reasonable distance.

# 5.2 Strengthening of Implementing Organizations

# 5.2.1 Principles

The implementation of the project will be organized along the following principles, mainly based on the NRWSS:

- □ building, to the extent possible, on existing organizations and their mandates and present roles, avoiding the establishment of parallel institutions and project-specific administration and bureaucracy,
- decentralization of implementation to the lowest appropriate level, which in the case of piped water supply schemes means the commune level,
- extension of the responsibility for water supply schemes to the communes while provision of support by the government (government bodies only carry out their state management responsibility and provide advisory guidance),

- organization of operation and management arrangements of the facilities prior to construction of facilities,
- integration of the responsibilities for initial implementation, management and O&M, including the financial and technical responsibility for rehabilitation and re-investment, to the ownership of the schemes, and
- provision of services related to implementation and O&M of the schemes by the private sector, to the extent reasonable and possible.

# 5.2.2 National and Provincial Level

The **Ministry of Agriculture and Rural Development**, particularly through **CERWASS**, is the focal body responsible for project coordination at the central level. In the implementation of the project MARD/CERWASS will particularly ensure the compliance of the project with NRWSS, provision of capacity building (IEC and HRD) to the respective PCERWASS in Dac Lac, Gia Lai and Kon Tum provinces, coordination of inter-provincial cooperation, and monitoring of the progress in the provinces. MARD/CERWASS will also ensure that the respective PCERWASS will have adequate human and material resources to support the communes in project implementation. An implementation of water supply systems will support the implementation of NRWSS in the three provinces and build on the achievements of CERWASS and other stakeholders, particularly DANIDA, prior to project implementation.

The **Ministry of Health** will have a key role in the capacity building of the provincial and lower level health authorities in IEC and water quality monitoring.

It is recommended that a **Steering Committee** (SC) will be established and a Project Director appointed. The SC will tentatively meet at least quarterly and its main duties of will include supervision of the implementation of the project, approval of the project's annual work plans, and monitoring and regular review of the progress of the project, and recommendation of action to be taken if necessary.

The members of the SC will tentatively comprise MARD (chairperson), CERWASS, MOH, PCP, Government officer in charge of rural water supply, State Bank, relevant mass organizations, Project Director (non-voting member), and Team Leader (non-voting member).

MARD/CERWASS will appoint a **Project Director**. He/she will be accountable to MARD/CERWASS and the SC for the progress of the project and the efficient and

transparent use of the allocated resources. MARD/CERWASS may also appoint other staff to be accountable to the Project Director for specific tasks of the project.

The key sector organization at the provincial level is **PCERWASS**. The PCERWASS in each project province is the focal point of institutional strengthening of organizations at lower level and support to communes in project implementation. PCERWASS will also be responsible for project coordination and monitoring in each of the project provinces.

It is expected that the respective **Provincial Steering Committees for Water and Sanitation** (PSCWS) in the project provinces will extend their duties to the coordination and monitoring of provincial resources to facilitate the implementation of the project. For that purpose, the Provincial Project Heads and Provincial Team Heads should participate in the meetings PSCWS as non-voting members. The duties and working modalities of PSCWS would be similar to those of the SC at the central level.

DARD/PCERWASS will appoint a **Provincial Project Head**. He/she will be accountable to MARD/CERWASS and PSCWS for the progress of the project and the efficient and transparent use of resources. DARD/PCERWASS may also appoint other staff to be accountable to the Provincial Project Head for specific tasks of the project.

An international team of experts or consultants will be appointed to provide institutional strengthening and technical assistance to the CERWASS and respective PCERWASS. There will be a **Provincial Team Head** (PTH), responsible for the technical assistance in each of the project provinces. He/she will have other long and short term experts/consultants under his/her responsibility. One PTH will assume the role of the **Team Leader**, who is responsible for the entire international team and will also liaise with and provide necessary support to CERWASS.

**Mass organizations**, particularly Women's Union will have a major role in IEC activities at the district and commune level and capacity building of the users/users in the project area. The role of DOC, together with PCERWASS, will be important in the quality assurance of construction and protection of the users (communes). This will call for substantial strengthening of regulatory framework at the central level and capacity building of and support to communes and Water Supply Units.

# 5.2.3 District and Commune/Town Level Organizations

According to NRWSS the government support to rural water supply should be decentralized to the **district level**. However, the implementation of NRWSS and the

related capacity building is at initial stage. Consequently, the capacity of the Units of Agriculture and Rural Development will not allow them to assume a major role in project implementation. In longer term, the districts will be the main level of implementation of the following functions: detailed planning and organization of the implementation of RWSS, giving advice to users about various technology options, mechanisms and procedures of financial support or other kinds of support through district water supply advisory service centers, managing systems of grants and loans through at the district giving guidance to user groups to manage construction and operation of piped schemes.

**Communes** (and towns) are the lowest administrative level, which is closest to the people. According to NRWSS, this level will work in close coordination with individual users, user groups, mass organizations, in particular the WU and banks to carry out most of government support function for RWSS. The commune level will act as coordinator and advisor to users and organizer of implementation of commune's RWSS plan.

As water supply system involves relatively complicated technology, deep boreholes with motorized pumping and piped supply, it is not likely that the schemes would be initiated, implemented and managed by cooperatives or other user-based organizations. Therefore, it is expected that the scheme implementation and management will be organized under respective CPC and TPC.

It is recommended that a specific body, **Water Supply Unit** (WSU), will be established under CPC/TPC for piped water supply. It is recommended that key staff members will be recruited prior to project implementation, in order to train the staff during the construction and involve them in project supervision. It is also recommended that representation of users will be included in the management structure of the unit. A **board** would be a distinct body to supervise unit management and staff. Boards will need substantial training and follow-up support to become efficient and effective, focusing on strategic decisions, monitoring of the performance, and supervision.

In the post-implementation management the board will generally monitor and control the financial and technical performance of the WSU, user satisfaction, agree upon resetting of tariff, support the WSU management and staff in enforcement of rules and regulations, and take strategic decisions, such as promotion to increase water sales when necessary, demand management measures (tariff adjustment, regulation of water use) if necessary and investment in expansion/upgrading and rehabilitation. It is important that the board will not interfere in the day-to-day management and operation.

Services provided by the **competitive sector**, public and private companies, will be utilized in the implementation. Private and state construction companies will be invited to bid for the construction of schemes in selected communes. It is expected that the communes will be responsible for construction management and supervision. They will obviously need substantial support to successfully undertake this responsibility. This support is one of the key areas of the technical assistance.

Private and public institutions can also be involved in capacity building and IEC in addition to government bodies and mass organizations. The assignments should be tendered and managed in transparent and competitive manner.

# 5.2.4 Coordination with Relevant Donors

To strengthen the executing agencies, the study team has held a series of meetings to discuss about the possible coordination, especially, with DANIDA, UNICEF, and ADB.

The concept paper was prepared in Figure 5.2 for coordination with the relevant donors and agencies at the F/S phase. The paper illustrates the present and possible coordination activities for the relevant donors.

# **DANIDA**

At the national level, DANIDA started the Water Sector Program Support (WaterSPS) to cover the water sector in Vietnam including national capacity building, and rural water supply and sanitation (RWSS). DANIDA helped formulate the NRWSS for the strategy of rural water supply and sanitation in Vietnam. MARD revised the draft NRWSS submitted by DANIDA, and authorized the revised NRWSS in 2001. The present JICA study is in line with the NRWSS (the target years and goals and the basic approach) formulated by DANIDA.

At the local level, DANIDA initiated the RWSS component of Water SPS in Dac Lac in 2001 to support the implementation of NRWSS by applying the demand responsive approach up to 2005. The program aims to establish guidelines for the rural water supply systems in 3 districts of Dac Lac province (different from the JICA's target districts), considering financial, institutional and social sustainability and focusing on the rehabilitation of piped water supply systems. The RWSS component focuses on IEC, and the establishment of the local organizations for effective O&M and management, and the rehabilitation of the existing piped water systems. DANIDA agreed to the JICA study team that they can provide their IEC materials used for the WaterSPS program for 3 districts in Dac Lac province.

## **UNICEF**

UNICEF has been the principal donor in the field of rural water supply and sanitation through the WATSAN Program in cooperation with CERWASS and MOH since 1982. The WATSAN Program focuses on the implementation of IEC activities by developing appropriate approaches and methods, promotion of coordination with the relevant international and national agencies, and the capacity building of the sector related organizations. The present master plan study is based on the IEC documents prepared by UNICEF.

UNICEF tries to help poor people by introducing shallow hand pump wells and sanitary latrines in the Central Highlands since the 1990s. However, most hand pump wells do not function due to the shortage of spare parts and lack of administration. Taking into account the situation of hand pump wells, especially for public use, UNICEF has adjusted its program to support individual households by dug well construction and sanitation. The present master plan recommends that the improvement of individual dug wells be supported by UNICEF.

In the course of the discussions with UNICEF, they were interested in monitoring the piped systems prioritized by the present study. The cooperation by UNICEF shall be integrated at the implementation stage if possible with regard to the monitoring.

# ADB

In Ngoc Hoi town next to K2-3 (Dak Su), an ADB project is under preparation for the town water supply. There is a preliminary plan available showing the proposed establishment of a reservoir on the same hill as the planned K2-3 reservoir site of this master plan study. It has been recommended to ADB that the K2-3 system be supplied from the town's reservoir and that the O&M of the K2-3 system be taken over by the town.

In response to the request of the study team, the TPC of Ngoc Hoi town and DARD positively agreed to the master plan by the study team. However, Dak Su commune (K2) denied the plan and preferred to have an independent system rather than an integrated system. More effort will be necessary to ensure the integration of the systems and sustainable O&M for the system.

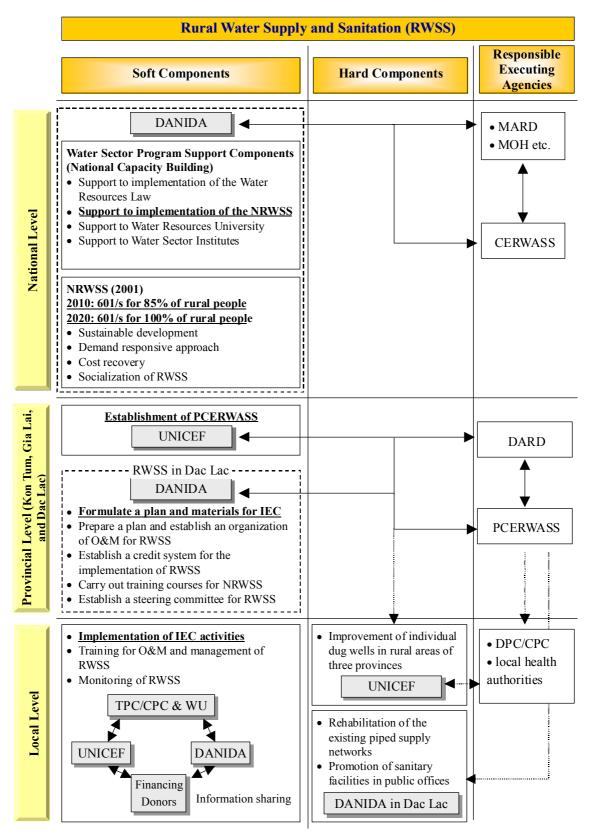


Figure 5.2 Concept Paper for Coordination

# 5.3 Economic Evaluation of the Priority Systems

## 5.3.1 General Principles

As a general principle of the NRWSS, users will be responsible for all construction costs and all operating costs for RWSS facilities. There are, however, cases, when the government will provide financial support in the form of grants to certain types of users and certain types of technologies:

- the poor, the very poor and the social policy target households who suffer difficulties,
- full piped water supply schemes, which are promoted by the government, and
- a number of special cases.

Water supply systems fall under the category of full piped schemes. Even when accepting grants in investments, NRWSS states that in all cases users shall fund all operation costs and shall control the actual payment for construction, O&M, etc. The NRWSS assumes that in the future an **average rural household could pay between 3% and 5% of its total income for clean water and sanitation**. However, the tariff including the initial investment cost may reach more than five times as the tariff excluding the initial investment cost. Consequently, it is judged to be impossible to refund the initial cost by the users themselves with heavy water charges. Therefore, the initial investment cost is assumed to be donated by grant. Instead, it has been assumed that there will be no second round of grant for rehabilitation, upgrading and other similar re-investments. Therefore, the financial analysis involves an element of **re-investment**. Also, the communes/users will be responsible for their connections, including water meters.

According to NRWSS, in formulating tariff methodologies and recommendations it is recognized that water tariffs should meet five key objectives, namely:

- □ economic to ensure that charges for water are related to economic costs, thus achieving efficiency of resource allocation in the water sector,
- □ financial to ensure each Water Supply Company (WSC) has sufficient revenue to cover all its operating costs, debt servicing, taxes, and a proportion of capital expenditure,
- □ social to ensure that the poorer members of the community have access to a safe water supply at a price which they can afford,

- conservation that the tariff plays a role in managing the demand for water and the conservation of resources, and
- □ administrative to ensure that any recommendations are capable of implementation by each WSC in terms of metering, billing and revenue collection and that the tariffs are readily comprehensible to users.

# 5.4 Estimation of Operation and Maintenance, and Re-Investment Costs

The O&M costs include direct costs and fixed costs. Power and chemical costs are the most notable direct costs. Personnel costs of VND 300,000 – VND 450,000, which are quite substantial in the case of small utilities in spite of generally low personnel costs in Vietnam, are in a way a combination of direct and fixed costs. Certain staff is mandatory irrespective of the number of users and volume of water sales, within the scale of these small utilities. On the other hand, the number of staff also depends on the number of users; meter readers are the clearest example of this. The maintenance costs are largely fixed; scheduled maintenance has to be performed irrespective of the volume of business.

This financial analysis recognizes power and chemical costs, personnel costs and maintenance costs. In the previous study maintenance costs were considered to be included in the re-investment cost. The analysis in this stage is more detailed and it has been harmonized with the recommendations of the international consultants providing support to CERWASS in the implementation of NRWSS.

The direct costs per produced cubic meter, including power and chemical costs, have been calculated on the following assumptions:

- □ pumping efficiency of 50%,
- □ cost of electricity VND 750/kWh, and
- □ chemical cost (cost of chlorine) VND 25/m3.

The estimation of **personnel costs** is based on the estimated staffing requirements, as presented in Section 5.1.2 and the estimated monthly personnel costs in various categories. These monthly costs reflect the Vietnamese salary level and the requirements of the positions.

In the case of communes where two piped schemes have been recommended, it has been assumed that the minor system (K2-1, D3-2 and D4-2) does not need to

employ a manager and accountant at all. In practice, the division of the cost implications of shared staff is to be agreed upon case by case.

The **maintenance costs** have been estimated following the principles recommended in the implementation of NRWSS. They have been calculated on an appropriate percentage basis of the capital costs of the works; 1.0% for building and civil works and 3.0% for electrical and mechanical works. However, the maintenance cost in the year of respective investment (2003 and 2013) is estimated at 50% of the above figures, taking into account warranties provided by contractors and suppliers.

The initial investments are assumed to take place in 2003 and 2013. It is anticipated that the **re-investments** will be implemented by user's contribution or local contractors using locally available materials and equipment. Based on experience from Vietnamese construction costs, the reinvestment cost have been estimated at 50% of the costs presented in cost estimates. The estimated life times of 12 years for electro-mechanical installations and 30 years for civil works and pipelines have been adopted from recommendations of international consultants providing support to CERWASS in the implementation of NRWSS. The life time of boreholes is estimated at more than 28 years of financial analysis period.

The estimate of water sales has been reduced from the estimate applied in the previous study. The estimate was based on the design estimates. However, to be on the safe side, design figures need to be excessive rather than too low. On the other hand, financial viability analyses need to be based on conservatively moderate water sale projections rather than overly optimistic figures. Therefore the initial percentage of water users through house connections is estimated at 35% in 2003 and the initial per capita water use through house connections 35 lpcd. In the tariff calculations for the pilot models the initial water use per capita was 35 lpcd for house connections and 15 lpcd for public taps. With the exception of K3, the water use from relatively few public taps will remain very low in comparison with water sold through house connections. Moreover, the public tap water use will decrease over the time as house connections increase. Therefore, in order to simplify calculations, only house connections are included in the cost calculations. In comparison with other uncertain parameters the impact of public taps is negligible. The annual growth of served population through house connections (including population increase and connection rate) is estimated at 8% and the annual growth of per capita water use at 3%, respectively. The latter growth calculated on the initial water use of 35 lpcd will result in 60 lpcd by 2021.

It is estimated that the **non-revenue water** (including physical leakage, bad debts and administrative losses) represents 20% of water production. Consequently, water production is estimated to include water sales and non-revenue water. Direct costs have been calculated for produced water.

For longer term cash flow analyses the **analysis period** is from 2003 until 2030. However, the population figures and other parameters are constant between 2021 and 2030 in order to avoid bias of the inaccuracy of estimated growth beyond the design period.

Cost projections have been made separately for O&M costs excluding reinvestment financing. These costs are the basis of the cash flow analysis together with projected revenues. The re-investment needs have been taken into account by calculating annual and cumulative **saving targets** for financing of re-investments. In financial terms this is equal to annual and cumulative **operation margin**.

The **tariff** analysis has been made on the basis of four principles. Firstly, operation margin has to be positive, although sometimes only marginally, every single year. Secondly, actual cumulative savings (for re-investments) have to account to at least 63% of the cumulative saving targets by 2020. Thirdly, the break-even point between the actual cumulative savings and saving targets has to be reached within 25 years from the initial investment (by 2028). Fourthly, the tariffs are estimated to be constant from 2003 until 2012 and again from 2013 until the end of the analysis period (2030). The tariff increase in 2013 is easily justified by the second tier of investments.

The **affordability** analysis compares the annual expenditure on water of one user of the scheme (based on estimated per capita water use and assumed tariff) with the average annual income within respective commune/town. To be on the safe side the income has been assumed to stay constant throughout the period. Therefore, the actual ability to pay (ATP) in 2020 is likely to be much higher than in this analysis.

# 5.4.1 Ability of Payment for Estimated Tariff

The annual costs of each scheme, including O&M cost and annualized reinvestment costs in three cross-sectional years (2005, 2010 and 2020) are tabulated in Table 5.3. As power and chemical costs are direct costs, they are fully dependent on the operational volume, i.e., the amount of water pumped and treated. Consequently, there is a considerable variation between the utilities and between the years. The personnel costs, especially during the first years when the water sales will remain substantially below the system capacity, the personnel costs are quite similar to fixed costs because of the relative influence of managers and accountants. The variation between utilities is quite limited in 2005 but it increases along with the number of operational staff and meter readers as the business volume increases.

The annual re-investment saving needs have a significant impact on annual costs, especially in the early years of operation when water sales remain relatively low. The re-investment saving increases the O&M cost in 2005 by about 140%- 300% and in 2020 by about 90%-220%.

(	ommune								Annual	cost (MV	ND/a)							
		Power	and chem	icals	Р	ersonnel		Main	tenance co	ost	Reinves	stment		and total w investmen		G	Grand total	l
		2005	2010	2020	2005	2010	2020	2005	2010	2020	-2012	2014-	2005	2010	2020	2005	2010	2020
]	Kon Tum																	
K	.1	7.776	13.246	38.431	19.200	30.900	44.700	62.472	62.472	82.830	265.768	357.280	89.448	106.617	165.961	355.216	372.385	523.242
K	2-1	1.699	2.895	8.399	9.600	19.200	23.400	14.767	14.767	20.704	51.296	79.577	26.066	36.862	52.503	77.362	88.157	132.080
K	2-3	5.128	8.734	25.342	17.100	28.800	33.000	31.046	31.046	42.354	129.363	177.033	53.273	68.580	100.696	182.637	197.943	277.729
K	.3	6.052	10.309	29.910	17.100	28.800	33.000	21.830	21.830	32.680	61.058	95.397	44.982	60.938	95.591	106.039	121.996	190.988
K	4	4.335	7.384	21.423	19.200	28.800	38.100	42.064	42.064	53.084	137.166	178.367	65.599	78.248	112.607	202.766	215.414	290.974
0	ia Lai																	
C	1	13.559	23.096	67.011	26.100	37.800	55.800	53.347	53.347	67.356	192.944	248.658	93.006	114.243	190.168	285.950	307.187	438.825
C	2	32.887	56.019	162.534	30.300	49.500	71.100	85.085	85.085	113.114	334.583	451.615	148.272	190.604	346.749	482.855	525.186	798.364
, C	3	22.275	37.942	110.086	28.200	45.000	69.000	49.401	49.401	62.314	183.583	236.386	99.875	132.343	241.400	283.459	315.926	477.786
7-34	4	7.707	13.128	38.090	19.200	30.900	44.700	31.667	31.667	42.463	115.038	159.376	58.574	75.695	125.253	173.611	190.732	284.629
0	5	8.959	15.261	44.277	19.200	28.800	38.100	28.309	28.309	36.528	105.829	141.882	56.468	72.370	118.905	162.297	178.199	260.787
C	6	8.110	13.814	40.081	19.200	30.900	42.300	22.916	22.916	32.884	76.368	117.697	50.226	67.630	115.265	126.594	143.998	232.962
C	7	3.966	6.755	19.598	17.100	26.700	30.900	21.597	21.597	24.370	74.529	84.537	42.662	55.051	74.868	117.191	129.581	159.405
Ι	ac Lac																	
Γ	1	18.623	31.722	92.040	28.500	46.800	70.500	53.689	53.689	70.191	202.161	273.722	100.813	132.212	232.731	302.974	334.373	506.453
Γ	2	38.382	65.379	189.691	35.100	53.100	83.100	61.669	61.669	84.365	253.857	354.120	135.151	180.148	357.156	389.008	434.004	711.276
Γ	3-1	12.587	21.441	62.209	21.300	35.100	51.000	30.413	30.413	41.459	110.425	155.669	64.301	86.954	154.667	174.725	197.379	310.336
Γ	3-2	6.567	11.185	32.453	13.800	20.700	27.000	25.794	25.794	36.948	97.949	145.069	46.160	57.679	96.401	144.110	155.628	241.470
Γ	4-1	15.120	25.755	74.727	21.300	35.100	53.100	47.036	47.036	58.176	176.205	221.967	83.456	107.891	186.003	259.661	284.096	407.970
Γ	4-2	3.955	6.736	19.545	11.700	23.400	27.600	19.413	19.413	23.734	74.768	90.115	35.068	49.550	70.879	109.836	124.317	160.994
Γ	5	6.300	10.732	31.137	21.300	33.000	46.800	49.455	49.455	65.984	183.862	247.580	77.055	93.186	143.922	260.917	277.048	391.501
Γ	6	27.471	46.793	135.765	23.400	40.200	57.300	44.454	44.454	59.286	175.983	235.957	95.325	131.447	252.351	271.308	307.430	488.307
Γ	7	12.839	21.869	63.451	21.300	35.100	51.000	34.223	34.223	46.112	121.742	162.694	68.361	91.192	160.563	190.104	212.934	323.258

 Table 5.2
 Annual costs MVND/a

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The annual costs per cubic meter are presented in Table 5.3. These unit costs are more applicable for comparison between schemes.

The mere O&M costs per cubic meter vary between VND 1,600/m<sup>3</sup> and VND 6,300/m<sup>3</sup> in 2005 and between VND 700/m<sup>3</sup> and VND 2,600/m<sup>3</sup> in 2020. The reinvestment costs per cubic meter increase the costs dramatically up, varying between VND 4,600/m<sup>3</sup> and VND 18,600/m<sup>3</sup> in 2005 and between VND 1,600/m<sup>3</sup> and VND 18,600/m<sup>3</sup> in 2005 and between VND 1,600/m<sup>3</sup> and VND 6,400/m<sup>3</sup> in 2020.

The unit costs in the early years are extremely high, due to high impact of fixed costs and very low water sales. The tariffs do not need to include in these critical years any substantial part for re-investment saving. The main thing is that the cash flow (operation margin) is positive.

The unit costs in 2020 that include re-investment saving are much closer to the long term tariff requirements, although the tariffs have to be somewhat higher to fill the financing gaps of earlier years.

The lowest viable tariff in 2005 is VND 1,850/m<sup>3</sup> (D2) and the highest required tariff in that year is VND 8,000/m<sup>3</sup> (K2-1). The tariff requirements in 2020 vary between VND 2,200/m<sup>3</sup> and VND 8,250/m<sup>3</sup>.

The calculated tariffs look relatively high in the Vietnamese context. For example, the Provincial People's Committee in Dak Lak has set a ceiling of VND 1,800/m<sup>3</sup> for rural water tariffs. On the other hand the calculated tariffs do not seem to involve problems with the average affordability, except in all schemes in Kontum and possibly in D5, as can be seen in Table 5.3. Instead of the ability to pay, the calculated tariffs may be a political issue.

The willingness to pay was surveyed during the first field work. The willingness to pay for water was lower than the ability, the willingness ranging between 20% and 90% of the ability. While the ability to pay is really a critical issue for sustainability, the willingness to pay is a more dynamic parameter. The willingness may be raised up to the ability to pay through effective IEC. According to the survey (before any IEC), the estimated water bills would be lower than the expressed willingness to pay in 15 out of the 21 schemes in 2005.

Commu -ne		Annua	al unit (	costs (VN	(D/m <sup>3</sup> )		TE	ND ( 3)		(0)))
		ost excl investm		Cost inc	l. re-inve	stment	Tariff (V	ND/m <sup>*</sup> )	Affordabilit	y (%)*
	2005	2010	2020	2005	2010	2020	Up to 2012	After 2013-	2005	2020
K1-1	4,438	3,106	1,666	17,625	10,847	5,253	6,750	7,000	4.8	<mark>7.8</mark>
K2-1	6,258	5,195	2,550	18,573	12,425	6,416	8,000	8,250	<mark>10.9</mark>	17.5
K2-3	4,239	3,204	1,621	14,532	9,246	4,471	5,750	6,000	<mark>7.8</mark>	12.7
K3-1	3,455	2,748	1,486	8,146	5,502	2,969	3,750	3,800	4.8	<mark>7.5</mark>
K4	4,680	3,277	1,626	14,466	9,022	4,200	5,500	5,600	4.7	<mark>7.4</mark>
G1	2,952	2,129	1,221	9,075	5,723	2,818	3,400	3,750	1.5	2.7
G2	2,363	1,784	1,118	7,697	4,915	2,575	2,850	3,350	0.7	1.3
G3	2,767	2,153	1,353	7,853	5,139	2,678	3,100	3,500	1.0	1.7
G4-1	2,411	1,829	1,043	7,146	4,609	2,371	2,800	3,100	1.9	3.3
G5-1	3,034	2,283	1,293	8,721	5,621	2,835	3,300	3,800	1.4	2.5
G6-1	2,309	1,825	1,072	5,820	3,886	2,167	2,500	2,800	1.3	2.3
G7-1	5,002	3,789	1,776	13,739	8,919	3,781	5,300	5,400	2.7	4.3
D1	1,658	1,277	774	4,983	3,229	1,685	1,950	2,200	0.6	1.1
D2	1,609	1,259	860	4,632	3,034	1,714	1,850	2,200	0.8	1.5
D3-1	1,711	1,359	833	4,650	3,084	1,671	1,900	2,200	0.9	1.6
D3-2	2,355	1,727	995	7,352	4,661	2,493	2,700	3,250	1.3	2.4
D4-1	2,160	1,639	974	6,720	4,316	2,136	2,650	2,800	1.2	2.0
D4-2	3,470	2,878	1,419	10,868	7,221	3,223	4,000	4,500	1.8	3.1
D5-1	2,536	1,801	959	8,588	5,353	2,607	3,100	3,500	3.2	<mark>5.7</mark>
D6	1,956	1,584	1,048	5,568	3,704	2,028	2,300	2,600	0.7	1.2
D7	2,084	1,632	990	5,794	3,810	1,994	2,150	2,700	0.9	1.7

Table 5.3 Cost of water per cubic meter, tariff requirement and affordability

\*Water tariffs more than ATP (5% of income) are shadowed.

## 5.4.2 Financial Cash Flow Analysis

The cash flow of each scheme has been estimated separately. The main principle in cash flow projections is that there is a positive cash flow every single year and that every scheme is able to generate sufficient saving for re-investment in 25 year from the initial investment. The assumptions of the cash flow analysis are presented in Section 7.4.2 above. While the costs have been calculated along the same principles for every scheme the tariffs have been set on an iterative basis to facilitate a healthy cash flow. The financial performance charts, based on operation margin and the charts showing the cumulative savings, are attached in Appendix 11.

On the basis of above, the outcome of the cash flow analysis is not the critical criterion for the assessment of scheme sustainability (see Table 5.4 "Financial Cash Flow Analysis"). Because a healthy cash flow has been a basis for tariff calculation, the critical criterion is the ability and willingness to pay the required tariff. In this connection on has to bear in mind that **WSUs are not intended to generate profit or surplus in excess to financing of re-investment.** 

Table 5.4	Financial	Cash	Flow A	Analysis
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	1		2			3			4			5			б			7			8			9			10			11		
Commune	-	K1-1		K2-1		-	K2-3			K3-1			<b>K4-1</b>		i de la comita	GI			62			G3 1		in an in	G4-1			G5-1			G6 1	
Option		1	-	1			1			1			1			1			1			1			1			1			1	
Phase 1		578,218		151,059			350,210			181,563			406,601			601,322			965,360			591,512			344,955			337,704			227,066	
Phase 2		206,762		17,820			72,480			92,120			126,247			168,673			352,676			143,199			136,717			117,396			29,894	
Population		7,797		1,612			4,862			2,819			3,136			6,988			13,779			7,698			5,080			4,008			4,685	
Year	Expenditure	e Revenue Balance	Expenditur	e Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditur	e Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance
1	322	110 (213)	70	27	(43)	164	58	(106)	92	39	(52)	177	62	(114)	257	87	(170)	432	144	(287)	250	90	(159)	156	55	(101)	144	50	(95)	114	44	(70)
2	354	122 (232)	77	30	(47)	182	65	(117)	105	44	(62)	202	69	(133)	285	96	(188)	477	161	(317)	276	101	(176)	173	61	(112)	161	55	(106)	126	49	(77)
3	355	136 (219)	77	33	(44)	183	72	(110)	106	49	(57)	203	77	(126)	286	107	(179)	483	179	(304)	283	112	(172)	174	68	(106)	162	61	(101)	127	54	(72)
4	356	151 (205)	78	37	(40)	183	80	(103)	107	54	(52)	203	86	(117)	287	119	(168)	490	199	(291)	288	124	(164)	177	76	(101)	163	68	(95)	128	60	(67)
5	364	168 (196)	83	41	(41)	189	89	(99)	112	60	(52)	209	95	(113)	296	133	(163)	501	221	(279)	299	138	(160)	182	84	(98)	169	76	(93)	133	67	(66)
6	365	187 (178)	83	46	(37)	189	99	(90)	113	67	(46)	209	106	(103)	298	147	(150)	505	246	(259)	302	154	(148)	183	94	(90)	170	85		137	75	(62)
7	366	208 (158)	83	51	(32)	192	111	(82)	116	75	(41)	210	118	(92)	300	164	(136)	512	274	(239)	307	171	(136)	185	104	(80)	172	94	(78)	138	83	(55)
8	372	232 (141)	88	57	(31)	198	123	(75)	122	83	(39)	215	131	(84)	307	182	(125)	525	305	(221)	316	191	(125)	191	116	(75)	178	105	(74)	144	93	(51)
9	376	258 (118)	88	63	(25)	199	137	(62)	123	92	(31)	218	146	(72)	312	203	(109)	534	339	(195)	325	212	(113)	194	129	(65)	182	116		146	103	(43)
10	378	287 (91)	89	70	(19)	200	152	(48)	124	103	(22)	219	162	(57)	318	226	(92)	541	377	(164)	329	236	(94)	196	143	(53)	184	129		149	115	(35)
11	481	331 (150)	123	81	(42)	255	177	(78)	166	116	(50)	267	184	(83)	386	277	(109)	682	493	(189)	396	296	(100)	248	177	(71)	226	166	(60)	198	143	(55)
12	493	368 (125)	126	90	(36)	262	197	(65)	173	129	(44)	274	205	(69)	396	308	(88)	706	548	(158)	410	330	(81)	257	196	(61)	233	184	(48)	205	159	(46)
13	498	409 (88)	127	100	(27)	263	219	(44)	174	144	(31)	277	228	(49)	402	343	(60)	716	610	(106)	417	367	(50)	262	219	(44)	237	205	(32)	209	177	(33)
14	503	455 (48)	127	111	(16)	267	243	(23)	179	160	(19)	278	253	(25)	409	381	(28)	729	678	(50)	426	408	(19)	265	243	(22)	240	228	(12)	212	197	(15)
15	508	507 (2)	128	123	(4)	269	271	2	181	178	(3)	280	282	2	416	424	8	743	755	12	437	454	17	270	270	1	244	254	10	218	219	1
16	511	563 52	130	137	7	271	301	30	183	198	14	282	313	32	422	472	50	758	839	81	448	505	57	273	301	28	249	282	33	223	243	20
17	517	627 110	131	153	21	273	335	62	186	220	34	286	349	63	430	525	95	780	934	154	460	561	101	281	335	54	253	314	61	227	271	44
18	523	697 174	132	170	38	278	373	95	191	244	53	291	388	97	439	584	145	798	1,039	240	478	624	147	285	372	88	261	350	89	233	301	68
19	530	776 246	133	189	56	281	415	134	194	272	78	295	432	136	446	650	203	819	1,155	337	492	695	202	291	414	123	268	389	121	240	335	95
20	530	776 246	133	189	56	281	415	134	194	272	78		432	136	446	650	203	819	1,155	337	492	695		291	414		268	389		240	335	95
FIRR NPV	11044 1400	-89	6		-9%	<b>b</b>		-7%			-7%			-8%															-7%			-7%
INF Y																	-7%			-8%			-7%			-8%						
Commune	12	00VND) -1,15	3		-228			-566			-275			-618			-919	18		-8%	19		-854			-8%			-507			-370
	12			DI		14	02			D3-1			D3-2			D4-1		18	D4-2		19	D5-1			D6			D7				-370
Option	12	07-1 1	3	D1 1			D2 1			D3-1 1			D3-2 1			1		18	D4-2 1		19	D5-1 1			1			D7 1			Total	-370
Option Phase 1	12	G7-1 1 227,066	3	D1 1 640,632			D2 1 926,830			D3-1 1 337,039			D3-2 1 297,530			<b>1</b> 500,457		18	D4-2 1 250,341		19	D5-1 1 460,679			1 469,229			D7 1 363,980			9,209,378	-370
Option Phase 1 Phase 2	12	G7-1 1 227,066 29,894	3	D1 1 640,632 233,064			D2 1 926,830 375,219			D3-1 1 337,039 141,311			D3-2 1 297,530 133,328			1 500,457 165,608		18	D4-2 1 250,341 127,854		19	D5-1 1 460,679 176,027			1 469,229 104,813			D7 1 363,980 130,138			9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population		G7-1 1 227,066 29,894 1,837	3 13	D1 1 640,632 233,064 12,903	-228	14	D2 1 926,830 375,219 18,464	-566	15	D3-1 1 337,039 141,311 8,556	-275	16	D3-2 1 297,530 133,328 4,463	-618	17	1 500,437 165,608 7,775	-919		D4-2 1 250,341 127,854 2,034	-1,556		D5-1 1 460,679 176,027 8,920	-854	20	1 469,229 104,813 10,619	-546	21	D7 1 363,980 130,138 7,484	-507		9,209,378	-370
Option Phase 1 Phase 2	Expenditure 104	G7-1 1 227,066 29,894 1,837	3 13 Expenditur	D1 1 640,632 233,064 12,903	-228	14 Expenditure	D2 1 926,830 375,219 18,464 Revenue	-566	15 Expenditure	D3-1 1 337,039 141,311 8,556	-275	16 Expenditur	D3-2 1 297,530 133,328 4,463	-618	17 Expenditure	1 500,457 165,608	-919	18 Expenditure 99	D4-2 1 250,341 127,854 2,034	-1,556 Balance	Expenditure	D5-1 1 460,679 176,027 8,920	-854	20 Expenditure	1 469,229 104,813 10,619 Revenue	-546		D7 1 363,980 130,138 7,484			9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population	Expenditure	G7-1 1 227,066 29,894 1,837	3 13	D1 1 640,622 233,064 12,903 e Revenue	-228	14	D2 1 926,830 375,219 18,464	-566	15	D3-1 1 337,039 141,311 8,556 Revenue	-275	16	D3-2 1 297,530 133,328 4,463 s Revenue	-618	17	1 500,437 165,608 7,775	-919	Expenditure	D4-2 1 250,341 127,854 2,034	-1,556		D5-1 1 460,679 176,027 8,920 Revenue	-854	20	1 469,229 104,813 10,619	-546	21 Expenditure	D7 1 363,980 130,138 7,484 Revenue	-507		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3	Expenditure 104 115 117	07-1           1           227,066           29,894           1,837           • Revenue         Balance           37         (67)           41         (74)           45         (72)	3 13 13 14 14 14 14 14 14 14 14 14 14	101 1 640,632 233,064 12,903 e Revenue 96 107 119	-228 Balance (174) (195) (184)	14 Expenditure 346 383 389	<b>B2</b> 926,830 975,219 18,464 Revenue 126 140 155	-566 Balance (221) (243) (234)	15 Expenditure 157 173 175	D3:1 1 337,029 141,311 8,556 Revenue 58 64 71	-275 Balance (99) (109) (103)	16 Expenditur 128 143 144	D3-2 1 297,530 133,328 4,463 e Revenue 43 48 53	-618 Balance (8.5) (81) (77)	17 Expenditure 233 258 260	1 500,437 165,608 7,775 Revenue 83	-919 Balance (150) (166) (157)	Expenditure 99 109 110	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40	-1,556 Balance (67) (73) (69)	Expenditure 233 258 261	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94	-854 Balance (157) (174) (167)	20 Expenditure 242 269 271	1 469,229 104,813 10,619 Revenue 91 101 112	-546 Balance (151) (168) (159)	21 Expenditure 171 189 190	D7 1 363,980 130,138 7,484 Revenue 57 63 71	-507 Balance (114) (125) (120)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4	Expenditure 104 115 117 118	G7-1           1           227,066           29,894           1,837           9           Revenue           Balance           37           (67)           41           (74)           45           50           (67)	3 13 13 13 13 13 13 13 13 13 1	201 3 640,622 233,064 12,903 e Revenue 96 107 119 132	-228 Balance (174) (195) (184) (175)	14 Expenditure 346 383 389 395	02 375,219 18,464 Revenue 126 140 155 173	-566 Balance (221) (243) (234) (223)	15 Expenditure 137 173 175 178	<b>D3-1</b> <b>1</b> 337,029 148,311 8,556 Revenue 58 64 71 79	-275 Balance (99) (109) (103) (99)	16 Expenditur 128 143 144 145	D3-2 1 297,530 133,328 4,463 • Revenue 43 48 53 59	-618 Balance (8.5) (81) (77) (74)	17 Expenditure 233 258 260 263	1 300,457 165,608 7,775 Revenue 83 92 102 114	-919 Balance (150) (166) (157) (150)	Expenditure 99 109 110 110	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 45	-1,556 Balance (67) (73) (69) (65)	Expenditure 233 258 261 262	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105	-854 Balance (157) (174) (167) (157)	20 Expenditure 242 269 271 274	1 469,329 104,813 10,619 Revenue 91 101 112 125	-546 Balance (151) (168) (159) (150)	21 Expenditure 171 189 190 192	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78	-507 Balance (114) (125) (120) (113)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4 5	Expenditure 104 115 117 118 123	G7-1           1           227,066           29,894           1,837           e Revenue           Balance           37           (67)           41           (74)           45           70           50           (67)           56	3 13 13 14 15 10 10 10 10 10 10 10 10 10 10 10 10 10	101 1 640,622 233,064 12,903 e Revenue 96 107 119 132 147	-228 Balance (174) (195) (184) (175) (168)	14 Expenditure 346 383 389 395 405	02 375,219 18,464 Revenue 126 140 155 173 192	-566 Balance (221) (243) (234) (223) (213)	15 Expenditure 137 173 175 178 <b>185</b>	D3-1 1 337,029 148,311 8,556 Revenue 58 64 71 79 88	-275 Balance (99) (103) (99) (96)	16 Expenditur 128 143 144 145 146	D3-2 1 297,530 133,328 4,463 • Revenue 43 48 53 59 <b>65</b>	-618 Balance (85) (81) (77) (74) (70)	17 Expenditure 233 258 260 263 <b>270</b>	1 300 457 165,608 7,775 Revenue 83 92 102 114 127	-919 Balance (150) (166) (157) (150) (143)	Expenditure 99 109 110 110 116	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 40 45 50	-1,556 Balance (67) (73) (69) (65) (66)	Expenditure 233 258 261 262 <b>267</b>	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105 117	-854 Balance (157) (174) (167) (157) (151)	20 Expenditure 242 269 271 274 285	1 469,329 104,813 10,619 Revenue 91 101 112 125 139	-546 Balance (151) (158) (159) (150) (146)	21 Expenditure 171 189 190 192 <b>200</b>	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78 <b>87</b>	-507 Balance (114) (125) (120) (113) (113)		9,209,378 3,081,240	370
Option Phase 1 Phase 2 Population Year 1 2 3 4	Expenditure 104 115 117 118 <b>123</b> 123	G7-1         1           1         227,066           29,894         1,837           1,837         (67)           41         (74)           45         (72)           50         (67)           56         (67)           62         (61)	3 13 14 14 14 14 14 14 14 14 14 14	101 1 1 233.064 12,903 e Revenue 96 107 119 132 147 163	-228 Balance (174) (174) (184) (175) (168) (158)	14 Expenditure 346 383 389 395 405 412	<b>B2</b> <b>1</b> 926,830 \$75,219 18,464 <b>Revenue</b> 126 140 155 173 <b>192</b> 214	-566 Balance (221) (243) (234) (223)	15 Expenditure 137 173 175 178 185 186	<b>D3-1</b> <b>1</b> 337,039 141,311 8,556 Revenue 58 64 71 79 <b>88</b> 98	-275 Balance (99) (103) (103) (99) (96) (83)	16 Expenditur 128 143 144 145 <b>146</b> 147	D3-2 1 297,530 133,328 4,463 Revenue 43 48 53 59 <b>65</b> 73	-618 Balance (85) (81) (77) (74) (70) (66)	17 Expenditure 233 258 260 263 270 272	1 500,457 165,608 7,775 Revenue 83 92 102 114 127 141	-919 Balance (150) (156) (157) (150) (143) (131)	Expenditure 99 109 110 110 110 116	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 45	-1,556 Balance (67) (73) (69) (65) (66) (60)	Expenditure 233 258 261 262 <b>267</b> 268	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105 117 130	854 Balance (157) (174) (167) (157) (151) (133)	20 Expenditure 242 269 271 274 285 292	1 469,329 104,813 10,619 Revenue 91 101 112 125 139 154	-546 Balance (151) (168) (159) (150) (146) (137)	21 Expenditure 171 189 190 192 200 202	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78 <b>87</b> 97	-507 Balance (114) (125) (120) (113) (113) (105)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4 5 6	Expenditure 104 115 117 118 123	G7-1         1           1         227,066           29,894         1,837           1,837         (67)           41         (74)           45         (72)           50         (67)           56         (67)           62         (61)	3 13 13 14 15 10 10 10 10 10 10 10 10 10 10 10 10 10	101 1 640,622 233,064 12,903 e Revenue 96 107 119 132 147	-228 Balance (174) (195) (184) (175) (168)	14 Expenditure 346 383 389 395 405	02 375,219 18,464 Revenue 126 140 155 173 192	-566 Balance (221) (243) (233) (213) (199)	15 Expenditure 137 173 175 178 <b>185</b>	D3-1 1 337,029 148,311 8,556 Revenue 58 64 71 79 88	-275 Balance (99) (103) (99) (96)	16 Expenditur 128 143 144 145 146	D3-2 1 297,530 133,328 4,463 • Revenue 43 48 53 59 <b>65</b>	-618 Balance (85) (81) (77) (74) (70)	17 Expenditure 233 258 260 263 <b>270</b>	1 300 457 165,608 7,775 Revenue 83 92 102 114 127	-919 Balance (150) (166) (157) (150) (143)	Expenditure 99 109 110 110 116	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 40 45 50 56	-1,556 Balance (67) (73) (69) (65) (66)	Expenditure 233 258 261 262 <b>267</b>	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105 117	-854 Balance (157) (174) (167) (157) (151)	20 Expenditure 242 269 271 274 285	1 469,329 104,813 10,619 Revenue 91 101 112 125 139	-546 Balance (151) (158) (159) (150) (146)	21 Expenditure 171 189 190 192 <b>200</b>	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78 <b>87</b>	-507 Balance (114) (125) (120) (113) (113)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4 5 6 7 8 8 9	Expenditure 104 115 117 118 123 123 124 130 132	O7-1         I           1         227,066         29,894           1,837         8         8           37         67,94         1,637           38         67,95         67,95           39         69,44         74,9           41         74,9         45         72,05           50         67,75         62         (61)           69         (55)         77         (33)           78         6(47)         44         (47)	3 13 13 13 14 15 16 17 17 17 17 17 17 17 17 17 17 17 17 17	<b>D1</b> <b>3</b> <b>640,622</b> <b>233,064</b> <b>12,903</b> <b>e</b> Revenue <b>96</b> <b>107</b> <b>119</b> <b>132</b> <b>147</b> <b>163</b> <b>182</b> <b>202</b> <b>225</b>	-228 Balance (174) (195) (168) (175) (168) (133) (143) (132) (115)	14 Expenditure 346 383 305 405 412 420 434 434	02 375,219 375,219 18,464 Revenue 126 140 155 173 192 214 238 238 294	-566 Balance (211) (243) (233) (213) (123) (119) (183) (169) (147)	15 Expenditure 137 173 173 178 185 186 186 186 186 187 203	D3:1 337,029 144,311 8,556 8,556 64 71 79 88 98 98 98 109 122 135	-275 Balance (99) (103)	16 Expenditum 128 143 144 145 146 147 148 156 157	D3-2 1 297,530 133,328 4,463 <b>Revenue</b> 43 48 53 59 <b>65</b> 73 81 90 100	-618 Balance (\$5) (\$1) (74) (70) (66) (62) (58) (54)	17 Expenditure 233 258 260 263 270 272 277 277 277 277 284 290	1 500,457 165,608 7,775 Revenue 83 92 102 114 114 127 141 157 174 194	-919 Balance (130) (150) (157) (150) (143) (131) (120) (110) (90)	Expenditure 99 109 110 110 116 116 116 119 124 125	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 45 50 56 62 69 77	-1,556 Balance (67) (73) (69) (69) (69) (69) (60) (60) (77) (33) (43)	Expenditure 233 258 261 262 267 268 277 268 277 277 278	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178		20 Expenditure 242 269 271 274 285 292 292 292 293 307 313	1 469,229 104,813 10,619 Revenue 91 101 112 125 139 154 172 191 212	-546 Balance (151) (163) (159) (159) (130) (146) (137) (146) (117) (117) (100)	21 Expenditure 171 189 190 200 200 200 200 200 201 213 218	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78 87 97 108 120 134	-507 Balance (114) (122) (123) (113) (105) (96) (93) (85)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4 5 6 7 8 9 10	Expenditure 104 115 117 118 123 124 130 132 133	G7.1         G7.1           1         227,066         29,894           2837         677         41           7         677         44         (74)           44         (74)         56         677           56         677         62         61)           69         (55)         77         (53)           86         (47)         95         (63)	3 Expenditur 270 301 303 307 314 321 324 334 340 344	D1 440,622 233,064 12,903 e Revenue 96 107 119 132 147 163 182 202 225 250	-228 Balance (174) (195) (183) (143) (143) (143) (143) (143) (143) (143) (143)	14 Expenditure 346 383 389 395 405 412 420 434 441 452	02 326,320 375,219 13,464 Revenue 126 140 155 173 192 214 238 265 294 328	-566 Balance (221) (243) (233) (233) (199) (183) (183) (147) (124)	15 Expenditure 157 173 175 186 188 186 188 186 203 208	D3:1 327,029 144:311 8,556 Revenue 58 64 71 79 88 98 98 98 109 122 135 150	275 Balance (09) (109) (103) (99) (103) (99) (103) (99) (103) (99) (103) (99) (103)	16 Expenditur 128 143 144 145 146 147 148 156 157 158	D3-2 1 297,530 133,328 4,463 • Revenue 43 48 53 59 65 73 81 90 100 1112	-618 Balance (85) (81) (77) (74) (70) (66) (62) (58) (54) (54) (47)	17 Expenditure 233 258 260 263 270 272 277 284 270 272 277 284 290 295	1 500,457 165,608 7,775 Revenue 83 92 92 102 114 127 144 127 144 157 174 194 216	-919 Balance (150) (166) (157) (130) (143) (131) (143) (131) (120) (110) (90) (79)	Expenditure 99 109 110 110 116 116 119 124 125 126	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 45 50 56 62 69 77 85	-1,556 Balance (67) (73) (69) (69) (69) (69) (60) (37) (53) (48) (41)	Expenditure 233 258 261 262 267 268 271 277 278 280	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 199	854 Balance (157) (174) (167) (151) (133) (127) (117) (100) (21)	20 Expenditure 242 269 271 274 285 292 298 207 313 313 323	1 469,229 104,813 10,619 Revenue 91 101 112 125 139 154 172 191 212 236	-546 Balance (151) (168) (159) (146) (147) (146) (137) (126) (117) (100) (87)	21 Expenditure 171 189 190 192 200 202 204 213 218 221	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78 87 97 108 120 134 149	-507 Balance (114) (122) (120) (113) (105) (96) (93) (83) (72)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4 5 6 7 8 9 10 11	Expenditure 104 115 117 118 123 124 130 132 133 146	OT-1         I           227,056         29,894           1,837         707.           41         (74)           45         (72,056)           56         (67)           62         (61)           63         (61)           64         (74)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (74)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           <	3 13 14 15 16 17 17 17 17 17 17 17 17 17 17	01 3 640,522 233,064 12,903 e Revenue 96 107 119 132 147 147 162 202 225 250 314	-228 Balance (174) (195) (184) (175) (183) (143) (143) (143) (132) (113) (94) (117)	14 Expenditure 346 383 389 395 405 412 420 434 441 451 579	02 375,219 18,464 Revenue 126 140 155 173 192 214 228 265 294 228 265 294 2328 2433	-566 Balance (221) (243) (234) (223) (213) (199) (183) (169) (147) (124) (146)	15 Expenditure 157 175 175 178 185 186 188 197 203 208 261	D3 1 37/020 357/020 3.556 Revenue 58 64 71 79 88 98 109 122 135 150 194	275 Balance (99) (100) (100) (100) (100) (100) (100) (99) (99) (99) (90) (79) (79) (79) (79) (79) (79) (79) (79	16 Expenditur 128 143 144 145 146 147 148 156 157 158 213	D3-2 1 297,50 133,328 4,463 • Revenue 43 48 53 59 65 73 81 90 100 112 149	-618 Balance (83) (81) (77) (70) (66) (62) (53) (54) (47) (63)	17 Expenditure 233 238 260 263 270 272 277 277 284 290 205 330	3001 4571 5001 4571 165,0008 7,775 Revenue 833 92 1002 1102 1102 1104 1277 141 1377 174 194 2166 254	-919 Balance (150) (157) (150) (157) (130) (131) (120) (110) (20) (110) (90) (79) (97)	Expenditure 99 100 110 110 116 116 119 124 125 126 144	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 45 50 56 62 69 77 85 50 107	-1,556 Balance (67) (73) (69) (60) (60) (60) (60) (53) (53) (43) (41) (33)	Expenditure 233 258 261 262 267 268 271 277 278 280 335	D5-1 1 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 199 249	854 Balance (157) (174) (167) (157)	20 Expenditure 242 269 271 274 285 292 298 307 313 323 339	1 469,229 104,813 10,619 8 evenue 91 101 112 125 139 154 172 191 154 172 191 212 236 297	-546 Balance (151) (168) (159) (159) (140) (140) (120) (117) (100) (87) (102)	21 Expenditure 171 189 192 200 202 204 213 213 213 221 273	D7 1 363,980 7,484 Revenue 57 63 71 78 87 97 108 120 134 149 208	-507 Balance (114) (122) (113) (113) (113) (05) (05) (72) (65)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4 5 6 7 8 9 10 11 12	Expenditure 104 115 117 118 123 124 130 132 133 134 6 148	OT.1         OT.1           1         227,066         29,894           237,066         29,894         37           8         Revenue         Balance           37         (67)         44         (74)           445         (72)         56         (67)           56         (67)         62         (61)           69         (53)         77         (73)           95         (35)         108         (35)           108         (35)         120         (28)	3 Expenditur 270 301 303 307 314 321 324 340 344 344 446	D1         I           640,652         233,064           12,903         233,064           12,903         6           Revenue         96           96         107           119         132           147         163           182         202           225         250           314         349	-228 Balance (174) (195) (184) (175) (143) (147) (143) (143) (143) (147)	14 Expenditure 346 383 389 405 412 420 434 441 441 4579 579 603	02 906320 375219 13,464 Revenue 140 155 173 192 214 285 294 328 482	-566 Balance (221) (243) (223) (223) (223) (223) (223) (233) (169) (147) (147) (144) (124) (124)	15 Expenditure 157 173 175 178 185 186 188 188 188 203 208 208 208 201 270	D3 1 337,029 148,311 8,556 Revenue 58 64 71 79 88 98 98 109 122 133 150 122 133 150	275 Balance (99) (109) (103) (99) (96) (83) (79) (76) (83) (76) (83) (76) (83) (76) (83) (76) (83) (76) (83) (76) (76) (75) (75) (75) (75) (75) (75) (75) (75	16 Expenditur 128 143 144 145 146 147 148 156 157 158 213 220	D3-2 1 297,50 133,328 4,463 4,463 8 Revenue 43 48 53 59 <b>65</b> 73 59 <b>65</b> 73 81 90 100 1012 1149 166	-618 Balance (\$5) (\$1) (77) (74) (70) (65) (65) (54) (54)	17 Expenditure 233 258 260 263 270 272 270 272 277 277 284 290 295 350 364	3001 457 3001 457 165,608 7,775 Revenue 92 102 114 127 141 157 174 194 216 254 282	-919 Balance (150) (166) (150) (150) (143) (143) (131) (120) (110) (90) (79) (97) (82)	Expenditure 99 100 110 110 110 116 116 119 124 125 126 124 124 125 126	D4-2 1 230,341 127,834 2,034 Revenue 33 36 40 45 50 56 62 69 977 85 107 119	-1,556 Balance (67) (73) (69) (	Expenditure 233 258 261 262 267 268 271 277 278 280 355 368	D5-1 1 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 199 249 277	854 Balance (157) (174) (167) (151) (151) (117) (117) (100) (81) (100) (81) (91)	20 Expenditure 242 269 271 274 275 285 292 298 292 298 307 313 323 399 414	1 469.229 104.813 10,619 Revenue 91 101 112 125 139 154 172 191 212 236 297 330	-546 Balance (151) (168) (159) (150) (146) (137) (146) (137) (146) (137) (100) (87) (100) (83)	21 Expenditure 171 190 190 202 200 200 202 204 213 218 221 273 282	D7 1 363,908 7,484 Revenue 57 63 71 78 87 97 108 120 134 149 208 231	-507 Balance (114) (125) (113) (113) (113) (105) (93) (85) (72) (51)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 1 2 3 4 5 6 7 8 9 10 11	Expenditure 104 115 117 118 123 124 130 132 133 146	OT-1         I           227,056         29,894           1,837         707.           41         (74)           45         (72,056)           56         (67)           62         (61)           63         (61)           64         (74)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (74)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           70         (73)           <	3 13 14 15 16 17 17 17 17 17 17 17 17 17 17	01 3 640,522 233,064 12,903 e Revenue 96 107 119 132 147 147 132 147 182 202 225 230 314	-228 Balance (174) (195) (184) (175) (183) (143) (143) (143) (132) (113) (94) (117)	14 Expenditure 346 383 389 395 405 412 420 434 441 452 579	02 375,219 18,464 Revenue 126 140 155 173 192 214 228 265 294 228 265 294 2328 2433	-566 Balance (221) (243) (234) (223) (213) (199) (183) (169) (147) (124) (146)	15 Expenditure 157 173 175 178 186 188 197 203 208 261 208 261 270 278	D3 1 337 029 345 311 3,556 Revenue 58 64 71 79 88 98 109 122 135 150 194	275 Balance (99) (100) (100) (100) (100) (100) (100) (99) (99) (99) (90) (79) (79) (79) (79) (79) (79) (79) (79	16 Expenditur 128 143 144 145 146 147 148 156 157 158 213	D3-2 1 297,50 133,328 4,463 • Revenue 43 48 53 59 65 73 81 90 100 112 149	-618 Balance (83) (81) (77) (70) (66) (62) (53) (54) (47) (63)	17 Expenditure 233 238 260 263 270 272 277 277 284 290 205 330	3001 457 5001 457 165,008 7,775 Revenue 83 92 102 102 114 127 144 137 174 194 216 254	-919 Balance (150) (157) (150) (157) (130) (131) (120) (110) (20) (110) (90) (79) (97)	Expenditure 99 100 110 110 116 116 119 124 125 126 144	D4-2 1 250,341 127,854 2,034 Revenue 33 36 40 45 50 56 62 69 77 85 50 107	-1,556 Balance (67) (73) (69) (60) (60) (60) (60) (53) (53) (43) (41) (33)	Expenditure 233 258 261 262 267 268 271 277 278 280 335	D5-1 1 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 199 249	854 Balance (157) (174) (167) (157)	20 Expenditure 242 269 271 274 285 292 298 307 313 323 339	1 469,229 104,813 10,619 8 evenue 91 101 112 125 139 154 172 191 154 172 191 212 236 297	-546 Balance (151) (168) (159) (159) (140) (140) (120) (117) (100) (87) (102)	21 Expenditure 171 189 192 200 202 204 213 213 213 221 273	D7 1 363,980 7,484 Revenue 57 63 71 78 87 97 108 120 134 149 208	-507 Balance (114) (122) (113) (113) (113) (05) (05) (72) (65)		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population Year 2 2 3 4 5 6 6 7 7 8 9 10 11 12 13 14 15	Expenditure 104 115 117 123 123 124 130 132 130 132 133 146 148 149 151	OT-1         I           227 066         29,894           L337         67           9,894         1,837           8         (7,9)           41         (7,9)           43         (7,2)           50         (67)           56         (67)           56         (67)           57         (53)           77         (53)           77         (53)           70         (32)           108         (38)           103         (26)           1134         (16)           145         11	S         13           Expenditur         270           301         301           303         307           314         324           334         340           344         430           4461         475	D1         D1           11         12           233,064         12,903           12,903         96           96         107           119         132           147         163           182         202           225         250           314         349           388         432           480         480	-228 Balance (174) (195) (168) (175) (168) (143) (143) (115) (143) (115) (117) (97) (65) (30) 5	14 Expenditure 346 383 389 405 412 420 434 412 420 434 441 452 579 603 616 63 63 649	D2         II           III         0906,830           375,219         375,219           III         126           140         125           173         192           214         238           264         328           482         328           482         336           596         663	-566 Balance (211) (243) (234) (233) (139) (143) (143) (147) (144) (146) (146) (146) (146) (146) (147) (133) (153)	15 Expenditure 157 173 173 178 186 186 188 197 208 201 203 203 203 203 203 203 203 203 203 203	D3:1         1           337,029         144:311           8,556         Revenue           58         64           71         79           88         98           98         122           133         150           1944         216           240         267	275 Balance (9) (10)	16 Expenditum 128 143 144 145 146 147 148 157 158 157 158 220 224 226 228	D3-2 1 297,530 133,328 4,463 48 53 59 65 73 81 90 100 112 149 166 183 206 229	-618 Balance (85) (81) (77) (74) (70) (66) (62) (54) (47) (54) (39) (20) 0	17 Expenditure 233 258 260 263 270 263 277 277 277 277 284 209 295 300 369 369 376 383	3 300,457 165,608 7,775 Revenue 83 92 102 114 127 102 114 127 104 127 104 127 104 127 104 127 144 157 174 194 216 216 216 216 216 216 216 216	-919 Balance (150) (150) (157) (150) (140) (140) (140) (131) (120) (131) (120) (131) (120) (132) (33) (23) (33) (33) (33) (33) (33) (	Expenditure 99 109 110 116 116 116 119 124 123 126 124 123 126 144 144 148 151 152 154	D4-2 1 250,341 127,854 2,034 Revenue 33 36 400 45 50 56 62 69 977 77 855 107 119 132 147 147 152 147 152 147 153 153 153 153 153 153 153 153	-1,556 Balance (07) (73) (69) (	Expenditure 233 258 261 262 267 268 271 277 278 280 277 278 280 355 368 372 374 378	D5-1 1 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 199 249 277 309 343 382	854 (157) (177) (167) (151) (151) (133) (127) (100) (81) (100) (81) (100) (81) (100) (91) (94) (31) (3) (3) (3) (3) (3) (4) (4) (4) (4) (5) (4) (4) (4) (4) (4) (4) (4) (4	20 Expenditure 242 269 271 274 285 298 307 323 309 414 424 424 424	1 469,229 10,619 91 101 112 125 139 154 172 191 212 236 297 330 368 409 455	-546           Balance           (151)           (153)           (159)           (137)           (120)           (117)           (100)           (83)           (56)           (24)           10	21 Expenditure 171 189 190 200 200 204 213 218 221 233 222 204 213 218 221 233 282 291 295 302	D7 1 363,980 7,484 Revenue 57 63 71 78 87 97 108 87 97 108 87 97 100 134 149 208 231 257 286 318	-507 Balance (114) (122) (120) (113) (105) (96) (95) (72) (63) (71) (34) (9) 16 (61) (34) (9) (16) (16) (16) (17)		9,209,378 3,081,240	
Option Phase 1 Phase 2 Population Year 1 2 3 4 4 5 6 6 7 7 8 8 9 9 10 11 12 13 13 14 14 15	Expenditure 104 115 117 118 123 124 130 132 133 146 148 149 151 154 155	07.1 227,066 29,894 1,837 6 Revenue Balance 7 Revenue Balance 7 (2),994 4 (74) 4 (74) 1 (74) 4 (74) 1 (75) 1 (75)	3 2 2 2 2 2 2 2 2 2 2 2 2 2	D1         D1           640,532         233,064           12,903         12,903           e         Revenue           96         107           1132         147           163         182           202         230           314         349           388         432           430         534	-228 Balance (174) (184) (175) (184) (143) (143) (143) (143) (143) (143) (143) (143) (145)	14 Expenditure 346 383 389 395 405 412 420 434 441 441 452 579 603 616 633 649 666	D2           1           926,830           975,219           18,464           Revenue           126           140           155           141           122           232           244           238           265           294           328           433           483           536           996           663           738	-566 Balance (221) (243) (233) (233) (233) (233) (169) (147) (124) (146) (146) (146) (146) (146) (146) (146) (15) (15) (15) (15) (15) (15) (15) (15	15 Expenditure 157 173 173 178 185 186 188 188 197 203 208 261 270 203 261 278 285 285 285 285 286	D3 1 337,029 337,029 144,214 8,556 8 8 6 4 71 79 8 8 8 6 4 71 79 8 8 8 8 8 8 109 122 135 150 194 2267 267 267 297 330	275 Balance (199) (109) (103)	16 Expenditum 128 143 144 145 146 147 148 156 157 158 213 220 224 226 228 233	D3-2 1 297,530 133,328 4,463 e Revenue 43 48 53 59 65 73 81 90 100 100 100 112 149 165 206 229 224	-618 Balance (83) (81) (77) (70) (66) (62) (53) (54) (47) (63) (54) (63) (54) (62	17 233 288 260 260 260 270 272 277 277 277 277 277 277 277 27	1 500,457 165,508 33 92 92 102 114 157 124 141 157 174 157 174 216 254 225 314 349 349 342	-919 Balance (150) (157) (150) (143) (131) (120) (113) (120) (110) (96) (79) (79) (72) (82) (55) (27) 5 5 43	Expenditure 99 109 110 110 116 116 116 119 124 125 126 144 144 145 151 152 155	D4-2 1 250,341 27,854 2,034 Revenue 33 36 40 40 56 66 67 77 85 85 107 119 132 147 163 182	-1,556 Balance (67) (73) (69) (	Expenditure 233 258 261 262 267 268 271 277 278 280 355 368 372 374 374 378 383	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 199 249 277 309 343 382 425	854 (157) (174) (167) (151) (151) (151) (127) (117) (100) (81) (106) (91) (84) (64) (64) (31) 3 41	20 Expenditure 242 269 271 285 292 208 307 313 323 323 399 414 424 433 445	1 449.229 10.419 91 10.19 112 125 139 154 172 154 172 236 297 297 2330 368 409 368 409 405 506	546 Balance (15) (168) (139) (140) (137) (140) (137) (140) (147) (140) (177) (102) (87) (87) (102) (87) (87) (102) (87) (102) (87) (102) (87) (102) (1	21 Expenditure 171 189 190 200 200 200 202 204 213 213 213 221 273 282 291 295 300 309	D7 1 363,980 7,484 <b>Revenue</b> 57 63 71 78 <b>87</b> 97 108 120 134 149 208 231 257 266 318 354	-507 Balance (114) (122) (123) (113) (105) (96) (93) (85) (72) (72) (65) (72) (65) (72) (65) (72) (72) (72) (72) (72) (72) (72) (72		9,209,378 3,081,240	370
Option           Phase 2           Propulation           Year           1           2           3           4           5           6           7           8           9           10           11           12           13           14           15           16           17	Expenditure 104 115 123 124 132 132 132 133 146 148 148 148 148 148 148 151 151 154 155	07.1         1           227.066         29.894           L837         67.1           Revenue         Balance           8         41           (7.4)         43           (7.5)         56           9.50         66           9.50         66           9.50         67           9.5         63           108         639           120         120           134         (16)           144         (16)           145         11           184         205           205         47	S         13           Expenditur         270           301         301           307         314           324         340           344         340           446         453           461         475           485         495	D1         D1           14         52           233064         12,903           12,903         6           96         107           119         132           147         163           182         225           23014         349           382         432           480         534	-228 Balance (174) (195) (184) (173) (163) (133) (133) (133) (133) (133) (133) (133) (133) (133) (133) (133) (133) (133) (133) (135) (137)	14 Expenditure 346 383 389 305 405 412 420 434 441 4579 603 616 633 649 668	D2         I           11         206,830           375,219         325,219           18,664         126           140         125           173         192           214         238           225         294           328         294           328         294           328         296           663         738           821         21	-566 Balance (221) (243) (234) (234) (233) (143) (143) (143) (146) (144) (146) (121) (147) (157)	15 Expenditure 157 173 173 178 186 188 197 203 208 206 270 270 278 289 289 289 289 289 289 204	D3:1 337,039 145,311 8,556 58 64 71 79 88 98 98 109 122 135 130 98 98 109 122 135 135 130 124 216 240 267 297 330	275 Balance (99 (100) (1	16 Expenditum 128 143 144 145 146 147 146 147 146 157 158 213 220 224 228 223 226 228 223 236	D3-2 1 297,530 133,328 4 8 8 8 8 9 9 65 73 81 59 65 73 81 100 112 166 183 206 229 254 283	-618 Balance (85) (81) (77) (74) (60) (62) (63) (54) (63) (54) (63) (54) (63) (54) (20) 0 21) 47	17 Expenditure 233 260 263 270 277 277 284 290 265 270 277 277 284 290 265 350 364 366 383 383 389	1 300 432 165 608 7,775 Revenue 83 92 102 102 102 102 102 102 102 10	-919 Balance (150) (166) (157) (143)	Expenditure 99 100 110 110 116 116 119 125 126 125 126 144 148 151 152 154 155 157	D4-2 1 250,341 27,854 2,034 Revenue 33 36 400 435 500 566 62 699 777 855 1077 119 132 1477 163 1822 2002	-1,556 Balance (67) (73) (65) (60) (77) (55) (60) (77) (53) (48) (48) (48) (29) (19) (29) (19) (20) (	Expenditure 233 258 261 262 267 268 271 277 278 280 355 368 372 374 378 383 388	D5-1 1 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 249 247 249 277 343 382 422	854 Balance (157) (174) (167) (151) (138) (151) (138) (117) (100) (81) (100) (91) (106) (91) (106) (31) 3 41 84	20 Expenditure 242 269 271 274 285 298 307 313 323 399 414 423 445 445 472	1 469.22P 10,619 Revenue 91 101 112 125 139 154 172 154 172 191 212 226 297 330 368 409 455 563	546 Balance (151) (168) (150) (140) (137) (120) (117) (107)	21 Expenditure 171 189 192 200 202 204 213 218 221 273 282 282 291 273 282 295 302 209 303 315	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78 87 97 108 120 134 149 208 231 231 236 318 354 394	-507 Balance (114) (122) (113) (113) (113) (103) (09) (03) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72		9,209,378 3,081,240	-370
Option Phase 1 Phase 2 Population 1 2 3 3 4 5 5 6 6 7 8 9 9 10 11 12 13 14 14 15 16 17 18	Expenditure 104 115 117 118 123 124 130 132 133 146 132 133 146 148 149 151 154 154 155	OT.1           227,066           29,894           39,894           1,337           67,000           41           749           741           745           71,050           66           771           50           677           63           6108           635           777           53           640           65           77           56           677           63           6108           639           108           (28)           134           165           1184           2005           47           2035           2035           47           2228           68	S         12           Image: State St	D1           40,652           233,064           12,903           e           Revenue           96           107           119           132           147           163           202           231           447           163           322           314           349           432           432           432           432           430           534           534           661	-228 Belance (174) (199) (184) (175) (168) (143) (143) (143) (143) (143) (143) (143) (143) (143) (143) (145) (97) (65) (65) (65) (65) (65) (65) (65) (65	14 Expenditure 346 412 420 434 441 452 579 603 616 633 616 633 649 666 688 711	D2         I           1         1           395,63,00         395,5119           13,664         Revenue           126         140           140         155           173         192           214         265           294         328           433         482           536         663           738         821           913         913	-566 Balance (221) (243) (223) (223) (223) (223) (223) (233) (169) (183) (169) (183) (169) (183) (169) (183) (169) (183) (169) (183) (169) (183) (194) (183) (194)	15 Expenditure 157 175 175 185 186 186 187 203 208 261 278 261 278 285 289 296 304 310	D3:1         1           323,038         144,311           8,556         8           64         71           79         88           100         122           133         130           142,311         150           122,323         123           133         130           194         216           240         267           330         367           300         367           409         90	275 Balance (09) (109) (109) (109) (109) (09) (09) (09) (09) (07) (07) (07) (07) (07) (07) (07) (07	16 Expenditur 128 143 144 145 146 147 148 156 157 158 213 202 224 226 224 228 223 233 236 241	D3-2 1 297,530 297,530 297,530 297,530 297,530 4,463 48 53 59 65 73 81 90 100 112 149 166 183 206 229 254 283 315	-618 Balance (85) (81) (77) (74) (62) (62) (62) (64) (64) (64) (64) (64) (64) (64) (63) (64) (64) (63) (64) (63) (63) (63) (63) (63) (63) (63) (63	17 Expenditure 233 258 260 260 270 277 277 277 277 277 277 277 277 27	1 5004327 165508 7,775 Revenue 83 92 102 102 102 114 127 141 157 174 194 216 254 282 314 349 349 349 349 349 349 349 34	-919 Balance (150) (166) (143) (150) (15) (15) (15) (15) (15) (15) (15) (15	Expenditure 99 109 110 110 116 116 119 124 125 126 124 124 125 151 151 152 155 155 155 161	D4-2 1 230,341 230,341 2,034 2,034 Revenue 33 36 40 40 40 45 50 66 62 69 97 77 119 132 147 107 119 132 147 147 158 198 198 198 198 198 198 198 19	-1,556 Balance (67) (73) (69) (60) (60) (57) (53) (41) (33) (41) (33) (41) (33) (41) (29) (19) (5) (19) (2) (19) (5) (6) (4) (2) (19) (2) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (4) (5) (5) (4) (5) (4) (5) (5) (5) (5) (5) (5) (5) (5	Expenditure 233 258 261 262 266 271 277 280 355 280 355 368 372 374 378 383 383 383 383 383	D5-1 1 460,679 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 199 249 247 209 343 382 425 526	854 Balance (157) (174) (167) (151) (151) (127) (117) (100) (81) (100) (81) (100) (81) (100) (81) (100) (81) (100) (81) (100) (81) (100) (11) (11) (11) (11) (12) (12) (12) (12	20 Expenditure 242 269 271 274 285 292 285 292 298 307 313 323 399 414 424 424 424 435 458	1 449,222 10,619 91 112 12 139 154 172 154 172 154 172 154 172 122 236 297 330 368 405 506 563 506	546 Balance (151) (168) (159) (146) (137) (146) (137) (146) (137) (146) (137) (146) (137) (102) (87) (102) (87) (102) (87) (102) (87) (102) (87) (102) (87) (102) (87) (102) (	21 Expenditue 171 190 190 200 200 200 200 200 202 204 213 213 213 221 273 282 291 295 295 309 315 323	D7 1 363,9%0 130,138 7,484 <i>Revenue</i> 57 63 771 78 <b>87</b> 710 87 108 120 134 149 208 231 237 286 318 354 354 438	-507 Ealance (114) (122) (113) (105) (05) (05) (05) (05) (05) (05) (05) (		9,209,378 3,081,240	370
Option           Phase 2           Propulation           Year           1           2           3           4           5           6           7           8           9           10           11           12           13           14           15           16           17	Expenditure 104 115 123 124 132 132 132 133 146 148 148 148 148 148 148 151 151 154 155	07.1         1           227.066         29.894           L837         67.1           Revenue         Balance           8         41           (7.4)         43           (7.5)         56           9.50         66           9.50         66           9.50         67           9.5         63           108         639           120         120           134         (16)           144         (16)           145         11           184         205           205         47	S         13           Expenditur         270           301         301           307         314           324         340           344         340           446         453           461         475           485         495	D1         D1           14         52           233064         12,903           12,903         6           96         107           119         132           147         163           182         225           23014         349           382         432           480         534	-228 Balance (174) (195) (184) (173) (163) (132) (113) (132) (113) (113) (113) (117) (97) (63) (117) (97) (63) 5 5 5 99	14 Expenditure 346 383 389 305 405 412 420 434 441 4579 603 616 633 649 668	D2         I           11         206,830           375,219         325,219           18,664         126           140         125           173         192           214         238           225         294           328         294           323         482           536         596           663         738           821         21	-566 Balance (221) (243) (234) (234) (233) (143) (143) (143) (146) (144) (146) (121) (147) (157)	15 Expenditure 157 173 175 178 186 188 186 188 203 203 203 203 203 203 203 203 204 304 319	D3:1 337,039 145,311 8,556 58 64 71 79 88 98 98 109 122 135 130 98 98 109 122 135 135 130 124 216 240 267 297 330	275 Balance (99 (100) (1	16 Expenditum 128 143 144 145 146 147 146 147 146 157 158 213 220 224 228 223 226 228 223 236	D3-2 1 297,530 133,328 4 8 8 8 8 9 9 65 73 81 59 65 73 81 100 112 166 183 206 229 254 283	-618 Balance (85) (81) (77) (74) (60) (62) (63) (54) (63) (54) (63) (54) (63) (54) (20) 0 211 47	17 Expenditure 233 260 263 270 277 277 284 290 265 270 277 277 284 290 265 350 364 366 383 383 389	1 300 432 165 608 7,775 Revenue 83 92 102 102 102 102 102 102 102 10	-919 Balance (150) (166) (157) (143)	Expenditure 99 100 110 110 116 116 119 125 126 125 126 144 148 151 152 154 155 157	D4-2 1 250,341 27,854 2,034 Revenue 33 36 400 435 500 566 62 699 777 855 1077 119 132 1477 163 1822 2002	-1,556 Balance (67) (73) (65) (60) (77) (55) (60) (77) (55) (60) (77) (53) (48) (48) (48) (29) (19) (29) (19) (20) (	Expenditure 233 258 261 262 267 268 271 277 278 280 355 368 372 374 378 383 388	D5-1 1 176,027 8,920 Revenue 76 85 94 105 117 130 144 160 178 249 247 249 277 343 382 422	854 Balance (157) (174) (167) (151) (138) (151) (138) (117) (100) (81) (100) (91) (64) (31) 3 41 84	20 Expenditure 242 269 271 274 285 298 307 313 323 399 414 423 445 445 472	1 469.22P 10,619 Revenue 91 101 112 125 139 154 172 154 172 191 212 226 297 330 368 409 455 563	546 Balance (151) (168) (150) (140) (137) (120) (117) (107)	21 Expenditure 171 189 192 200 202 204 213 218 221 273 282 282 291 273 282 295 302 209 303 315	D7 1 363,980 130,138 7,484 Revenue 57 63 71 78 87 97 108 120 134 149 208 231 231 236 318 354 394	-507 Balance (114) (122) (113) (113) (113) (103) (09) (03) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72) (63) (72		9,209,378 3,081,240	370

In practice WSUs and their boards have the responsibility for financial management and ensuring of healthy cash flows. When a WSU encounters financial problems it has three principal alternatives: to raise tariffs, increase sales volume or reduce costs, or a combination of the three. Experience has shown that although water is a basic need of human beings, the price to pay for water has a strong impact on water use. Economists call this price elasticity and it implies that the total revenue may not be increased by tariff raise.

## 5.5 Economic Evaluation

To supplement the financial analysis, the economic analysis was first quantitatively carried out using the EIRR analysis.

# 5.5.1 Identification of Economic Benefits and Demerits

The estimated economic benefits to be derived from rural water supply projects will become:

- B-1. Improvement of public health due to decrease in water-borne diseases
- B-2. Increase in work time or study time by reducing water transportation and time
- B-3. Improvement of gender issues by B-1 to B-2, and through the community activities in B-3
- B-4. Decrease in medical expenditures for governments and clinics
- B-5. Increase in employment chance by the construction of the systems and the need for O/M
- B-6. Increase in business activities to provide local materials for the systems
- B-7. Improvement of awareness on hygiene and sanitation through IEC
- B-8. Higher living standard and longer life expectancy by the use of clean and safe water

However, there might be some economic demerits as follows:

- D-1. Decrease in vendor businesses by the systems in some areas
- D-2. Environmental impact of groundwater lowering on shallow wells raising water right issues
- D-3. Land acquisition problems that might be raised if solved properly.

According to the social survey, households who take water from venders are limited. Furthermore, the business for venders is very limited both spatially and seasonally. This economic demerit is considered very limited.

As concluded in the EIA analysis, the water level was lowered in the existing shallow wells in K3 and D5 as a result of the pumping tests. The water right issues should be taken into consideration before the implementation. This issue will raise a social conflict between villages who use piped water and dug wells, and damage the economic foundation for the local communities. In K3-1, the pilot model has been monitored if there is such an issue.

# 5.5.2 Economic Cash Flow Analysis

## <u>General</u>

Cash flow analysis by the use of economic internal rate of return "EIRR" was calculated based on the estimated economic benefits, and demerits. Most of the benefits and demerits identified in the previous section have qualitative effects, only benefits B1, B2 and demerit D-1 have quantifiable effects.

The quantifiable effect related to B1 is cost reduction for medical care, and that for B2 is cost saving of water collection. Venders will reduce the benefits related to vending business.

# **Assumptions**

Assumptions of the quantifiable analysis are as follows:

- ATP (3% of the annual income) will be used if the necessary water tariff exceeds 3% of the annual income.
- Incidences of water-borne diseases collected by the social survey are used for the analysis.
- Reduction in water-borne diseases is estimated as high as 50 % for typhoid, cholera, dysentery, and diarrhea.
- Annual cost saved by reducing the diseases is estimated as high as VND 250,000 (average medical cost) for treatment for typhoid, cholera, dysentery, diarrhea, and trachoma. Cost saving by disease reduction is thus calculated as follows:

Total saving by water collection =

250,000 VND/household \* no. of households suffering from each disease

• Reduction of time for water collection is due to the households taking water from the springs, and is estimated as long as 1 hour.

• Time saved for water collection is valued at the average VND 1,000 using the household incomes per hour for farmers collected by the social survey. The annual saving is thus calculated as follows:

Total saving by water collection =

500 VND/hour \* 1 hour/day \* 365 days \* % of using springs/rivers \* no. of households

• Demerits associated with the reduction in vending business are offset by benefits derived by the cost reduction for water bought from venders. In a closed society, net demerits are zero, so the economic analysis omitted did not take any calculations for vending business.

## <u>Results</u>

EIRR for the every proposed system is calculated as shown Table 5.5. The following are the results of the economic cash flow analysis:

- The EIRRs of K3-1, G6-1, D3-1, D4-2, and D6 are relatively large (+5 to 15%). These systems are economically feasible.
- The EIRRs of K1-1, K2-1, K2-3, and D5-1 could not be calculated or had large negative values (-6% to -27%). These systems are economically unfeasible.
- The EIRR of the other systems varies between -4 to 4%.

#### Table 5.5 EIRR Cash Flow

																						-				0				•		_		10							
Commune	I K1-1				2 K2-1			3 K2-3				4 K3-1			5 K4-1				GI			G2				8 G3-1				9 H 1				10 G5-1				11 66-1			
	NI-1				1			N2-3				1			N4-1 }				1			62				63-1 1			data da babar	79-1. 1				63-1							
Option Phase 1	1	\$70	3,218		1	151,059		1	350,2	210		0.01940101010	181,568		00.800	406,6	501	10000000	<u>, a <b>k</b>a ja ja ja ja</u>	601,322	************	10004000	965,	260	000000	1010010101	591,51	<u></u>	101010101010101	- <b>K</b> -0101010	344,95	(0)0)0)0)0 ( <b>5</b>	11010101010	1004000	337,	704		0000000000	227,	066	1010101010
Phase 2			5,762		-	17,820			72,4				92,120		-	126,2				168,673			352,				143,19				136,71				117,			-	29,8		
			797			17,820			4,86											6,988			13,7								5,080			-				-	4,6		
Population		<i>'</i> ,	197			1,012			4,80	5∡ T T			2,819		-	3,13	90 T T			6,988			1.5,	//9 			7,698				5,080				4,0	08		-	4,6	1	
Year	EXP	REV	E/B	BAL	EXP	REV EA	B BAL	EXP	REV	E/B	BAL	EXP	REV E	/B BAL	EXP	REV	E/B	BAL	EXP 1	REV E	B BAL	EXP	REV	E/B	BAL	EXP	REV	E/B H	BAL E	EXP :	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL
2003	322	68	36	(219)	70	7 5	(57)	164	22	10	(131)	92	25 2	4 (42)	177	62	22	(93)	257	87 3	(139)	432	144	21	(267)	250	90	30 (	(129) 1	156	55	19	(82)	144	50	8	(86)	114	45	24	(45)
2004	354	75	39	(240)	77	8 6	(63)	182	25	11	(146)	105	28 2	6 (51)	202	69	23	(110)	285	96 3	3 (155)	477	161	22	(294)	276	101	32 (	(144) 1	173	61	21	(91)	161	56	9	(97)	126	50	25	(50)
2005	355	84	42	(230)	77	9 6		183	28	12	(143)	106	31 2		203	77	25			107 3		483	179	24	(280)	283						22	(83)	162	62	10	(90)		55	27	(44)
2006	356	93	45	(218)	78	10 7		183	31	13	(139)	107		1 (41)	203	86	27			119 3		490	199	26	(264)	288	124					24	(T)	163	69	10	(84)		62	30	(36)
2007	364	103	49	(212)	83	11 7	× 2	189	34	14	(140)	112		3 (40)	209	95	30	· · ·			2 (122)	501	221	28	(251)	299	138					26	(72)	169	77	11	(81)	133	69	32	(33)
2008	365	115	53	(197)	83	13 8		189	38	15	(136)	113		6 (34)	209	106	32				5 (105)	505	246	31	(228)	302	154				94	28	(61)	170	86	12	(73)	137	76	35	(26)
2009	366	128	57	(181)	83	14 8		192	42	16	(134)	116		9 (29)	210	118	34				P (87)	512	274	33	(205)	307	171		(89) 1	185	104	31	(50)	172	95	13	(63)	138	85	37	(15)
2010	372	142	61	(168)	88	16 9		198	47	18	(133)	122		2 (27)	215	131	37			182 5		525	305	36	(185)	316	191					33	(42)	178	106	14	(58)	144	94	40	(9)
2011	376	158	66	(151)	88	17 10		199	52	19	(127)	123		5 (19)	218	146	40			203 5		534	339	39	(156)	325						36	(30)	182	118	15	(49)		105	44	3
2012	378	176	72	(130)	89	19 10		200	58	21	(121)	124		9 (10)	219	162	43			226 6		541	377	42	(122)	329	236		~ ~		143	39	(14)	184	131	16	(36)	149	117	47	15
2013	481	196	77	(208)	123	21 11		255	177	22	(56)	166		3 2	267	184	47				5 (42)	682	493	45	(144)	396	296		2.4		177	42	(29)	226	166	18	(43)		143	51	(4)
2014	493	218	84	(192)	126	24 12		262	197	24	(41)	173		7 12	274	205	51			308 7		706	548	49	(110)	410	330					45	(16)	233	184	19	(29)		159	55	9
2015	498	243	90	(165)	127	27 13		263	219	26	(18)	174		2 29	277	228	55			343 7		716	610	52	(54)	417	367					49	5	237	205	21	(12)		177	59	27
2016	503	270	98	(136)	127	30 14		267	243	28	5	179		7 46	278	253	59			381 8		729	678	57	6	426	408				243	52	31	240	228	22	10	212	197	64	49
2017	508	300	105	(103)	128	33 15		269	271	30	32	181	175 7		280	282	64			424 9		743	755	61	73	437						57	57	244	254	24	34	218	219	69	70
2018	511	334	114	(63)	130	37 16		271	301	33	63	183		8 89	282	313	69			472 9		758	839	66	147	448	505					61	89	249	282	26	59	223	243	75	95
2019	517	372	123	(22)	131	41 18		273	335	35	97	186		4 115	286	349	74			525 1		780	934	71	225	460						66	120	253	314	28	89	227	271	81	124
2020	523	413	133	23	132	45 19		278	373	38	133	191	241 9		291	388	80			584 1		798	1,039	77	317	478						71	159	261	350	30	119	233	301	87	155
2021	530	460	143	74 74	133 133	50 21 50 21		281	415	41	175 175	194 194		8 172 8 172	295	432 432				650 1: 650 1:		819	1,155	83 83	420 420	492 492						77 77	200	268 268	389	33	154 154	240 240	335	94 94	189 189
2022 EIRR	530	460	143		133	50 21		281	415	41		194	268 9		295	432			440 1	650 1:		819	1,155	85		494	690			291	414	11	200	208	389	33	-2%		355	94	
																		29%			29/6				-4%				2%				20%								10%
	US\$(=15	000VND)	)	-27% -1,287			#DIV/0 -380	•			-6% -700			7% -161				2% -439			2% -665				-4% -1,384				2% 608				2% -387				-2%				10% -170
	US\$(=13	000VND)																															2% -387								
		000VND)			12							16			16				17			10				10			-608	20	_		2% -387						-		
NPV	US\$(=15)	000VND)			13 D1			14 12				15 D3-1			16 D3-2			-439	17 D4-1			18 D4-2				19 D5-1			-608	20 D6			2% -387	21							
	12	000VND)						14							16 D3-2 1			-439								19 D5-1 1			-608				2% -387	21 D7 1					 		
NPV Commune	12		7,066		Dl	640,632		14	926,8	850		D3-1	337,039		D3-2	297,3		-439		500,457		D4-2	250,	341		D5-1	460,67		-608	D6	469,22	9	2% -387	D7	363,	980			9,209	9,378	
NPV Commune Option	12	227			Dl	640,632 233,064		14	926,8 375,2			D3-1	337,039 141,311		D3-2	297,5	530	-439		500,457 165,608		D4-2	250, 127,			D5-1	460,67	9	-608	D6	469,22 104,81		2% -387	D7	363,						
NPV Commune Option Phase 1	12	227	7,066		Dl			14		219		D3-1			D3-2		530	-439				D4-2		,854		D5-1		9	-608	D6		3	29% -387	D7		138			9,209	1,240	
NPV Commune Option Phase 1 Phase 2	12	227	7,066		Dl	233,064	-380	14	375,2	219		D3-1	141,311 8,556		D3-2	133,3	530 328 53	-439	D4-1	165,608	-665	D4-2	127,	,854		D5-1	176,02 8,920	9	-608	D6	104,81	3	29% -387	D7	130,	138			9,209	1,240	
NPV Commune Option Phase 1 Phase 2 Population	12 G7-1 1	227 29, 1,; REV	7,066 ,894 837 E/B	-1,287	D1 1	233,064 12,903 REV EA	-380	14 D2 L	375,2 18,4 REV	219 64 E/B	-700	D3-1 1	141,311 8,556 REV E	-161 ///////////////////////////////////	D3-2 1 EXP	133,3 4,46 REV	330 328 33 E/B	-439	EXP	165,608 7,775 REV E	-665 B BAL	EXP	127, 2,0 REV	,854 134	-1,384 BAL	D5-1 1 EXP	176,02 8,920 REV	9 7 E/B I	BAL E	D6	104,81 10,619 REV	3 9 E/B	-387	D7 1 EXP	130, 7,4 REV	138 84	-435	Total	9,209	1,240	
Commune Option Phase 1 Phase 2 Population Year 2003 2004	12 07-1 1 EXP 104 115	227 29, 1,: REV 37 41	7,066 ,894 837 E/B 11 12	-1,287 BAL (56) (62)	EXP 270 301	233,064 12,903 REV E/I 96 24 107 25	-380 -380 	14 12 12 12 14 12 14 14 14 14 14 14 14 14 14 14 14 14 14	375,2 18,4 REV 126 140	219 64 E/B 50 54	-700 BAL (170) (189)	EXP 157 173	141,311 8,556 REV E 58 3 64 3	-161 /// ////////////////////////////////	D3-2 1 EXP 128 143	133,3 4,46 REV 43 48	330 328 33 E/B 18 19	-439 BAL (67) (77)	EXP 1 233 258	165,608 7,775 REV E 83 2 92 2	-665 B BAL 2 (129) 4 (143)	D4-2 1 EXP 99 109	127, 2,0 REV 33 36	,854 134	-1,384 BAL (59) (65)	D5-1 1 EXP 233 258	176,02 8,920 REV 71 79	9 7 E/B I 15 (( 16 ()	608	2XP 242 269	104,81 10,619 REV 91 101	3 9 E/B 20 21	-387 BAL (132) (147)	D7 1 EXP 171 189	130, 7,4 REV 57 63	138 84 E/B	-435 BAL (114) (125)	Total	9,209	1,240	
Commune Option Phase 1 Phase 2 Population Year 2003 2004 2005	12 07-1 1 EXP 104 115 117	227 29, 1,: REV 37 41 45	7,066 ,894 837 E/B 11 12 13	-1,287 BAL (56) (62) (59)	EXP 270 301 303	233,064 12,903 REV EA 96 24 107 25 119 28	-380 -380 	14 192 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	375,2 18,4 REV 126 140 155	219 64 E/B 50 54 39	-700 BAL (170) (189) (175)	EXP 157 173 175	141,311 8,556 REV E 58 3 64 3 71 3	-161 //B BAL 3 (67) 5 (74) 8 (65)	D3-2 1 EXP 128 143 144	133,3 4,4¢ REV 43 48 53	530 528 53 18 18 19 21	-439	EXP 1 233 258 260	165,608 7,775 REV E 83 2 92 2 102 2	-665 B BAL 2 (129) 4 (143) 5 (132)	D4-2 1 EXP 99 109 110	127, 2,0 REV 33 36 40	854  34 ЕЛВ  8  8  9	-1,384 BAL (59) (65) (61)	D5-1 1 EXP 233 258 261	176,02 8,920 REV 71 79 88	9 7 E/B I 15 (( 16 () 18 ()	-608	2XP 242 269 271	104,81 10,619 REV 91 101 112	3 9 E/B 20 21 23	-387 BAL (132) (147) (136)	D7 1 EXP 171 189 190	130, 7,4 REV 57 63 71	138 84 E/B 0 0 0	-435 BAL (114) (125) (120)	Total	9,209	1,240	
Commune Option Phase 1 Phase 2 Population Year 2003 2004 2005 2006	12 G7-1 1 EXP 104 115 117 118	227 29, 1,: REV 37 41 45 50	7,066 ,894 837 E/B 11 12 13 14	-1,287 BAL (56) (62) (59) (54)	201 1 EXP 270 301 303 307	233,064 12,903 REV EA 96 24 107 25 119 28 132 30	-380 -380 	14 192 EXP 346 383 389 395	375,2 18,4 REV 126 140 155 173	219 64 E/B 50 54 59 64	-700 BAL (170) (189) (175) (159)	<b>D3-1</b> 1 EXP 157 173 175 178	141,311 8,556 REV E 58 3 64 3 71 3 79 4	-161 ///////////////////////////////////	D3-2 1 EXP 128 143 144 145	133,2 4,46 REV 43 48 53 59	330 328 33 E/B 18 19 21 22	-439 BAL (67) (77) (71) (64)	EXP 1 233 258 260 263	165,608 7,775 REV E 83 2 92 2 102 2 114 2	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122)	D4-2 1 EXP 99 109 110 110	127, 2,0 REV 33 36 40 45	854  34  E/B   8   8   9   10	-1,384 BAL (59) (62) (61) (50)	D5-1 1 EXP 233 258 261 262	176,02 8,920 REV 71 79 88 98	9 7 E/B I 15 (( 16 () 18 ()	-608	D6 1 2XP 242 269 271 274	104,81 10,619 REV 91 101 112 125	3 E/B 20 21 23 25	-387 BAL (132) (147) (136) (125)	D7 1 EXP 171 189 190 192	130, 7,4 REV 57 63 71 78	138 84 E/B 0 0 0 0	-435 BAL (114) (125) (120) (113)	Total	9,209	1,240	
NPV Commune Option Phase 1 Phase 2 Population Year 2003 2004 2005 2006 2007	12 G7-1 1 EXP 104 115 117 118 123	2227 29, 1,: REV 37 41 45 50 56	7,066 ,894 837 E/B 11 12 13 14 15	-1,287 BAL (56) (62) (59) (54) (52)	201 1 EXP 270 301 303 307 314	233,064 12,903 REV EA 96 24 107 25 119 28 132 30 147 32	-380 -380 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3	14 52 11 EXP 346 383 389 395 405	375,2 18,4 REV 126 140 155 173 192	219 64 E/B 50 54 39 64 69	-700 BAL (170) (189) (175) (124)	<b>D3-1</b> 1 EXP 157 173 175 178 <b>185</b>	141,311 8,556 REV E 58 3 64 3 71 3 79 4 88 4	-161 //B BAL 3 (67) 5 (74) 8 (63) 1 (57) 5 (52)	D3-2 1 EXP 128 143 144 145 146	133,2 4,46 REV 43 48 53 59 65	330 328 33 E/B 118 19 21 21 22 22 24	-439 BAL (67) (71) (64) (59)	EXP 1 233 258 260 263 270	165,608 7,775 REV E 83 2 92 2 102 2 114 2 127 3	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114)	D4-2 1 EXP 99 109 110 110 116	127, 2,0 REV 33 36 40 45 50	854 34 E/B 8 9 10 10 10	-1,384 BAL (59) (61) (59) (53)	D5-1 1 EXP 233 258 261 262 267	176,02 8,920 REV 71 79 88 98 109	9 7 E/B I 15 ( 16 ( 18 ( 21 (	-608	242 242 269 271 274 285	104,81 10,619 REV 91 101 112 125 139	3 9 E/B 20 21 23 25 27	-387 BAL (132) (147) (125) (119)	D7 1 EXP 171 189 190 192 200	130, 7,4 REV 57 63 71 78 87	138 84 E/B 0 0 0	-435 BAL (114) (120) (113) (113)	Total	9,209	1,240	
Commune Option Phase 1 Phase 2 Population Year 2003 2004 2005 2006	12 G7-1 1 EXP 104 115 117 118	227 29, 1,: REV 37 41 45 50	7,066 ,894 837 E/B 11 12 13 14	-1,287 BAL (56) (62) (59) (54) (52) (45)	270 301 303 307	233,064 12,903 REV EA 96 24 107 25 119 28 132 30	-380 -380 -38 -38 -38 -38 -38 -38 -38 -38	14 192 EXP 346 383 389 395	375,2 18,4 REV 126 140 155 173	219 64 E/B 50 54 59 64	-700 BAL (170) (189) (175) (159) (144) (125)	<b>D3-1</b> 1 EXP 157 173 175 178	141,311           8,556           REV         E           58         3           64         3           71         3           79         4           88         4           98         4	-161 //B BAL 3 (67) 5 (74) 8 (65) 1 (57) 5 (52) 8 (40)	D3-2 1 EXP 128 143 144 145	133,2 4,46 REV 43 48 53 59	330 328 33 E/B 18 19 21 22	-439 BAL (67) (77) (71) (64) (69) (68)	EXP 1 233 258 260 263 270 272	165,608 7,775 REV E 83 2 92 2 102 2 114 2	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114) 2 (99)	D4-2 1 EXP 99 109 110 110	127, 2,0 REV 33 36 40 45	854  34  E/B   8   8   9   10	-1,384 BAL (39) (62) (61) (53) (49)	D5-1 1 EXP 233 258 261 262	176,02 8,920 REV 71 79 88 98 109 121	99 77 15 ( 16 ( 18 ( 19 ( 22 (	-608 (140) 2 (140) 2 (140) 2 (153) 2 (144)	D6 1 2XP 242 269 271 274 285 292	104,81 10,615 REV 91 101 112 125 139 154	3 E/B 20 21 23 25	-387 BAL (132) (147) (125) (119) (109)	D7 1 EXP 171 189 190 192	130, 7,4 REV 57 63 71 78	138 84 E/B 0 0 0 0 0	-435 BAL (114) (125) (123) (113) (105)	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           Year           2003           2004           2005           2006           2007           2008           2010	12 07-1 1 EXP 104 115 117 118 123 124 130	227 29, 1,; REV 37 41 45 50 56 62 69 77	7,066 ,894 837 E/B 11 12 13 14 15 16 17 19	-1,287 BAL (56) (62) (59) (54) (52) (43) (34)	270 301 303 307 314 321 324 334	233,064 12,903 REV Eff 96 24 107 25 119 28 132 30 147 32 163 35 182 37 202 40	-380 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3	14 02 11 EXP 346 383 389 405 412 420 434	375,2 18,4 REV 126 140 155 173 192 214 238 265	219 664 50 54 59 64 69 74 80 86	-700 BAL (170) (189) (173) (173) (159) (144) (123) (103) (33)	D3-1 1 EXP 157 173 175 178 185 186 188 197	141,311 8,556 REV E 58 2 64 3 71 2 79 4 88 4 109 5 122 5	-161 ///////////////////////////////////	D3-2 1 EXP 128 143 144 145 146 147 148 156	133,2 4,46 REV 43 48 53 59 65 73 81 90	530 528 53 E/B 118 19 21 21 22 24 26 28 30	-439 BAL (67) (71) (64) (56) (48) (35)	EXP 1 233 258 260 263 270 272 277 284	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           127         3           141         3           157         3           174         3	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114) 2 (99) 5 (83) 7 (72)	D4-2 1 1 EXP 99 109 110 110 116 116 116 119 124	127, 2,0 REV 33 36 40 45 50 56 62 69	854 134 E/B 8 8 9 10 10 11 12 13	-1,384	D5-1 1 EXP 233 258 261 262 267 268 271 277	176,02 8,920 REV 71 79 88 98 109 121 135 150	99 77 15 (C 16 (C 18 (C 19 (C 21 (C 22 (C 24 (C 26 (C)	-608 	D6 1 1 2XP 2 242 269 271 285 292 298 307	104,81 10,619 REV 91 101 112 125 139 154 172 191	3 E/B 20 21 23 25 27 29 31 34	-387 BAL (132) (147) (136) (125) (119) (109) (92) (83)	D7 1 EXP 171 189 190 192 200 200 200 200 204 213	130, 7,4 REV 57 63 71 78 87 97 108 120	138 84 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (125) (120) (113) (113) (105) (93)	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2007           2008           2009           2010           2011	12 G7-1 1 EXP 104 115 117 118 123 123 124 130 132	227 29, 1,; REV 37 41 45 50 56 62 69 77 86	7,066 ,894 837 E/B 11 12 13 14 15 16 17 19 20	-1,287 BAL (56) (62) (59) (54) (52) (43) (34)	270 301 303 307 314 321 324 334 340	233,064 12,903 REV Eff 96 24 107 25 119 28 132 30 147 32 163 33 182 37 202 40 225 44	-380 -3 -3 -3 -3 -3 -3 -3 -3 -3 -3	14 D2 EXP 346 383 389 395 405 412 420 434 441	375,2 18,4 REV 126 140 155 173 192 214 238 265 294	219 664 E/B 50 54 59 64 69 74 80 86 93	-700 BAL (170) (189) (173) (173) (159) (144) (123) (103) (33)	D3-1 1 EXP 157 173 175 178 185 185 185 188 197 203	141,311 8,556 REV E 58 3 64 3 71 2 79 4 88 4 109 5 122 5 135 6	-161 ///////////////////////////////////	D3-2 1 EXP EXP 128 143 144 145 146 147 148 156 157	133,2 4,46 REV 43 48 53 59 65 73 81 90 100	330 328 33 18 19 21 21 22 24 26 28 30 33 33	-439 BAL (77) (64) (64) (64) (64) (71) (64) (71) (64) (71) (64) (73) (73) (73) (73) (73) (74)	D4-1 1 EXP 1 233 258 260 260 270 272 277 277 284 290	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           127         3           141         3           157         3           174         3           194         4	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 7 (122) 5 (83) 7 (72) 3 (56)	D4-2 1 1 EXP 99 109 110 110 116 116 116 119 124 125	127, 2,0 REV 33 36 40 45 50 56 56 62 69 77	854 134 E/B 8 8 9 10 10 11 12 13 14	-1,384	D5-1 1 EXP 233 258 261 262 267 268 271 277 278	176,02 8,920 REV 71 79 88 98 98 109 121 135 150 167	99 77 15 (C 16 (C 18 (C 19 (C 21 (C 22 (C 24 (C 26 (C)	-608 	D6 1 2XP 242 269 271 274 285 292 298 807 813	104,81 10,619 REV 91 101 112 125 139 154 172 191 212	3 E/B 20 21 23 25 27 29 31 34 36	-387 BAL (132) (147) (136) (125) (119) (109) (92) (83)	D7 1 EXP 171 189 190 192 200 202 204 213 218	130, 7,4 REV 57 63 71 78 87 97 108 120 134	138 84 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (125) (120) (113) (113) (105) (95) (85)	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2007           2008           2001           2010           2011	12 G7-1 1 EXP 104 115 117 118 123 123 124 130 132 133	227 29, 1,: REV 37 41 45 50 56 62 69 77 77 86 95	7,066 ,894 837 11 12 13 14 15 16 17 19 20 22	-1,287 BAL (56) (59) (54) (59) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (55) (52) (52) (52) (52) (52) (52) (52	201 1 EXP 270 301 307 314 321 324 324 3340 344	233,064 12,903 REV Eff 96 24 107 25 119 28 132 30 147 32 163 35 182 37 202 40 225 44 250 47	380 	14 D2 1 EXP 346 389 395 405 412 420 434 434 432	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328	219 664 50 54 59 64 59 64 69 74 80 86 93 101	-700 BAL (170) (189) (173) (179) (179) (129) (124) (103) (83) (54) (23)	D3-1 1 1 57 173 175 178 185 186 188 197 203 208	141,311 8,556 REV E 58 2 64 3 71 2 79 4 88 4 98 4 109 5 122 5 135 6 150 6	-161 //B BAL 3 (67) 5 (74) 8 (40) 1 (57) 5 (52) 8 (40) 2 (27) 6 (19) 1 (7) 6 9	D3-2 1 1 EXP 128 143 144 145 146 147 148 156 157 158	133,2 4,4¢ REV 43 48 53 59 65 73 81 90 100 112	330 328 33 E/B 19 21 221 224 26 28 30 33 33 33 33 35	-439 BAL (67) (77) (71) (64) (59) (48) (39) (39) (39) (32) (34) (11)	D4-1         I           I         I           I         I           I         I           I         I           I         I           I         I           II         I           II         I           III         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           127         3           141         3           157         3           174         3           194         4           216         4	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114) 2 (99) 5 (63) 7 (72) 0 (56) 4 (36)	D4-2 1 1 EXP 99 109 110 116 116 116 119 124 125 126	127, 2,0 REV 33 36 40 45 50 56 62 69 77 85	854 134 E/B 8 8 9 10 10 10 11 12 13 14 15	-1,384 BAL (39) (63) (61) (53) (49) (43) (43) (33) (26)	D5-1 1 EXP 233 258 261 262 267 268 271 277 278 280	176,02 8,920 REV 71 79 88 98 109 121 135 150 167 186	9 7 7 15 15 16 16 19 21 22 24 26 24 28 30	-608 	D6 1 2XP 242 269 271 274 285 292 298 307 313 323	104,81 10,619 REV 91 101 112 125 139 154 172 191 212 236	3 E/B 20 21 23 25 27 29 31 34 36 39	-387 BAL (132) (147) (130) (125) (119) (109) (93) (64) (43)	D7 1 EXP 171 189 190 192 200 202 204 213 218 221	130, 7,4 REV 57 63 71 78 87 97 108 120 134 149	138 84 E/B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (125) (113) (113) (105) (96) (93) (83) (72)	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2006           2006           2008           2009           2010           2011           2012	12 G7-1 1 EXP 104 115 117 118 123 124 130 132 133 146	2227 299 1,: REV 37 41 45 50 56 62 69 777 86 62 95 108	7,066 ,894 837 11 12 13 14 15 16 17 19 20 22 24	-1,287 BAL (59) (62) (59) (54) (52) (44) (52) (44) (52) (44) (52) (45) (14)	D1         I           1         1           EXP         270           301         303           303         304           321         324           334         344           430         344	233,064           12,903           REV         Eff           96         24           107         25           119         28           132         30           147         32           182         37           202         40           225         44           250         44           51         51	380 	14 102 EXP 346 383 389 389 405 412 420 434 441 452 579	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 433	219 664 50 54 39 64 69 74 80 86 93 101 109	-700 BAL (170) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (199) (144) (123) (103) (123) (103) (12	D3-1 1 1 57 173 175 175 185 186 188 186 188 197 203 208 261	141,311           8,556           REV         E           58         2           64         3           71         2           79         4           88         4           109         5           122         5           135         6           194         7	-161 ///////////////////////////////////	D3-2 1 EXP EXP 128 143 144 145 146 156 157 158 213	133,2 4,44 REV 43 48 53 59 65 73 81 90 100 112 149	530 528 53 18 19 21 22 24 26 30 33 33 33 33 33 33	-439 BAL (67) (71) (64) (59) (48) (29) (24) (24) (11) (2)	D41           1           233           258           260           263           270           272           277           284           295           350	165,608           7,775           REV         E           83         2           99         2           102         2           114         2           127         3           141         3           157         3           174         3           194         4           216         4           254         4	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114) 2 (99) 5 (83) 7 (72) 0 (56) 4 (36) 7 (30)	D4-2 1 1 EXP 99 109 110 110 116 119 124 125 144	127, 2,0 REV 33 36 40 45 50 56 62 69 77 77 85 107	854 134 E/B 8 8 9 10 10 11 12 13 14 15 16	-1,384 BAL (39) (61) (59) (63) (63) (53) (43) (43) (43) (43) (43) (32) (20) (21)	D5-1 1 EXP 233 258 261 262 267 268 271 277 278 280 355	176,02 8,920 REV 71 79 88 98 109 121 135 150 167 186 207	9 7 7 15 15 16 16 18 (19 18 (19 19 (21 22 (22 24 (22 24 (22 23 ) 30 33 33 (1)	-606 BAL E [146] 2 (163) 2 (153) 2 (15	D6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	104,81 10,615 REV 91 101 112 125 139 154 172 191 212 236 297	3 E/B 20 21 23 25 27 29 31 34 36 39 42	-387 BAL (132) (147) (136) (125) (119) (03) (03) (64) (45) (60)	D7 1 EXP 171 189 190 192 200 202 204 213 218 221 273	130, 7,4 REV 57 63 71 78 87 97 108 120 134 149 208	138 84 E/B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (125) (120) (113) (11	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2007           2008           2001           2010           2011	12 G7-1 1 EXP 104 115 117 118 123 123 124 130 132 133	227 29, 1,; REV 37 41 45 50 56 62 69 57 86 95 108 120	7,066 ,894 837 11 12 13 14 15 16 17 19 20 22 24 26	-1,287 BAL (56) (62) (54) (54) (53) (54) (53) (54) (54) (54) (54) (52) (44) (54) (54) (52) (44) (54) (52) (44) (56) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (54) (52) (52) (54) (52) (52) (54) (52) (52) (52) (54) (52) (52) (52) (52) (52) (52) (52) (52	D1 EXP 270 301 303 307 314 321 324 334 340 344 430 446	233,064           12,903           REV         En           96         24           107         25           119         28           132         30           147         32           163         35           182         37           225         44           250         47           314         51           340         55	380 	14 D2 1 2 2 2 2 2 2 2 2 2 2 2 2 2	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 433 482	219 64 50 54 50 54 64 69 74 80 86 93 101 109 118	-700 BAL (170) (189) (173) (179) (179) (129) (124) (103) (83) (54) (23)	D3-1 1 1 57 173 175 178 185 186 188 197 203 208	141,311           8,556           REV         E           58         2           64         3           71         2           79         4           88         4           109         5           122         5           135         6           194         7	-161 //B BAL 3 (67) 5 (74) 8 (63) 1 (57) 5 (52) 8 (40) 2 (27) 6 9 1 3 7 22	D3-2 1 1 EXP 128 143 144 145 146 147 148 156 157 158	133,2 4,46 REV 43 48 53 59 65 73 81 90 100 112 149 166	330 328 33 18 19 21 22 24 26 28 30 33 33 33 33 33 44	-439 	D4-1         I           I         I           233         I           233         I           258         I           263         I           270         I           277         I           284         I           290         I           350         I           364         I	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           157         3           174         3           194         4           216         4           224         4           224         4           224         3	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114) 2 (99) 5 (85) 7 (72) 0 (50) 4 (30) 4 (31)	D4-2 1 1 EXP 99 109 110 110 116 116 116 119 124 125 126 144 148	127, 2,0 REV 33 36 40 45 50 56 62 69 77 85 107 119	854 34 E/B 8 9 10 10 11 12 13 14 15 16 18	-1,384 -1,384 	D5-1 1 EXP 233 258 261 262 267 267 267 267 277 277 278 280 355 368	176,02 8,920 REV 71 79 88 98 109 121 135 150 167 186 207 230	9 77 15 (1 18 (1 19 (1 22 (1 24 (1 22 (1 24 (1 26 (1 28 (1) 33 (1) 33 (1)	-606 	D6 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	104,81 10,615 REV 91 101 112 125 139 154 172 191 212 236 297 330	3 E/B 20 21 23 25 27 29 31 34 36 39 42 46	-387 BAL (132) (133) (123) (119) (123) (119) (123) (119) (123) (119) (123) (12	D7 1 EXP EXP 171 189 190 192 200 202 204 213 218 221 218 221 273 282	130, 7,4 REV 57 63 71 78 87 97 108 120 134 149	138 84 E/B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (12) (12) (12) (13) (13) (13) (13) (13) (13) (13) (13	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2007           2008           2008           2010           2010           2012           2012           2013	12 (77-1 1 1 EXP 104 115 117 118 123 124 130 132 133 146 148 149 151	227 29, 1; REV 37 41 45 50 56 62 69 77 86 69 77 86 69 95 108 120 134 149	7,066 894 837 E/B 11 12 13 14 15 16 17 19 20 20 22 24 26 28 30	-1,287 BAL (59) (59) (54) (59) (44) (57) (44) (54) (45) (44) (57) (44) (42) (44) (42) (42) (42) (42) (42	D1         1           3         3           270         301           303         307           314         321           324         334           340         344           430         446           453         461	233,064 12,903 REV Eff 96 24 107 25 119 28 132 30 147 32 163 33 182 37 202 40 225 44 250 47 314 51 349 55 388 99 432 64	-380 -3 BAL 4 (130) 5 (169) 5 (149) 6 (149) 6 (147) 1 (143) 1 (105) 9 (2) 1 (125) 1 (22) 1	L4 D2 EXP 3466 383 389 395 405 412 420 434 411 452 579 603 616 33	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 433 482 536 596	219 64 50 54 59 64 69 74 80 86 93 101 109 118 127 137	-700 BAL (170) (137) (139) (144) (103) (139) (144) (103) (139) (144) (103) (139) (144) (122) (103) (139) (142) (122) (123) (123) (124) (12	D3-1 1 157 173 175 178 185 186 186 186 188 197 203 208 261 270 278 285	141,311           8,556           REV         E           58         2           64         2           79         4           88         4           109         5           122         5           135         6           194         7           216         7           240         8           267         8	-161 ///////////////////////////////////	D3-2 1 D3-2 1 EXP EXP 128 143 144 145 146 147 148 156 157 158 213 220 224 226	133,2 4,46 REV 43 48 53 59 65 73 81 90 100 1112 149 166 185 206	330 328 33 E/B 18 19 21 22 24 26 28 30 33 33 33 33 33 41 44 448	-439 BAL (67) (71) (71) (64) (56) (48) (23) (24) (11) (22) (13) 5 28	D4-1         I           I         I           233         I           233         258           260         263           270         277           284         295           350         364           369         376	165,608           7,775           REV         E           883         2           992         2           102         2           114         2           127         3           141         3           157         3           174         3           194         4           254         4           282         5           314         5           349         5	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114) 2 (99) 5 (85) 7 (72) 0 (14) 2 (99) 5 (85) 7 (7) 2 (99) 5 (85) 7 (7) 2 (99) 1 (31) 5 0 9 (33)	D4-2 1 1 EXP 99 100 110 116 116 119 124 125 144 148 151	127, 2,0 REV 33 36 40 45 50 62 69 77 85 107 119 132 147	854 134 E/B 8 8 9 10 10 10 11 12 13 14 15 16 18 19 21	-1,384 BAL (59) (65) (61) (59) (61) (59) (49) (43) (43) (43) (43) (43) (43) (43) (43	D5-1 1 EXP 233 258 261 267 268 271 277 280 355 368 372 374	176,02 8,920 REV 71 79 88 98 109 121 135 150 167 186 207 230 256 2284	99 77 15 (C 19 (C 19 (C 22 (C 26 (C 28 i 33 (C 33 (C) 33 (C) 33 (C) 33 (C)	-608 	EXP 242 269 271 274 285 292 298 307 313 323 399 414 424 433	104,81 10,615 REV 91 101 112 125 139 154 172 191 212 236 297 330 368 409	E/B 20 21 23 25 27 29 31 34 36 39 42 46 49 53	-387 -387 BAL (132) (147) (122) (119) (122) (119) (123) (119) (123) (119) (123) (119) (123) (119) (123) (123) (132) (133) (132) (133) (132	D7 1 EXP 171 189 190 202 204 213 221 273 282 295	130, 7,4 REV 57 63 71 78 87 97 97 108 120 134 149 208 231 257 286	138 84 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (122) (120) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (114) (11	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2007           2008           2009           2010           2011           2013           2014           2015           2014           2015           2016           2017	12 07-1 1 EXP 104 115 117 118 123 123 123 123 123 130 132 133 146 148 149 151 154	227 29, 1; REV 37 41 45 50 56 62 95 95 108 120 134 149	2,066 ,894 837 E/B 11 12 13 14 15 16 17 17 19 20 22 24 26 28 24 26 28 30 32	-1,287 BAL (50) (62) (59) (52) (43) (52) (44) (52) (44) (52) (44) (20) (16) (16) (16) (16) (16) (12) 28 44	270 301 307 303 307 314 324 334 340 344 430 446 453 446 453	233,064 12,903 REV Eff 96 24 107 25 119 28 132 30 147 32 163 33 163 33 163 33 163 33 163 33 163 33 163 33 163 33 163 33 164 45 163 4	-380 -3 BAL (150) (157) (157) (157) (150) (157) (157) (124) (125) (124) (124) (124) (124) (125) (124) (125) (124) (125) (124) (125) (124) (125) (124) (125) (124) (125) (124) (125) (125) (124) (125) (124) (125) (124) (125) (	14 122 122 14 14 14 14 14 14 14 14 14 14	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 433 482 536 596 663	E/B E/B 50 54 59 64 59 64 69 74 80 86 93 101 109 118 127 137 148	-700 BAL (170) (139) (175) (139) (175) (139) (175) (139) (139) (139) (139) (139) (139) (139) (144) (122) (133) (13)) (13	D3-1         1           1         1           157         173           173         175           185         186           188         197           203         203           204         261           270         278           285         289	141,311           8,556           REV         E           58         2           64         2           71         2           98         4           109         5           122         5           135         6           194         7           240         8           267         8           297         2	-161           //B         BAL           3         (67)           5         (74)           8         (65)           1         (57)           5         (52)           8         (40)           2         (27)           6         (19)           1         37           6         9           1         3           7         22           3         44           9         72           7         104	D3-2 1 1 EXP 128 143 144 145 146 147 156 157 158 213 220 224 226 228	133,2 4,44 REV 43 48 53 59 65 73 81 90 100 1112 149 166 185 206 229	330 328 33 EJB 18 19 21 22 24 26 28 33 33 33 33 33 33 41 44 48 52	-439 	EXP 1 233 258 260 263 260 263 270 272 277 284 290 295 350 364 369 376 383	165,608           7,775           REV         E           83         2           992         2           1012         2           114         2           127         3           141         3           157         3           144         2           154         4           254         4           2254         4           282         5           314         5           388         6	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 7 (	D4-2 1 1 EXP 99 109 110 116 116 116 116 124 125 126 144 148 151 152 154	127, 2,0 REV 33 36 40 45 56 62 69 77 85 107 119 132 147 163	854 134 E/B 8 8 9 10 10 11 12 13 14 15 16 18 19 21 22		D5-1 1 EXP 233 258 261 262 267 268 271 277 278 280 355 368 372 374 378	176,02 8,920 REV 71 79 88 98 109 121 135 150 167 186 207 230 230 236 284 316	99           77           15           16           17           18           19           221           222           24           224           224           33           33           33           41	-608 	D6         Image: Constraint of the second seco	104,81 10,615 REV 91 101 112 125 139 154 172 191 212 236 297 330 368 409 455	E/B 20 21 23 25 27 29 31 34 36 39 42 46 49 53 58	-387 BAL (132) (147) (122) (119) (123) (119) (123) (119) (136) (136) (136) (136) (136) (137) (136) (137) (136) (137) (13	D7 1 EXP EXP 171 189 192 200 202 204 213 218 221 273 282 291 295 302	130, 7,4 REV 57 63 71 78 87 97 108 120 134 149 208 231 257 286 318	138 84 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (120) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (114) (114) (114) (114) (114) (114) (114) (114) (114) (114) (114) (114) (114) (114) (113) (11	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2006           2001           2011           2012           2013           2014           2015           2018	12 G7-1 1 EXP 104 115 117 118 123 124 130 132 133 146 148 149 151 151 156	2227 29, 1, 7 8 7 7 4 1 45 50 56 62 69 77 76 69 77 78 69 95 108 120 1120 1121 120 120 120 120 120 120 1	7,066 894 837 E/B 11 12 13 14 15 16 17 19 20 22 24 26 28 30 32 35	-1,287 BAL (56) (52) (59) (54) (52) (53) (54) (52) (54) (52) (53) (54) (52) (53) (54) (53) (54) (53) (54) (53) (54) (53) (54) (54) (53) (54) (54) (54) (54) (54) (54) (54) (54	270 303 307 314 321 324 334 340 344 430 446 453 461 475	233,064 12,903 REV Eff 96 24 107 25 119 28 132 30 147 32 163 33 182 37 202 40 225 44 220 47 314 51 349 55 388 59 432 64 480 69 534 75	-380 -3 BAL 4 (150) 5 (169) 5 (159) 6 (146) 6 (125) 6 (125) 7 (125)	14 12 14 102 1 1 1 1 1 1 1 1 1 1 1 1 1	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 433 482 536 596 663 5738	E/B E/B 50 54 59 64 59 64 80 86 93 101 109 118 127 137 148 160	-700 BAL (170) (189) (144) (125) (144) (144) (149) (144) (149) (144) (149) (144) (123) (133) (33) (33) (33) (33) (34) (34) (34) (	203-1 1 1 1 1 1 1 7 7 1 7 3 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 1 7 5 7 1 7 5 7 1 7 5 1 7 5 7 1 7 5 1 7 1 7	141,311           8,556           REV         E           58         2           64         2           79         2           88         4           109         5           122         5           135         6           150         6           152         2           216         7           240         8           267         8           297         5           330         11	-161 ///////////////////////////////////	D3-2 1 1 EXP EXP 128 143 144 145 146 147 148 156 157 158 213 224 226 228 233	133,2 4,44 REV 43 48 53 59 65 73 81 90 100 112 149 166 185 206 185 229 254	330 232 33 E//B 18 19 21 22 24 26 23 33 33 33 33 33 33 33 33 33 33 33 33	-439 BAL (67) (77) (74) (76) (76) (77) (71) (74) (79) (79) (70) (70) (70) (70) (70) (70) (70) (70	EXP 1 233 258 260 263 270 277 284 290 295 350 364 369 376 383 389	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           127         3           157         3           194         4           254         4           282         5           314         5           349         5           388         6           432         6	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 0 (114) 2 (99) 5 (83) 7 (72) 0 (56) 4 (30) 7 (50) 1 (31) 5 0 3 33 4 69 9 112	D4-2 1 1 EXP 99 100 110 110 110 116 119 124 125 126 144 145 151 152 155	127, 2,0 REV 33 36 40 45 50 56 69 77 85 69 77 85 107 119 132 147 167 182	854 134 E/B 8 8 9 10 10 10 11 12 13 14 15 16 18 19 21 22 24		D5-1 1 EXP 233 258 261 267 268 271 277 278 280 355 368 372 374 378 383	176,02 8,920 REV 71 79 98 109 121 135 150 167 186 207 230 256 284 316 352	9 7 15 16 11 12 11 12 11 12 11 12 11 12 11 12 12	-608 	D6         Image: Constraint of the second seco	104,81 10,615 REV 91 101 112 125 139 154 172 191 212 236 297 330 368 409 455 506	E/B 20 21 23 25 27 29 31 34 36 39 42 46 49 53 58 62	-387 -387 BAL (132) (133) (123) (123) (139) (123) (19) (19) (19) (19) (19) (19) (19) (19	D7 1 EXP EXP 171 189 190 192 200 202 204 218 221 273 218 221 273 291 295 309	130, 7,4 REV 57 63 71 78 87 97 108 120 134 149 208 231 257 286 318 354	138 84 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (120) (120) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (114) (114) (114) (114) (114) (114) (114) (114) (114) (114) (112) (112) (112) (113) (11	Total	9,209	1,240	
NPV           Option           Phase 1           Phase 2           Population           2004           2004           2005           2006           2007           2008           2009           2010           2011           2013           2015           2017           2018	12 (77-1 1 1 EXP 104 115 117 118 123 124 130 132 133 134 130 132 133 134 136 151 156 157	227 29, 1, 1, 77 41 45 56 62 69 95 77 86 69 95 108 108 120 134 149 163 184 205	2,066 .894 837 E/B 11 12 13 14 15 16 17 19 20 22 24 26 30 32 28 30 32 33 33	-1,287 BAL (56) (62) (59) (54) (52) (45) (52) (45) (16) (16) (16) (16) (16) (16) (16) (16	270 301 307 303 307 314 324 334 340 344 430 445 445 461 475 485	233,064 12,903 REV Eff 96 244 107 25 119 28 119 28 119 28 119 28 132 30 147 32 163 33 182 37 202 40 225 44 420 47 314 51 338 59 442 450 47 538 59 452 54 452 54 452 54 453 55 554 55 555 555 555 55 555 555	-380 -3 BAL (150) (157) (157) (159) (157) (124) (124) (124) (124) (124) (124) (125) (125) (157) (125) (157) (	14 102 123 143 144 144 144 145 1420 1420 1420 1420 1420 1420 1420 1420 1420 1420 1420 1420 1441 1452 1579 16666 1666 1666 1666 1666 16	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 433 28 433 28 433 536 596 663 596 663 738 821	E/B E/B 50 54 59 64 69 74 80 93 101 109 118 1127 137 148 160 173	-700 BAL (170) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (193) (199) (19	D3-1         1           1         1           157         173           175         176           186         186           186         197           203         208           261         270           278         285           289         296           304         304	141,311           8,556           REV         E           58         2           64         2           71         2           98         4           109         5           133         6           150         6           150         6           240         8           297         9           330         11           367         1	-161           //B         BAL           3         (67)           5         (74)           8         (65)           1         (57)           5         (52)           2         (27)           6         (9)           1         (7)           6         9           1         3           7         22           3         441           9         72           7         104           14         138           13         176	D3-2 D3-2 T EXP EXP 128 143 144 145 146 147 148 156 157 158 213 220 224 228 223 226 228 223 236	133,2 4,44 REV 43 48 53 59 65 73 81 90 100 112 149 90 100 112 149 100 112 149 206 229 2254 283	530 228 33 E/JB 18 19 21 22 24 26 28 33 33 33 33 33 33 33 33 33 33 33 33 33	-439 	EXP 1 233 258 260 263 270 272 277 272 277 284 290 295 364 369 364 383 376 383 389 - 398	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           127         3           141         3           157         3           194         4           254         4           282         3           349         5           388         6           432         6           481         7	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 7 (122) 5 (85) 5 (85) 5 (85) 5 (85) 5 (85) 5 (85) 5 (85) 5 (85) 5 (85) 5 (87) 5 (9) 5 (9) 5 (9) 5 (12) 5 (	D4-2 1 1 EXP 99 109 110 110 116 116 116 124 125 126 144 148 151 152 154 155 157	127, 2,0 REV 33 36 40 50 56 62 57 69 77 85 107 132 147 163 132 147 163 202	854 134 E/B 8 8 9 10 10 10 11 12 13 14 15 16 18 19 21 22 24 26	BAL (39) (60) (59) (61) (59) (59) (59) (59) (59) (59) (59) (59	D5-1 1 EXP 233 258 261 262 267 268 271 277 278 280 355 368 372 374 378 388	176,02 8,920 REV 71 79 88 98 98 98 98 98 121 135 150 167 186 207 230 256 256 256 256 284 316 352 391	99 77 E/B I 115 ( 116 ( 118 (1	-608 -608 	D6 1 2XP 242 242 269 271 274 285 292 292 293 307 313 323 399 414 424 433 445 458 458	104,81 10,615 REV 91 101 112 125 139 154 172 191 212 236 297 330 368 409 455 506 563	3 20 21 23 25 27 29 31 34 36 39 42 46 49 53 38 62 67	-387 -387 BAL (132) (147) (125) (119) (25) (119) (25) (33) (64) (45) (60) (33) (64) (45) (61) (33) (64) (45) (64) (45) (64) (15) (15)	D7 1 EXP 171 189 192 200 202 204 213 213 221 273 282 295 302 309 315	130, 7,4 REV 57 63 71 78 87 97 108 87 97 108 120 134 149 208 231 257 286 318 257 286 318 354 394	138 84 E/B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (12) (12) (113)	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2007           2008           20010           20112           2013           2014           2015           2016           2017           2018           2019           2020	12 (77-1 1 ) EXP 104 115 117 118 123 123 124 130 124 132 133 146 151 154 154 155 157 159	2227 29, 1, 1, 77 77 86 95 62 69 56 62 69 95 103 120 134 120 134 149 165 184 205 228	2,066 ,894 837 11 12 13 14 15 16 17 19 19 20 22 24 26 28 30 32 35 38 30 32 35 38	-1,287 BAL (56) (62) (54) (54) (54) (54) (54) (54) (54) (54	201 30 270 301 303 307 321 324 334 340 344 430 446 453 446 453 461 475 485 495 506	233,064 12,903 REV Eff 96 244 107 25 119 28 132 30 147 32 163 35 182 37 202 40 225 44 250 47 334 55 388 59 432 64 480 69 534 75 594 81 661 87 594 81 504 81 505 82 505	-380 -380	14 D2 1 2 2 346 383 395 405 412 420 434 441 452 579 603 616 633 646 633 646 666 668	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 328 433 482 536 663 738 821 913	219 64 E/B 50 54 59 64 69 64 69 64 80 86 93 101 109 118 127 148 160 173 187	-700 BAL (170) (139) (144) (122) (133) (144) (122) (133) (144) (122) (133) (144) (122) (133) (13	D3: 1           1           1           157           173           175           178           186           188           197           203           204           270           278           289           296           304           310	141,311           8,556           REV         E           58         2           64         2           71         2           64         2           71         2           88         4           98         4           109         5           122         5           133         6           130         6           194         7           216         7           2267         8           330         11           367         1           409         1	-161           B         BAL           3         (67)           5         (74)           8         (63)           1         (57)           5         (27)           6         (19)           1         3           7         22           3         44           9         72           7         104           13         144           13         144           13         144           132         220	D3-2 1 1 EXP 128 143 144 145 146 147 148 157 158 213 220 224 226 228 233 236 241	133,2 4,44 REV 43 48 53 59 65 73 81 90 100 1112 149 166 185 206 229 254 2254 233,5	30 228 228 33 E/B 18 19 21 22 24 22 24 26 28 33 33 33 33 33 33 33 34 44 44	-439 -439 BAL (67) (77) (64) (50) (64) (50) (64) (50) (64) (50) (64) (50) (64) (50) (64) (50) (71) (64) (50) (72) (71) (64) (50) (72) (71) (64) (50) (72) (73) (74) (74) (74) (74) (74) (75) (74) (75) (74) (75) (74) (75) (74) (75) (	EXP 1 233 258 260 260 270 277 277 284 295 350 350 350 350 350 350 350 350 350 35	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           157         3           174         3           174         2           216         4           2254         4           3314         5           388         6           4322         6           481         7           335         8	-665 B BAL 2 (129) 4 (143) 5 (132) 7 (122) 7 (122) 7 (122) 7 (72) 2 (99) 5 (63) 7 (72) 2 (99) 5 (63) 7 (72) 2 (99) 5 (63) 7 (72) 5 (63) 7 (72) 5 (63) 7 (72) 5 (63) 7 (72) 5 (63) 7 (72) 5 (63) 7 (72) 5 (63) 7 (72) 7 (72)	D4-2 1 1 EXP 99 109 110 110 110 116 116 119 125 126 144 151 155 155 157 161	127, 2,0 REV 33 36 40 45 50 56 62 69 77 77 119 132 147 163 182 202 225	854 134 E/B 8 8 9 10 10 10 10 11 12 13 14 15 16 18 19 19 21 22 24 26 28		D5-1 1 EXP 233 258 261 262 268 271 277 278 280 355 368 372 374 378 383 383 383	176,02 8,920 REV 71 79 88 98 98 109 121 135 150 167 136 207 230 256 207 230 250 230 256 316 352 391 435	999777 EPB I 15 (C 18 (C 21 (C 24 (C 24 (C 24 (C 24 (C 24 (C 26 (C 24 (C 26 (C 26 (C 26 (C) 26 (C) 27 (C) 28 (C) 28 (C) 20 (C) 2	608 500 500 500 500 500 500 500 5	D6 2242 242 242 242 242 244 244 244 244 2	104,81 10,619 REV 91 101 112 125 139 154 172 212 212 212 212 212 236 297 330 368 409 455 506 563 626	3 20 21 23 25 27 29 31 34 36 49 53 58 62 67 77 2	-387 BAL (132) (147) (129) (129) (129) (129) (129) (129) (129) (129) (139) (139) (19)) (19	D7 1 EXP EXP 190 192 202 204 213 218 221 273 282 291 295 302 309 315 323	130, 7,4 REV 57 63 71 78 87 97 108 120 134 149 208 231 134 149 208 231 24 354 354 438	138 84 E/B 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (12) (120) (113) (102) (113) (103) (05) (72) (51) (34) (51) (34) (51) (34) (51) (34) (51) (34) (51) (34) (51) (51) (51) (51) (51) (51) (51) (51	Total	9,209	1,240	
NPV           Option           Phase 1           Phase 2           Population           2004           2004           2006           2007           2008           2009           2010           2011           2013           2014           2015           2017           2018	12 (77-1 1 1 EXP 104 115 117 118 123 124 130 132 133 134 130 132 133 134 136 151 156 157	227 29, 1, 1, 77 37 41 45 56 62 69 57 77 86 69 95 108 108 120 134 149 163 184 205	2,066 .894 837 E/B 11 12 13 14 15 16 17 19 20 22 24 26 30 32 28 30 32 33 33	-1,287 BAL (56) (62) (59) (54) (52) (45) (52) (45) (16) (16) (16) (16) (16) (16) (16) (16	270 301 307 303 307 314 324 334 340 344 430 445 445 461 475 485	233,064 12,903 REV Eff 96 244 107 25 119 28 119 28 119 28 119 28 132 30 147 32 163 33 182 37 202 40 225 44 420 47 314 51 338 59 442 450 47 538 59 452 54 452 54 452 54 453 55 554 55 555 555 555 55 555 555	-380 -3 -380 -3	14 102 123 143 144 144 144 145 1420 1420 1420 1420 1420 1420 1420 1420 1420 1420 1420 1420 1441 1452 1579 16666 1666 1666 1666 16	375,2 18,4 REV 126 140 155 173 192 214 238 265 294 328 433 28 433 28 433 536 596 663 596 663 738 821	E/B E/B 50 54 59 64 69 74 80 93 101 109 118 1127 137 148 160 173	-700 BAL (170) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (173) (189) (193) (199) (19	D3-1         1           1         1           157         173           175         176           186         186           186         197           203         208           261         270           2778         285           289         296           304         304	141,311           8,556           REV         E           58         2           64         2           71         2           98         4           109         5           133         6           150         6           150         6           240         8           297         9           330         11           367         1	.161           AB         BAL           3         (67)           5         (52)           8         (65)           1         (27)           5         (52)           8         (40)           2         (27)           6         (19)           1         (27)           6         (19)           1         3           4         9           7         2           3         444           9         72           7         104           13         176           13         136           12         220           13         266	D3-2 D3-2 T EXP EXP 128 143 144 145 146 147 148 156 157 158 213 220 224 228 223 226 228 223 236	133,2 4,44 REV 43 48 53 59 65 73 81 90 100 112 149 90 100 112 149 100 112 149 206 229 2254 283	30 228 228 33 E/B 18 19 21 22 24 22 24 26 28 33 33 33 33 33 33 33 34 44 44	-439 -439 	EXP 1 233 258 260 263 270 272 277 284 295 330 364 333 364 376 383 389 408 408 418 418	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           127         3           141         3           157         3           194         4           254         4           282         3           349         5           388         6           432         6           481         7	- 665 - 675 - 77 - 675 - 77 - 675 - 77 - 675 - 77 - 70 - 70	D4-2 1 1 EXP 99 109 110 110 116 116 116 124 125 126 144 148 151 152 154 155 157	127, 2,0 REV 33 36 40 50 56 62 57 77 85 107 132 147 163 132 147 163 202	854 134 E/B 8 8 9 10 10 10 11 12 13 14 15 16 18 19 21 22 24 26	BAL (39) (60) (59) (61) (59) (59) (59) (59) (59) (59) (59) (59	D5-1 1 EXP 233 258 261 262 267 268 271 277 278 280 355 368 372 374 378 388	176,02 8,920 REV 71 79 88 98 98 109 121 135 150 167 136 207 230 256 207 230 250 230 256 316 352 391 435	P           FB         I           15         (C           16         (C           18         (I           221         (C           224         (C           221         (C           33         (C           33         (C           33         (C           341         48           52         56           56         (C	608 2 2 2 2 2 2 2 2 2 2 2 2 2	D6	104,81 10,619 REV 91 101 112 125 139 154 172 191 212 236 297 330 368 409 455 506 563 626 697	3 20 21 23 25 27 29 31 34 36 39 42 46 49 53 58 62 67 77 2	-387 -387 BAL (132) (147) (125) (119) (25) (119) (25) (33) (64) (45) (60) (33) (64) (45) (61) (33) (64) (45) (61) (15) (15)	D7 1 EXP EXP 171 189 192 200 202 204 213 213 221 273 282 295 302 309 315	130, 7,4 REV 57 63 71 78 87 97 108 87 97 108 120 134 149 208 231 257 286 318 257 286 318 354 394	138 84 E/B 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (12) (12) (113)	Total	9,209	1,240	
NPV           Commune           Option           Phase 1           Phase 2           Population           2003           2004           2005           2006           2007           2008           2009           2010           2011           2013           2014           2015           2016           2017           2018           2019           2021           2021           2021           2021	12 (37-1) 1 1 EXP 104 115 117 118 123 123 123 123 123 130 132 133 130 132 133 134 135 151 154 155 157 159	227 29, 1, 7 8 8 9 5 6 2 6 9 5 6 2 6 9 5 7 7 7 8 6 9 5 108 6 9 7 7 7 8 6 9 5 120 134 145 122 124 124 9 7 12 9 8 7 12 9 8 7 12 9 7 12 9 8 7 12 9 7 12 9 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 12 9 7 7 7 12 9 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7	7,066 ,894 337 E/B 11 12 13 14 15 16 17 19 20 22 24 24 26 28 30 32 235 38 34 44 44	-1,287 BAL (59) (62) (59) (54) (54) (54) (54) (54) (54) (54) (54	270 301 303 307 314 321 324 324 324 324 340 344 430 445 344 430 445 461 475 495 506	233,064 12,903 REV Eff 96 24 107 25 119 28 132 30 147 32 202 40 225 44 225 44 534 75 388 59 4420 69 534 75 534 75 735 94 735 94 75 75 75 75 75 75 75 75 75 75	-380 -3 -380 -3	14 502 51 52 51 52 52 52 52 52 52 52 52 52 52 52 52 52	375,2 18,4 REV 126 140 155 173 173 173 214 238 265 294 328 433 265 326 536 536 536 536 536 536 536 53	E/B E/B 50 54 50 54 64 69 64 69 74 80 86 93 101 109 118 127 137 137 148 160 173 187 201	-700 BAL (170) (189) (189) (189) (189) (189) (19) (19) (19) (19) (19) (19) (19) (1	D3:1           1           157           173           175           178           185           186           188           197           203           261           2778           285           2896           304           319	141,311           8,556           REV         E           64         2           64         2           71         2           64         2           71         2           88         4           98         4           109         5           122         5           133         6           194         7           216         7           240         8           267         8           267         8           267         1           360         1           367         1           409         1           454         1	.161           78         BAL           3         (67)           5         (74)           8         (65)           1         (57)           5         (52)           2         (27)           6         (19)           1         3           7         12           3         444           9         72           7         104           134         136           131         1266	D3-2 D3-2 EXP EXP 128 143 144 145 146 147 146 156 157 158 213 220 224 226 223 220 224 226 223 233 236 245	133,2 4,44 REV 43 48 53 59 65 73 81 90 100 110 110 110 110 1149 166 185 206 185 229 254 229 254 233 330	330 128 128 133 E/B 18 19 21 22 24 26 24 26 33 33 33 33 34 41 44 42 56 60 65 70 70 70	-439 -439 	EXP 1 233 258 260 263 270 272 277 284 295 330 364 333 364 376 383 389 408 408 418 418	165,608           7,775           REV         E           83         2           92         2           102         2           114         2           127         3           141         2           157         3           174         3           194         4           254         4           282         5           349         5           348         6           432         6           432         6           335         8           955         8	- 665 - 675 - 77 - 675 - 77 - 675 - 77 - 675 - 77 - 70 - 70	D4-2 1 1 EXP 99 99 109 110 110 110 116 116 116 124 125 126 144 148 151 152 155 157 161 163	127, 2,0 REV 33 36 40 45 56 62 69 77 85 107 85 107 119 132 147 163 182 202 225	854 134 E/B 8 8 9 10 10 10 11 12 13 14 15 16 18 19 21 22 24 26 30	BAL (39) (65) (65) (65) (65) (65) (65) (65) (65	D5-1 1 EXP 233 258 261 262 267 267 267 267 267 277 278 280 335 372 374 383 388 392 397	176,02 8,920 REV 71 79 88 98 109 121 135 150 167 186 207 230 256 284 316 352 391 435	9 7 15 15 16 11 12 12 12 12 12 12 12 12 12	608 2 2 2 2 2 2 2 2 2 2 2 2 2	D6 2222 222 222 222 222 222 222 222 222	104,81 10,619 REV 91 101 112 125 139 154 172 191 212 236 297 330 368 409 455 506 563 626 697	3 20 21 23 25 25 27 29 31 34 36 39 42 46 49 49 53 36 58 67 67 72 78	-387 BAL (132) (147) (136) (122) (119) (25) (119) (25) (33) (64) (63) (63) (63) (63) (64) (63) (63) (63) (64) (63) (63) (64) (7) (7) (7) (7) (7) (7) (7) (7) (7) (7	D7 1 EXP EXP 171 189 190 200 202 204 213 218 221 273 229 204 213 218 221 273 229 309 315 333	130, 7,4 REV 57 63 71 78 87 97 97 108 120 134 149 208 231 257 286 318 354 354 394 487	138 84 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	-435 BAL (114) (122) (120) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (113) (114) (114) (114) (112) (113) (11	Total	9,209	1,240	

# 5.5.3 Socio-economic Considerations

Although the EIRRs were very low (around 0%) in some systems, there are many qualitative benefits. The general descriptions of the identified benefits are explained below:

- The present water quality tests show that the water taken from the wells explored by the study team and that will be used for the piped systems is very clean (low level of coliform). Many of the piped systems will be equipped with treatment plant for iron and manganese removal, and reduce the inconvenience related to washing.
- The study area has been affected by high incidences of water borne diseases, i.e. typhoid, cholera, dysentery, trachoma, and diarrhea. These diseases are considered to be originated from unsafe water containing a lot of contamination. Actually, the water quality analysis of the existing water sources (especially, shallow dug wells and springs/rivers) in the study area indicates that the water is overall contaminated by human and animal wastes.
- Usually, a household with these diseases annually spends about VND 250,000 for the treatment, except when the patient is very poor. Households therefore can reduce costs for medical care by using safe and clean water provided by the piped schemes. For poor people, the subsidy is provided to cover medical care costs for free.
- According to the social survey, more than 40% of the respondents take water from nearby springs in K1 and K3, and 30% in D2 and 20% in D5. In these communities, women and children usually fetch water from springs or the points to take water. The proposed piped systems will reduce the opportunity costs for women to work and for children to study.
- The board of water supply unit is recommended to include women for the management. This will increase the opportunity for women to take part in the management of water supply systems, and improve the gender situation.
- The water supply systems will also improve the information management through IEC activities. The promoters will be involved in various IEC activities in cooperation with the health workers in the communes/towns.

Serial	System		Construction		Projec	et Cost	Project co	ost per capita
No.	No.	Pop.	Cost (Thou. US\$)	(Thou. US\$)	(Thou. US\$)	Rank from the smallest	(US\$)	Rank from the smallest
	Kon Tum							
1*	K1-1	3,087	876	1,007	1,108	20	359	21
2	K2-1	638	156	180	198	1	310	20
3	K2-3	1,925	444	510	561	12	292	19
4	K3-1	2,306	205	236	260	2	113	7
5	K4-1	2,474	459	528	581	11	235	18
	Gia Lai							
6	G1	5,567	608	699	769	-	138	14
7	G2	11,084	1,065	1,225	1,347	21	122	12
8	G3-1	6,377	594	683	751	17	118	11
9	G4-1	4,292	346	397	437	9	102	9
10	G5-1	3,288	341	392	431	-	131	
11	G6-1	3,843	213	245	269	3	70	2
12	G7-1	1,507	227	261	287	4	191	17
	Dac Lac							
13	D1	10,795	641	737	810	15	75	3
14	D2	14,853	927	1,066	1,172	19	79	4
15	D3-1	6,619	337	388	426		64	1
16	D3-2	3,453	322	370	407	6	118	10
17	D4-1	6,901	544	626	689	-	100	-
18	D4-2	1,805	246	283	311	5	172	16
19	D5-1	4,992	567	652	717	14	144	15
20	D6	8,626	575	661	727	16	84	6
21	D7	5,735	358	412	453	10	79	4

Table 5.6Construction Cost Per Capita

\*The shaded systems are not so cost-effective, compared with the other systems.

In conclusion, if the benefits stated above are more than the per capita construction cost calculated below, the implementation of the proposed water supply systems will be verified.

The lifetime of systems is estimated as long as 20 years. Therefore, for example, if the total construction cost per capita is \$150 the estimated annual cost per capita would be US\$ 7. This amount of money is compared with the expected benefits as shown in Figure 5.1. Figure 5.1 shows that the annual medical expense and water cost per capita is around US\$14 in the most of cases. Therefore implementation of some of the water supply facilities will be verified.

However, the systems in K1-1, K2-1, K2-3, K4-1, G7-1, D4-2, and D5-1 will not become cost-effective, compared with the other systems.

Although the construction costs per capita of the systems in D3-2, and D7 are relatively low, these systems should be evaluated with regard to O&M and management potential. The systems of D3-2 and D7 have difficulty in financial affordability, management of the existing facilities (or lack of reliability).

On the other hand, the construction costs per capita of the systems in K4-1, G1, and G5-1 are relatively high, but should be considered with regard to equity. Many poor and ethnic minority people live in these communes.

# 5.6 Conclusion

In conclusion, the study suggests that out of the 21 priority systems the 14 systems in K2-3, K3-1, K4-1, G1, G2, G3, G4-1, G5, G6, D1, D2, D3-1, D4-1 and D6 be implemented by 2005, and the other 8 systems in K1-1, K2-1, K2-3, G7-1, D3-2, D4-2, D5-1, and D7 be implemented by the end of phase 1 as shown in Table 6.1.

The issues related to O&M are very crucial for the implementation. The systems in K1-1, K2-1, K2-3, D3-2, D4-2, D5-1, and D7 need capacity building before implementation as explained in the evaluation of O&M. The water quality of G7-1 has a problem.

The systems in K4-1 and D4-1 need more time for IEC activities to increase house connections and financial sustainability. The total cost for the priority projects at phase 1 is approximately US\$ 9.9 millions as shown below. This cost ignores the cost for necessary equipment to be procured in future. For these systems, alternative power supply such as generator and solar power systems will be considered in the Draft Final Report to reduce the O&M cost.

					(1,000 US\$)
Comn no. of v		Option at phase 1	Direct Cost	<b>Base Cost</b>	Construction Cost
Kon Tum			1,107	1,275	1,402
1	K2-3	1	443	510	561
2	K3-1	1	205	237	260
3	K4-1	1	459	528	581
Gia Lai			3,165	3,640	4,004
4	G1	1	608	699	769
5	G2	1	1,065	1,225	1,347
6	G3-1	1	594	683	751
7	G4-1	1	346	397	437
8	G5-1	1	341	392	431
9	G6-1	1	213	245	269
Dac Lac			3,023	3,477	3,824
10	D1	1	640	737	810
11	D2	1	927	1,065	1,172
12	D3-1	1	337	388	426
13	D4-1	1	544	626	689
14	D6	1	575	661	727
	Total		7,295	8,392	9,000
VAT (10 %)					900
<b>Grand Tota</b>	1				9,900

Table 5.7	Cost for the 13-S	System for the	Implementation in	2003-2005
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Note: The marked commune of K3-1, K4-1 and D4-1 are facing in-sustainable finance condition.

# Chapter 6 Approach to Information, Education and Communication (IEC)

# 6.1 IEC and Hygiene Promotion

This section recommends activities for information, education, and communication activities (IEC) to encourage an increased demand for safe and clean water and hygienic latrines, and to increase the number of participants in the water supply systems as much as possible. IEC is the key to the financial sustainability of the proposed water supply systems. If people rely too much on subsidies, their self-dependence will not mature.

Inhabitants of the rural areas of the Central Highlands have lacked experience in paying for centralized water supply systems and in maintaining and operating them.. The use of these systems has resulted in improvements in health conditions of the local people, a reduction in time spent for water fetching and an increase in time for productive activities, especially, for women. IEC has been identified as the best method to promote the use of safe and clean water.

Formal networks, i.e. formal meetings, and home visits will be used for IEC. Promoters should be appointed by WSU to implement IEC activities for the promotion of piped water supply.

# 6.2 Parties Responsible for IEC

The parties responsible for IEC include:

Management Unit of CERWASS/PCERWASS, CPC,

- - )

WSU, and

Promoters.

CERWASS/PCERWASS have decided to establish a Management Unit within the organization to train the local staff for rural water supply systems. The CERWASS/PCERWASS have decided to establish a Management Unit within the organization to train the local staff for rural water supply systems. The Management Unit should be responsible for the financial and technical support for IEC in the rural areas of the Central Highlands. The necessary finance should be earmarked for IEC.

External support (i.e. international cooperation) may be necessary to formulate a model program of IEC and to train the IEC staff of the Unit for the initial stage. It is recommended that the materials developed by DANIDA for IEC be utilized and revised to formulate the model program.

In each commune, promoters should be appointed by the WSU to promote additional connections to the water supply systems. WSU should pay for the promoters with financial support from the CPC/TPC.

Promoters will also co-operate with IEC activities at the commune. Villagers, including health workers, women's union, and teachers may be appointed as promoters if appropriate. People selected as promoters must have the respect of the local people, be able to communicate in the local languages, and know the benefits of safe and clean water. The Management Unit of PCERWASS should train promoters in the model program to become familiar with IEC.

# 6.2.1 Necessary Information for IEC

Necessary information to be distributed includes the following:

- 1) **Objectives** of the town meeting
- 2) The <u>water supply plan</u> including the drawings, project cost, maintenance cost and its implementation schedule
- 3) The <u>water quality data of the present water sources</u> and the benefits of safe and clean water
- 4) <u>Benefits</u> of safe and clean water should be emphasized using pictures and drawings
- 5) <u>Costs</u> for house connections and the water charge
- 6) Self support of the water supply system by the local people
- 7) **Operation and maintenance procedures for public taps**

## Objectives of town meeting

The most important information for meetings is to explain the objectives of the water supply schemes. These will be outlined to the local participants in the local languages by the promoters. It is necessary to explain: 1) that local people will benefit from the water supply system, and 2) the local people will be responsible for the management of the piped water supply system. The objectives should be repeated often during meetings.

## The water supply plan

The second of type information to be provided is about the water supply plan itself. The information in the plan includes:

- CERWASS/PCERWASS has to be executed the plan;
- the locations of the explored wells and the main and secondary pipes;
- the amount of construction cost and O&M cost;
- the method of providing house connections;
- the time schedule of construction; and
- the safe well yield of the explored wells.

<u>The structure of the explored well</u> will be visually shown to the local users using pictures and drawings because it will further encourage the promotion of safe and clean water. The 10 m concrete and/or clay sealing at the top of the explored well will protect the water source from contamination by surface water.

## Water quality

Health hazards, for example, diarrhea, trachoma, etc, from contaminated water will be explained. The importance of hygienic education such as appropriate latrine arrangement and cleaning of hands will also be explained.

The water quality of the present water sources will be explained to show the improved health benefits of using piped water (safe and clean). A simple table showing the water quality of the existing shallow dug wells (or surface water) compared to that of the explored (deep) well will be presented. Understanding the difference between the water quality in the deep well and the existing dug wells (or springs) encourages the promotion of safe and clean water. The comparison of **coliform** (an indicator of micro-organism contamination) between different water sources makes a difference to the local users. The effect of iron and/or manganese removal will also be explained.

## Benefits of safe and clean water

The benefits of providing safe and clean water will be explained, including of the positive effects on health and reduction in workload and time, especially for women and children who currently fetch water from springs or dug wells. This information should be emphasized in the ethnic minority communes.

The explanation shall be modified to suit the social and natural condition of each commune.

## Costs of the Project

Promoters need to explain the costs for the project, including construction cost, O&M cost and house connection cost. They also need to explain who shall pay each part of the project cost.

After explaining this information, the local people will have a much better understanding about the costs of a house connection and ongoing water charges.

## Responsibilities of the local users

It is necessary to explain that the water charge will include the costs for operation and maintenance, and reinvestment. To minimize O&M costs, the following activities are necessary:

- Protection of the groundwater sources by keeping the environment of the wells clean;
- Maintain in good condition for their water meter or taps
- Regularly payment of bills for water used

# Public taps

Public taps have been adopted in the design for many of the target ethnic minority villages during phase 1 (up to 2010). However, the operation and maintenance of public taps is complicated, because the tariff collection for public taps is more difficult than that for house connections. Information on how to collect water tariffs among users should be provided if necessary.

# 6.3 IEC Campaigns

Promoters appointed by WSU will implement IEC campaigns. These include the formal networks, town meetings, face-to-face communication such as home visit, and also local information media such as radio network and loudspeaker.

# 6.3.1 Formal Meeting

Formal meetings include regular town/commune meetings, meetings at health centers, meetings held by farmer's union, women's union and youth union. In particular, a <u>town meeting of the people's committee is the most common and</u> <u>easiest to organise</u>. The key points to follow for formal meetings are as follows:

- 1) A formal meeting is the starting point for IEC. IEC activities should start **4-5 months before the completion of construction works**.
- 2) Necessary information should be clearly identified and given to participants.
- 3) The **health center** (CHC) should be invited to the meeting and asked to cooperate.
- 4) Tell simple and clear messages.
- 5) A polite, and friendly **attitude** towards the local people is essential.
- 6) Leaflets and simple questionnaires should be provided after the meeting.

Most of the anticipated users of the piped water supply systems will be farmers. They would pay for a house connection by the income from a harvesting. IEC activities should be initiated (4 to 5 months) before the harvest season.

Cooperation from the health center is essential. The objective of the piped systems should be explained to the local people. In most cases, health workers are respected, and the local people follow their advice.

A gentle and polite attitude of promoters makes the local people comfortable and encourages the use of safe and clean water. As informal communication networks among family members, peers, and neighbours are essential for IEC, the attitude of promoters, whether friendly or arrogant, will quickly become known to all members of the communities.

As it is difficult to remember all details of spoken information at the meeting, simple leaflets will be prepared and distributed after the meeting. All the necessary information at the meeting will be printed in the Kinh and/or minority languages, as

UNICEF emphasizes the importance of the combination of printed materials such as leaflets together with the formal communication networks.

## 6.3.2 Face-to-face Communication

**Home visits** of exceptional case when it is required will follow the formal meeting. To promote house connections, promoters need to visit users' houses. Usually, home visits will be undertaken by community leaders (e.g. women's union, farmers' union, youth union), and it is recommended they accompany promoters to explain the necessary information.

In addition to the information elaborated above, the benefits of the provision of safe and clean water should be emphasized during the home visits. The most notable benefits of the use of safe and clean water are the promotion of health and the reduction in workload and time for water transportation. Illustrating with examples will help the local people more easily understand the benefits.

# 6.3.3 Local media

The local radio network and loud speakers are also useful if available. In the rural areas, communes/towns usually have access to the local radio network and loud speakers. The necessary information mentioned above can be broadcast on the radio in the local languages (Kinh and ethnic minorities' languages). Promoters need to contact CPC/TPC to provide the information outlined above.

# 6.4 Schedule of IEC and Promotors' Work

In order to ensure the effective IEC activities by promotors, a tentative schedule is shown in Table 1.1. The arrangements for staffing and their salaries should be discussed with PCERWASS and CPC/TPC or international donors if available. IEC activities are estimated as longer for the difficult communes by the construction stages. It is recommended to take a counter measurement such as long and periodical promoting to the difficult communes, and demonstrating the successful pilot model to the users.

	Descriptions	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	M/M
Α	Overall Management Team											
1	Team Leader											96
2	Capacity building specialist											36
3	Administrator											96
В	Provincial and Commune Team											
B1	Implementation Period of 5-system											
	(K2-3, G3-1, G2, D1, D2)			1		(constructi	on)					
1	Capacity building specialist											12
2	IEC activities by Promoters											24
B2	Implementation Period of 4-system											
	(K4-1, G1, G4-1, D3-1, D6)							(constructio	on)			
1	Capacity building specialist											12
2	IEC activities by Promoters											48
B3	Implementation Period of 5-system											
	(K3-1, G5-1, G6-1, D4-1)							1		(constructi	ion)	
1	Capacity building specialist											12
2	IEC activities by Promoters											72
B4	Implementation Period of 7-system											
	(K1-1, K2-1, G7-1, D3-2, D4-2, D5-1,	D7)							(c	onstruction	)	
1	Capacity building specialist											12
2	IEC activities by Promoters											96

## Table 6.1 Tentative schedule for Soft Component activities

<b>K</b> _1	Bo Y commune, Ngoc Hoi district				
<u>n-1,</u>	<u>Bo Y commune, Ngoc Hol district</u> Weaknesses		Strengths	1	Necessary Activities
	Living standard is very low.		The influence of CPC and		Overall IEC campaigns are
	About 20% suffer from typhoid.	-	village chiefs is strong.	-	necessary with the help of
	1/4 believes that springs are cleaner than groundwater,		The Ca Dong and Kinh live		<u>CHC</u> , including the
	and <u>about 43% drink surface water.</u>		together in the villages.		promotion of the use of deep
	The quantity of water is insufficient in the dry season		together in the vinages.		groundwater, hygienic
	(60%).				latrines, hand washing, and
	$\frac{1}{2/3}$ do not use a latrine, and 20% rarely collect garbage.				garbage collection.
•	K-2, Dak Su commune, Ngoc Hoi district			•	CHC has to hold village
	Weaknesses		Strengths		meetings with the help of
•	Living standard is very low, and villages are very		The influence of CPC and		village chiefs for minority
	scattered and difficult to access.		village chiefs is strong.		communities.
•	More than 40% suffer from typhoid.		<u>·····</u>	•	Intensive home visits by
•	WU is not active at all.				health workers and WU will
•	The quantity of water is insufficient in the both seasons				be necessary.
	<u>(83%, 47%).</u>				
•	More than 80% do not use a latrine, and 27% rarely				
	collect garbage.				
•	Hand washing is not well practiced.				
<u>K-3,</u>	Dak Ui commune, Dac Ha district	•			
	Weaknesses		Strengths		
•	Living standard is very low.	•	IEC activities have been		
•	About 36% suffer from typhoid, and 18% suffer from		carried out through the pilot		
	cholera.		model project.		
•	The quantity of water is insufficient in the dry season	•	The influence of CPC and		
	<u>(54%).</u>	_	village chiefs is strong.		
•	Only 7% use a latrine, and about 18% rarely collect	•	CHC' awareness is relatively		
	garbage.		high, and minority-oriented health care is carried out.		
-	Latrines are located close to dug wells.		health care is carried out.		
-	K-4, Dak Hiring commune, Dac Ha district Weaknesses	•	<u> </u>		
_		_	Strengths		
•	About 24% suffer from typhoid, and 48% suffer from	•	The influence of CPC and		
	$\frac{\text{diarrhea.}}{1/3}$ still believes that surface water is cleaner than		village chiefs is strong. CHC' awareness is relatively		
-	groundwater.	-	high, and a map is prepared		
	The quantity of water is insufficient in the dry season		to show the health conditions		
	(31%).		of the local people.		
•	Only 10% use a latrine, and about 1/3 rarely collect		me roem people.		
	garbage.				
•	Hand washing is not well practiced.				
<u>K-5</u> ,	Sa Nghia commune, Sa Thay district				
	Weaknesses		Strengths		Necessary Activities
•	About 53% suffer from typhoid.	•	The influence of CPC is very	•	Deep groundwater
•	The quantity of water is insufficient in the dry season		strong.		development, and
	<u>(63%).</u>	•	The commune is Kinh-		improvement of dug wells
•	Only 15% use a latrine for defecation.		dominated.		are urgent.
•	K-6, Chu Hreng commune, Kon Tum city	•		•	IEC campaigns for
	Weaknesses		Strengths		appropriate environment of dug wells, and latrine
•	About 27% suffer from typhoid.	•	Health workers are		<u>promotion</u> are necessary.
•	The quantity of water is insufficient in the dry season		influential in the Ba Na		promotion are necessary.
	<u>(53%).</u>		communities.		
				1	
•	Only 20% use a latrine for defecation.	•	The Ba Na people live		
•	Only 20% use a latrine for defecation.	•	The Ba Na people live together with the Kinh people in the same villages.		

 Table 6.2 Necessary Activities for Target Communes

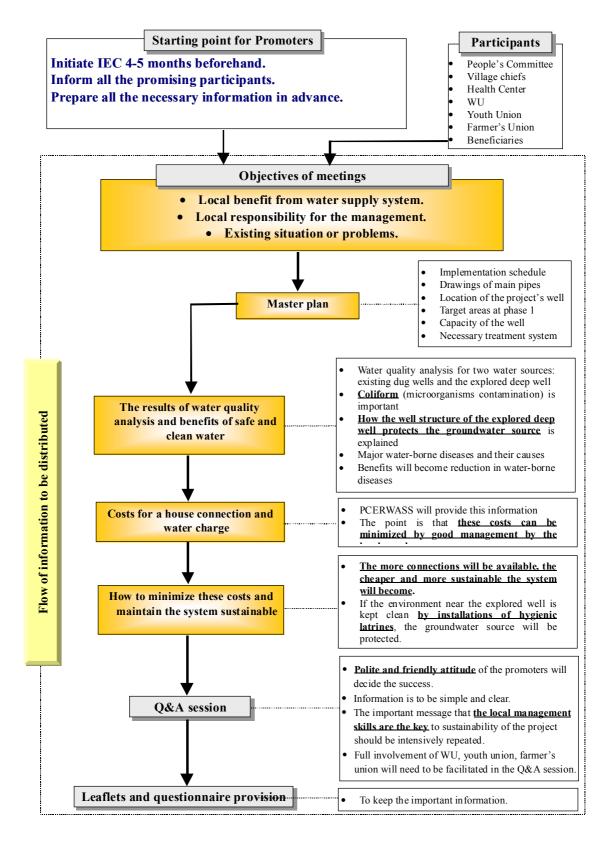


Figure 6.1 Information Flow at Town Meeting for Well-off Communities