Chapter 3 Cost Estimation and Implementation Plan

3.1 Project Cost

3.1.1 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 3.1.

Table 3.1 Composition of Project Cost

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

4) The unit costs applied for the cost estimates are tabulated in Table 3.2.

Table 3.2 Unit Cost for Major Items with Foreign and Local Currency Portion

No.	Construction Items	Unit	Unit Cost (US$)	FC Portion		LC Portion	
				(US$)	(%)	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

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 3.1 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”.

3.1.2 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 3.3 shows summary for 21 systems in phase 1 by four steps to the year 2010.

Table 3.3 Cost for the 21 Systems by 4-step Implementation

Phasing	Implementation Period	No. of System	Cost excluding procurement of equipment (US$ million 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**

The step-wised project cost is tabulated in Table 3.4 with the implementation mode of four cases of step 1, step 2 step 3 and step 4.

Table 3.4 Alternative Cost Study by Phasing Implementation in Phase1

(Alternative1:Four step implementation)

US$ 1.0=VND 15,000.0=JY 120.0

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**

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.

Table 3.5 Summary of Project Cost Divided FC and LC in Phase 1(to 2010)

Serial No.		Syatem No.	Name of Commune	FC <1 (US$)	LC <2 (US$)	Total <3 (US$)	Total Equivalent <3 (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		

<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 3.6 and 3.7.

Table 3.6 Cost for the 21 Systems by 3-step Implementation

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**

Table 3.7Cost for the 21 Systems by 2-step Implementation

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

3.1.3 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 3.8Soft Components

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

3.1.4 Procurement for Equipment

The procurement of A) well drilling and ancillary equipment and 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 cars for IEC activities, etc.

3.1.5 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 3.9Summary of Project Cost

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

3.2 Implementation Plan

3.2.1 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.

3.2.2 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.

Group A : Immediately implementation, when donor or the Vietnamese government's budget is ready

Group B : stage 2 implementation after the Group A was successfully completed

Group C : stage 3 implementation after the Group B

Group D : 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 3.10 after careful interpretation of the selected 21 systems from the viewpoints of project sustainability.

Table 3.10 Grouping for Implementation Priority

Serial No.		Province/ System No.	Name of Commune/Town	**Grouping for Implementation**	Water Source / numbers of drilling well & construction of intake till 2010	
		Kon Tum				
1	1	K1-1	Bo Y	**D**	Groundwater	7
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	**C**	Groundwater	0
5	5	K4-1	Dak Hring	**B**	Groundwater	1 intake
		Gia Lai				
6	1	G1	Kong Tang	**B**	Groundwater	1
7	2	G2	Nhon Hoa	**A**	Groundwater	6
8	3	G3-1	Chu Ty	**A**	Groundwater	1
9	4	G4-1	Thang Hung	**B**	Groundwater	1
10	5	G5-1	Ngia Hoa	**C**	Groundwater	1
11	6	G6-1	Ia rsiom	**C**	Groundwater	0
12	7	G7-1	Kong Yang	**D**	Groundwater	0
		Dac Lac				
13	1	D1	Krong Nang	**A**	Groundwater	2
14	2	D2	Ea Drang	**A**	Existing boreholes	6
15	3	D3-1	Krong Buk	**B**	Groundwater	1
16	4	D3-2	Krong Buk	**D**	Not drilled yet	1
17	5	D4-1	Ea Drong	**C**	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	**B**	Existing boreholes	3
21	9	D7	Krong Kmar	**D**	Groundwater	1

(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)

3.2.3 Implementation Schedule

The phasing implementation for the 21 systems is recommended taking into consideration of sustainability of projects as shown in Table 3.11.

Table 3.11 Phasing Plan of Implementation for 21 Systems

Step	Implementation period	Group	Kon Tum	Gia Lai	Dac Lac
1	2002-2004	A	K2-3	G2, G3-1	D1, D2
2	2004-2006	B	K4-1	G1, G4-1	D3-1, D6
3	2006-2008	C	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

3.3 Mode of Implementation

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

3.3.1 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 pre-condition 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

3.3.2 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 3.12 shows an evaluation for the construction and technical capability for each alternative plan.

Table 3.12 Evaluation of Facilities Construction Capability by Alternative Implementation Method

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

Notes O : possible Δ : 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 3.13 Technical and Financial Soundness of Alternatives 1 and 2

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

Notes O : advantage Δ : 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.

3.3.3 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 3.1 by four steps. Table 3.14 shows its summary.

Table 3.14 Summary of Implementation Schedule

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 3.15 Construction Schedule Plan

Step	Descriptions	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	NRWSS Target in Phase 1 (till 2010)										
	Master Plan										
	Feasibility Study										
	Financial Arrangement			1st step		2nd step		3rd step		4th step	
	Selection of consultant										
	Field survey and Investigation										
	Basic Design										
	Tender Design										
	Tender and Contract										
	Procurememnt of Equipment			design, tender & procurement							
	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, 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, D4-1)										
	Soft component										
	- Capacity building										
	- IEC										
	- O&M activities										
4th	Structural Measures (7-system, K1-1, K2-1, G7-1, D3-2, D4-2, D5-1, D7)										
	Soft component										
	- Capacity building										
	- IEC										
	- O&M activities										

3.3.4 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.

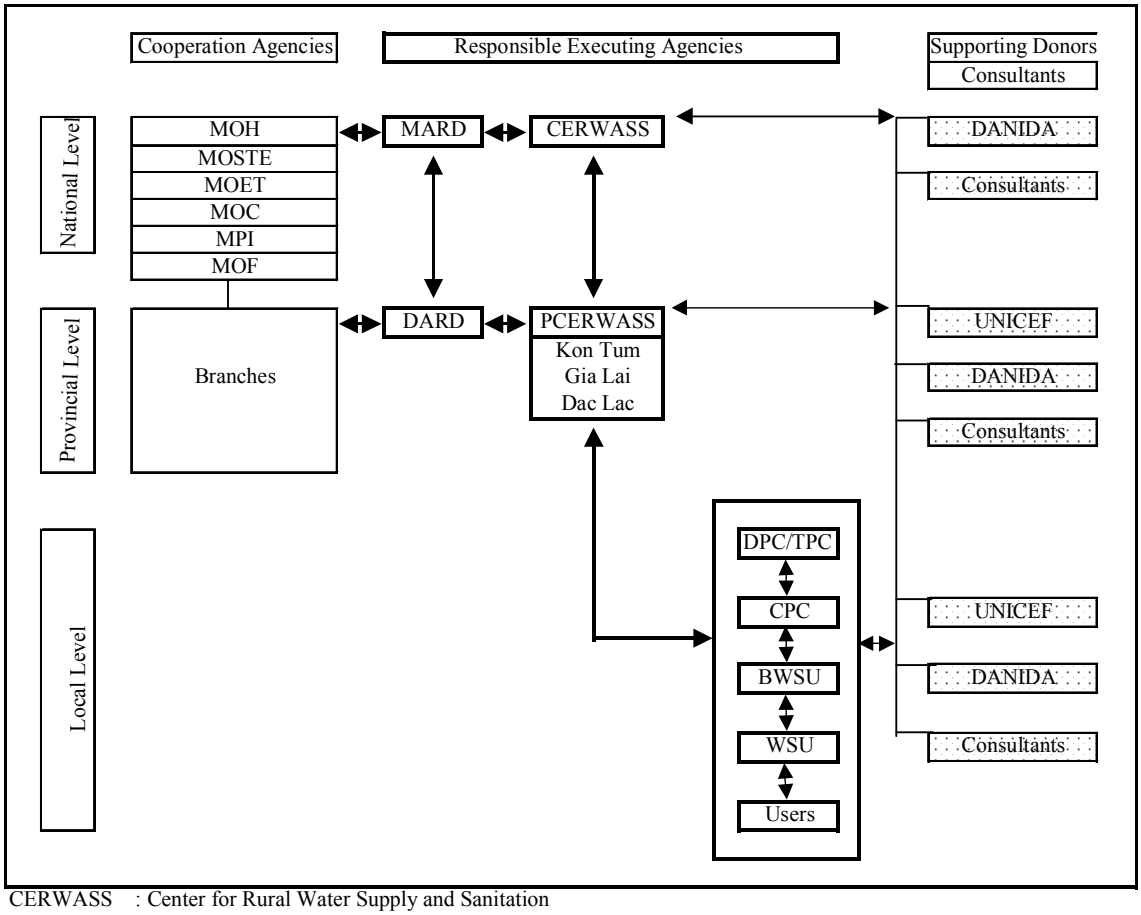
There are two kinds of financial preparation types. One is the Vietnamese government plans, including budgetary arrangements for IEC, HRD, technology guidance and investment costs for the projects. Two is by grant aid or loan funds from foreign countries based on the request from Vietnamese government.

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

3.3.5 Organization for Implementation

Tentative plan of the Organization for implementation is shown below Figure 3.1.



CERWASS : Center for Rural Water Supply and Sanitation
PCERWASS : Provincial Center for Rural Water Supply and Sanitation
MARD : Ministry of Agriculture and Rural Development
DARD : Department of Agriculture and Development
DPC/TPC : District Peoples Committee / Town Peoples Committee
CPC : Commune Peoples Committee
BWSU : Board of Water Supply Unit
WSU : Water Supply Unit
MOH : Ministry of Health
MOSTE : Ministry of Science, Technology and Environment
MOET : Ministry of Education and Training
MOC : Ministry of Construction
MPI : Ministry of Planning and Investment
MOF : Ministry of Finanace
JICA : Japan International Cooperation Agency
DANIDA : Danish International Development Assistance
UNICEF : United Nations Children`s Fund

Figure3.1 Organization Structure Plan for Implementation of Rural Water Supply Project in the Central Highlands

Chapter 4 Operation and Management

4.1 Organization of Operation and Maintenance

4.1.1 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 re-investment,
- 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.

4.1.2 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 organizations 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.

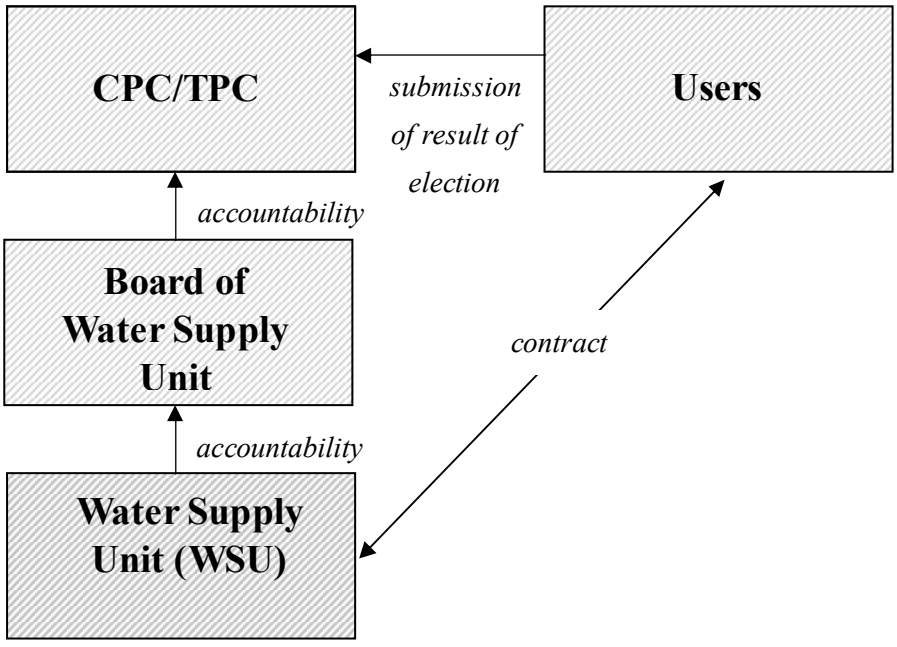


Figure 4.1 Organization for piped water supply

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 Scheme

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.

- **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.

- **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.

- **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.

- **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.

- **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).

- **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 4.1;

Table 4.1 Staffing Requirements

Commune	Manager			Accountant			Pump/treatment plant operator			Network inspector Meter reader			Water charge collector		
	2005	2010	2020	2005	2010	2020	2005	2010	2020	2005	2010	2020	2005	2010	2020
K1 Bo Y	½	½	1	½	½	1	1	3	3	1	1	1	1	1½	3½
K2-1 Dak Su	0	0	0	0	0	0	1	3	3	1	1	1	0	0	1
K2-3 Dak Su	½	½	½	½	½	½	1	3	3	1	1	1	½	1	2
K3 Dak Ui	½	½	½	½	½	½	1	3	3	1	1	1	½	1	2
K4 Dak Hring	½	½	1	½	½	½	1	3	3	1	1	1	1	1	2½
G1 Kong Tang	½	½	1	½	½	1	1	3	3	2	2	2	1½	2	5
G2 Nhon Hoa	½	1	1	½	1	1	1	3	3	2	2	2	2½	3½	7½
G3 Chu Ty	½	1	1	½	½	1	1	3	3	½	½	1	2	3	7
G4 Thang Hung	½	½	1	½	½	1	1	3	3	1	1	1	1	1½	3½
G5 Nghia Hoa	½	½	1	½	½	½	1	3	3	1	1	1	1	1	2½
G6 Ia Rsion	½	½	1	½	½	½	1	3	3	1	1	1	1	1½	3½
G7 Kong Yang	½	½	½	½	½	½	1	3	3	1	1	1	½	½	1½
D1 Krong Nang	1	1	1	½	1	1	1	3	3	1	1	2	2½	4	8½
D2 Ea Drang	1	1	1	1	1	1	1	3	3	1	1	2	3½	5½	11½
D3-1 Krong Puk	½	½	1	½	½	1	1	3	3	1	1	1	1½	2½	5
D3-2 Krong Puk	0	0	0	0	0	0	1	3	3	1	1	1	1	1½	3
D4-1 Ea Drong	½	½	1	½	½	1	1	3	3	1	1	1	1½	2½	5½
D4-1 Ea Drong	0	0	0	0	0	0	1	3	3	1	1	1	½	1	2
D5 Ea Wer	½	½	1	½	½	1	1	3	3	1	1	1	1½	2	4
D6 Kien Duc	½	1	1	½	½	1	1	3	3	1	1	1	2	3	6½
D7 Krong Kmar	½	½	1	½	½	1	1	3	3	1	1	1	1½	2½	5

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.

4.1.3 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 WS*U (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.

4.2 Strengthening of Implementing Organizations

4.2.1 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.

4.2.2 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.

4.2.3 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.

4.2.4 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 4.2 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.

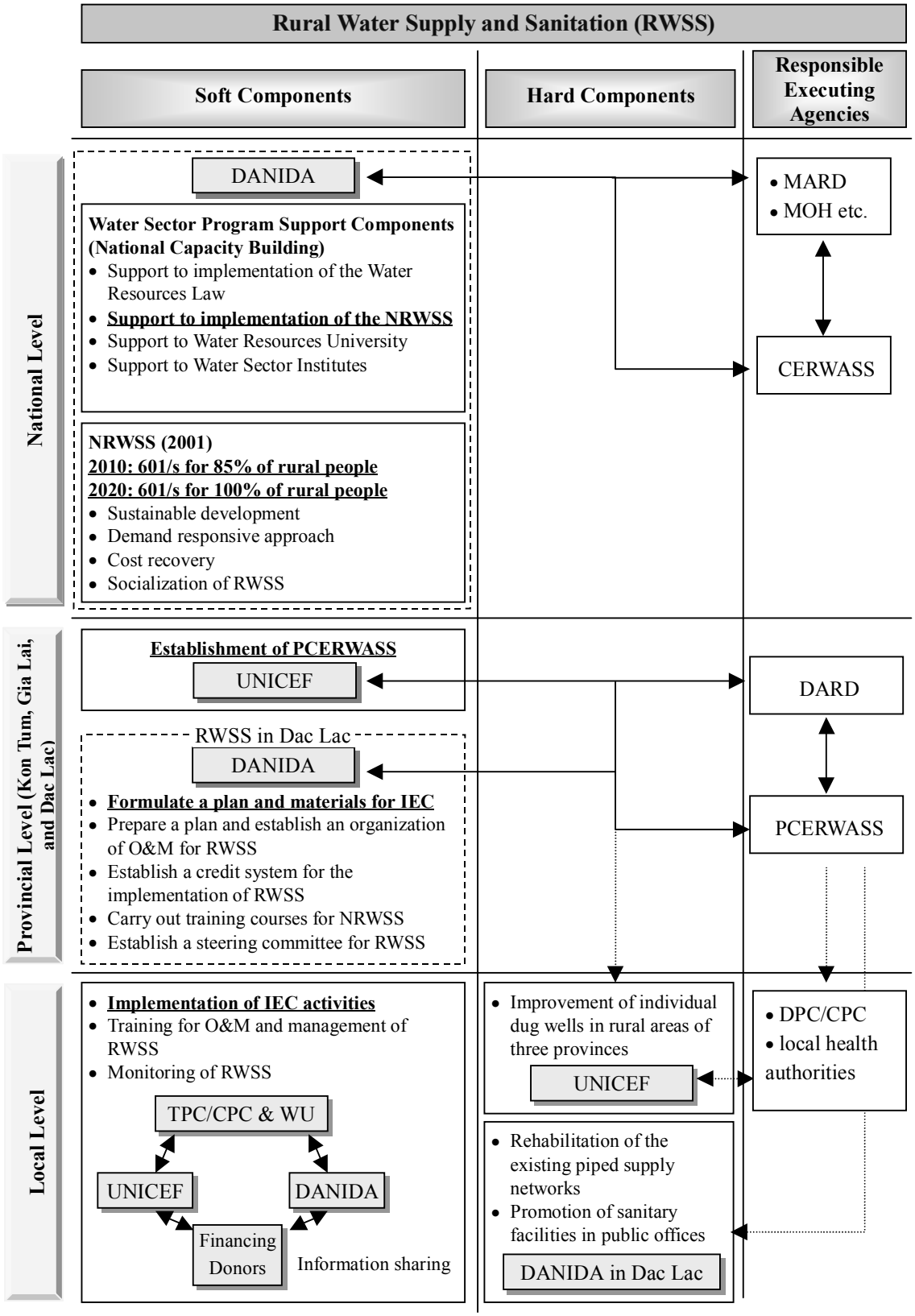


Figure 4.2 Concept Paper for Coordination

4.3 Economic Evaluation of the Priority Systems

4.3.1 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.

4.4 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, 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/m^3.

The estimation of **personnel costs** is based on the estimated staffing requirements, as presented in Section 5.1.3 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 atmore 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 per capita water use at 15 lpcd. The annual growth of served population (including population increase and connection rate is estimated at 8% and the annual growth of per capita water use 1.5%, respectively. The latter growth results in 60 lpcd in 2020.

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 re-investment 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%[1] 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.

4.4.1 Ability of Payment for Estimated Tariff

The annual costs of each scheme, including O&M cost and annualized re-investment costs in three cross-sectional years (2005, 2010 and 2020) are tabulated in Table 4.2. 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.

[1] There are two exceptions from this criterion. K2-1 with the highest tariff requirement will reach a rate of 61% by 2020 and G7 with the second highest tariff requirement will reach a rate of 62% by 2020. Fulfillment of this criterion would further increase their tariff requirements.

The re-investment saving increases the O&M cost in 2005 by about 150%- 250% of. By 2020 the re-investment saving increases the O&M cost by about 70%-180%.

Table 4.2 Annual costs MVND/a

Commune	Annual cost (MVND/a)																
	Power and chemicals			Personnel			Maintenance cost			Reinvestment		Grand total w/o re-investment			Grand total		
	2005	2010	2020	2005	2010	2020	2005	2010	2020	-2012	2014-	2005	2010	2020	2005	2010	2020
Kon Tum																	
K1	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
K2-1	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
K2-3	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
K3	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
K4	4.335	7.384	21.423	19.200	28.800	38.100	34.624	34.624	45.644	125.724	166.925	58.159	70.808	105.167	183.883	196.532	272.092
Gia Lai																	
G1	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
G2	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
G3	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
G4	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
G5	8.959	13.814	44.277	19.200	30.900	38.100	28.309	22.916	36.528	105.829	141.882	56.468	67.630	118.905	162.297	143.998	260.787
G6	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
G7	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
Dac Lac																	
D1	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
D2	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
D3-1	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
D3-2	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
D4-1	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
D4-2	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
D5	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
D6	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
D7	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

The annual costs per cubic meter are presented in Table 4.3. These unit costs are more applicable for comparison between schemes.

The mere O&M costs per cubic meter vary between VND 1,600/m^3 and VND 6,300/m^3 in 2005 and between VND 700/m^3 and VND 2,600/m^3 in 2020. The re-investment costs per cubic meter increase the picture dramatically up, varying between VND 4,600/m^3 and VND 18,600/m^3 in 2005 and between VND 1,600/m^3 and VND 6,400/m^3 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^3 (D2) and the highest required tariff in that year is VND 8,000/m^3 (K2-1). The tariff requirements in 2020 vary between VND 2,200/m^3 and VND 8,250/m^3.

The calculated tariffs look relatively high in the Vietnamese context. For example, the Provincial People's Committee in Dac Lac has set a ceiling of VND 1,800/m^3 for rural water tariffs. On the other hand the calculated tariffs, without a couple of exceptions (K2-1, K2-3 and K-3) do not seem to involve problems with average affordability, as can be seen in Table 4.3. Instead of the ability to pay, the calculated tariffs may be a political issue. The willingness to pay surveyed during the first field work period suggests that the willingness would exceed the estimated expenditure on water in the case of 14 out of the 21 schemes in 2005 and in 8 out of 21 schemes in 2020. 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.

Table 4.3 Cost of Water per cubic meter and Tariff requirement and Affordability

Commu-ne	Annual unit costs (VND/m³)						Tariff (VND/m³)		Affordability (%)*	
	Cost excl. re-investment			Cost incl. re-investment						
	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	7.8
K2-1	6,258	5,195	2,550	18,573	12,425	6,416	8,000	8,250	10.9	17.5
K2-3	4,239	3,204	1,621	14,532	9,246	4,471	5,750	6,000	7.8	12.7
K3-1	3,455	2,748	1,486	8,146	5,502	2,969	3,750	3,800	4.8	7.5
K4	4,680	3,277	1,626	14,466	9,022	4,200	5,500	5,600	4.7	7.4
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	5.7
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

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

4.4.2 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 4.4 "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 4.4 Financial Cash Flow Analysis

	1			2			3			4			5			6			7			8			9			10			11		
Commune	K1-1			K2-1			K2-3			**K3-1**			**K4-1**			**G1**			**G2**			**G3-1**			**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			181,568			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	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	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	(86)	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	(66)	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	(54)	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	295	432	136	446	650	203	819	1,155	337	492	695	202	291	414	123	268	389	121	240	335	95
FIRR			**-8%**			**-9%**			**-7%**			**-7%**			**-8%**			**-7%**			**-8%**			**-7%**			**-8%**			**-7%**			**-7%**
NPV	US$(=15000VND)		**-1,153**			**-228**			**-566**			**-275**			**-618**			**-919**			**-1,556**			**-854**			**-546**			**-507**			**-370**

	12			13			14			15			16			17			18			19			20			21			
Commune	G7-1			**D1**			**D2**			**D3-1**			D3-2			**D4-1**			D4-2			D5-1			**D6**			D7			**Total**
Option	1			**1**			**1**			**1**			1			**1**			1			1			**1**			1			
Phase 1	227,066			640,632			926,850			337,039			297,530			500,457			250,341			460,679			469,229			363,980			**9,209,378**
Phase 2	29,894			233,064			375,219			141,311			133,328			165,608			127,854			176,027			104,813			130,138			**3,081,240**
Population	1,837			12,903			18,464			8,556			4,463			7,775			2,034			8,920			10,619			7,484			**145,519**
Year	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance	Expenditure	Revenue	Balance			
1	104	37	(67)	270	96	(174)	346	126	(221)	157	58	(99)	128	43	(85)	233	83	(150)	99	33	(67)	233	76	(157)	242	91	(151)	171	57	(114)			
2	115	41	(74)	301	107	(195)	383	140	(243)	173	64	(109)	143	48	(81)	258	92	(166)	109	36	(73)	258	85	(174)	269	101	(168)	189	63	(125)			
3	117	45	(72)	303	119	(184)	389	155	(234)	175	71	(103)	144	53	(77)	260	102	(157)	110	40	(69)	261	94	(167)	271	112	(159)	190	71	(120)			
4	118	50	(67)	307	132	(175)	395	173	(223)	178	79	(99)	145	59	(74)	263	114	(150)	110	45	(65)	262	105	(157)	274	125	(150)	192	78	(113)			
5	**123**	56	(67)	**314**	**147**	(168)	**405**	**192**	(213)	**185**	**88**	(96)	**146**	**65**	(70)	**270**	127	(143)	**116**	50	(66)	**267**	**117**	(151)	**285**	**139**	(146)	**200**	**87**	(113)			
6	123	62	(61)	321	163	(158)	412	214	(199)	186	98	(88)	147	73	(66)	272	141	(131)	116	56	(60)	268	130	(138)	292	154	(137)	202	97	(105)			
7	124	69	(55)	324	182	(143)	420	238	(183)	188	109	(79)	148	81	(62)	277	157	(120)	119	62	(57)	271	144	(127)	298	172	(126)	204	108	(96)			
8	130	77	(53)	334	202	(132)	434	265	(169)	197	122	(76)	156	90	(58)	284	174	(110)	124	69	(55)	277	160	(117)	307	191	(117)	213	120	(93)			
9	132	86	(47)	340	225	(115)	441	294	(147)	203	135	(68)	157	100	(54)	290	194	(96)	125	77	(48)	278	178	(100)	313	212	(100)	218	134	(85)			
10	133	95	(38)	344	250	(94)	452	328	(124)	208	150	(57)	158	112	(47)	295	216	(79)	126	85	(41)	280	199	(81)	323	236	(87)	221	149	(72)			
11	146	108	(38)	430	314	(117)	579	433	(146)	261	194	(67)	213	149	(63)	350	254	(97)	144	107	(38)	355	249	(106)	399	297	(102)	273	208	(65)			
12	148	120	(28)	446	349	(97)	603	482	(121)	270	216	(55)	220	166	(54)	364	282	(82)	148	119	(29)	368	277	(91)	414	330	(83)	282	231	(51)			
13	149	134	(16)	453	388	(65)	616	536	(80)	278	240	(39)	224	185	(39)	369	314	(55)	151	132	(19)	372	309	(64)	424	368	(56)	291	257	(34)			
14	151	149	(2)	461	432	(30)	633	596	(37)	285	267	(18)	226	206	(20)	376	349	(27)	152	147	(5)	374	343	(31)	433	409	(24)	295	286	(9)			
15	154	165	11	475	480	5	649	663	15	289	297	8	228	229	0	383	388	5	154	163	10	378	382	3	445	455	10	302	318	16			
16	156	184	28	485	534	50	666	738	71	296	330	34	233	254	21	389	432	43	155	182	26	383	425	41	458	506	48	309	354	45			
17	157	205	47	495	594	99	688	821	133	304	367	63	236	283	47	398	481	82	157	202	45	388	472	84	472	563	90	315	394	79			
18	159	228	68	506	661	155	711	913	202	310	409	98	241	315	73	408	535	127	161	225	64	392	526	134	488	626	138	323	438	115			
19	162	253	92	521	735	214	737	1,016	279	319	454	135	245	350	105	418	595	176	163	250	87	397	585	188	510	697	186	332	487	155			
20	162	253	92	521	735	214	737	1,016	279	319	454	135	245	350	105	418	595	176	163	250	87	397	585	188	510	697	186	332	487	155			
FIRR			-6%			**-7%**			**-7%**			**-6%**			-7%			-8%			-6%			-8%			**-7%**			-6%			

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.

4.5 Economic Evaluation

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

4.5.1 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.

4.5.2 Economic Cash Flow Analysis

General

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.

Results

EIRR for the every proposed system is calculated as shown Table 4.5. 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 4.5 EIRR Cash Flow

	1				2				3				4				5				6				7				8				9				10				11			
Commune	K1-1				K2-1				K2-3				**K3-1**				**K4-1**				**G1**				**G2**				**G3-1**				**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				181,568				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	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	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	24	(42)	177	62	22	(93)	257	87	31	(139)	432	144	21	(267)	250	90	30	(129)	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	26	(51)	202	69	23	(110)	285	96	33	(155)	477	161	22	(294)	276	101	32	(144)	173	61	21	(91)	161	56	9	(97)	126	50	25	(50)
2005	355	84	42	(230)	77	9	6	(62)	183	28	12	(143)	106	31	29	(46)	203	77	25	(100)	286	107	36	(143)	483	179	24	(280)	283	112	35	(137)	174	68	22	(83)	162	62	10	(90)	127	55	27	(44)
2006	356	93	45	(218)	78	10	7	(61)	183	31	13	(139)	107	35	31	(41)	203	86	27	(90)	287	119	39	(130)	490	199	26	(264)	288	124	38	(126)	177	76	24	(77)	163	69	10	(84)	128	62	30	(36)
2007	**364**	103	49	(212)	**83**	11	7	(64)	**189**	34	14	(140)	**112**	39	33	(40)	**209**	95	30	(84)	**296**	133	42	(122)	**501**	221	28	(251)	**299**	138	41	(120)	**182**	84	26	(72)	**169**	77	11	(81)	**133**	69	32	(33)
2008	**365**	115	53	(197)	**83**	13	8	(63)	**189**	38	15	(136)	**113**	43	36	(34)	**209**	106	32	(71)	**298**	147	45	(105)	**505**	246	31	(228)	**302**	154	44	(104)	**183**	94	28	(61)	**170**	86	12	(73)	**137**	76	35	(26)
2009	**366**	128	57	(181)	**83**	14	8	(61)	**192**	42	16	(134)	**116**	48	39	(29)	**210**	118	34	(57)	**300**	164	49	(87)	**512**	274	33	(205)	**307**	171	47	(89)	**185**	104	31	(50)	**172**	95	13	(63)	**138**	85	37	(15)
2010	**372**	142	61	(168)	**88**	16	9	(64)	**198**	47	18	(133)	**122**	53	42	(27)	**215**	131	37	(47)	**307**	182	53	(72)	**525**	305	36	(185)	**316**	191	51	(74)	**191**	116	33	(42)	**178**	106	14	(58)	**144**	94	40	(9)
2011	**376**	158	66	(151)	**88**	17	10	(62)	**199**	52	19	(127)	**123**	59	45	(19)	**218**	146	40	(32)	**312**	203	57	(52)	**534**	339	39	(156)	**325**	212	55	(58)	**194**	129	36	(30)	**182**	118	15	(49)	**146**	105	44	3
2012	378	176	72	(130)	89	19	10	(59)	200	58	21	(121)	124	66	49	(10)	219	162	43	(13)	318	226	61	(31)	541	377	42	(122)	329	236	60	(34)	196	143	39	(14)	184	131	16	(36)	149	117	47	15
2013	481	196	77	(208)	123	21	11	(90)	255	177	22	(56)	166	114	53	2	267	184	47	(36)	386	277	66	(42)	682	493	45	(144)	396	296	64	(36)	248	177	42	(29)	226	166	18	(43)	198	143	51	(4)
2014	493	218	84	(192)	126	24	12	(90)	262	197	24	(41)	173	127	57	12	274	205	51	(18)	396	308	72	(17)	706	548	49	(110)	410	330	69	(12)	257	196	45	(16)	233	184	19	(29)	205	159	55	9
2015	498	243	90	(165)	127	27	13	(87)	263	219	26	(18)	174	142	62	29	277	228	55	5	402	343	77	18	716	610	52	(54)	417	367	75	25	262	219	49	5	237	205	21	(12)	209	177	59	27
2016	503	270	98	(136)	127	30	14	(83)	267	243	28	5	179	158	67	46	278	253	59	34	409	381	84	56	729	678	57	6	426	408	81	62	265	243	52	31	240	228	22	10	212	197	64	49
2017	**508**	300	105	(103)	**128**	33	15	(80)	**269**	271	30	32	**181**	175	72	66	**280**	282	64	66	**416**	424	90	98	**743**	755	61	73	**437**	454	87	104	**270**	270	57	57	**244**	254	24	34	**218**	219	69	70
2018	**511**	334	114	(63)	**130**	37	16	(77)	**271**	301	33	63	**183**	195	78	89	**282**	313	69	101	**422**	472	97	148	**758**	839	66	147	**448**	505	94	151	**273**	301	61	89	**249**	282	26	59	**223**	243	75	95
2019	**517**	372	123	(22)	**131**	41	18	(73)	**273**	335	35	97	**186**	217	84	115	**286**	349	74	137	**430**	525	105	200	**780**	934	71	225	**460**	561	102	204	**281**	335	66	120	**253**	314	28	89	**227**	271	81	124
2020	**523**	413	133	23	**132**	45	19	(68)	**278**	373	38	133	**191**	241	91	141	**291**	388	80	177	**439**	584	114	259	**798**	1,039	77	317	**478**	624	110	257	**285**	372	71	159	**261**	350	30	119	**233**	301	87	155
2021	**530**	460	143	74	**133**	50	21	(62)	**281**	415	41	175	**194**	268	98	172	**295**	432	87	223	**446**	650	123	326	**819**	1,155	83	420	**492**	695	119	321	**291**	414	77	200	**268**	389	33	154	**240**	335	94	189
2022	530	460	143	74	133	50	21	(62)	281	415	41	175	194	268	98	172	295	432	87	223	446	650	123	326	819	1,155	83	420	492	695	119	321	291	414	77	200	268	389	33	154	240	335	94	189
EIRR				**-27%**				**#DIV/0!**				**-6%**				**7%**				**2%**				**2%**				**-4%**				**2%**				**2%**				**-2%**				**10%**
NPV	US$(=15000VND)			**-1,287**				**-380**				**-700**				**-161**				**-439**				**-665**				**-1,384**				**-608**				**-387**				**-435**				**-170**

	12				13				14				15				16				17				18				19				20				21				**Total**			
Commune	G7-1				**D1**				**D2**				**D3-1**				D3-2				**D4-1**				D4-2				D5-1				**D6**				D7							
Option	1				1				1				1				1				1				1				1				1				1							
Phase 1	227,066				640,632				926,850				337,039				297,530				500,457				250,341				460,679				469,229				363,980				9,209,378			
Phase 2	29,894				233,064				375,219				141,311				133,328				165,608				127,854				176,027				104,813				130,138				3,081,240			
Population	1,837				12,903				18,464				8,556				4,463				7,775				2,034				8,920				10,619				7,484				145,519			
Year	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL	EXP	REV	E/B	BAL				
2003	104	37	11	(56)	270	96	24	(150)	346	126	50	(170)	157	58	33	(67)	128	43	18	(67)	233	83	22	(129)	99	33	8	(59)	233	71	15	(146)	242	91	20	(132)	171	57	0	(114)				
2004	115	41	12	(62)	301	107	25	(169)	383	140	54	(189)	173	64	35	(74)	143	48	19	(77)	258	92	24	(143)	109	36	8	(65)	258	79	16	(163)	269	101	21	(147)	189	63	0	(125)				
2005	117	45	13	(59)	303	119	28	(157)	389	155	59	(175)	175	71	38	(65)	144	53	21	(71)	260	102	25	(132)	110	40	9	(61)	261	88	18	(155)	271	112	23	(136)	190	71	0	(120)				
2006	118	50	14	(54)	307	132	30	(146)	395	173	64	(159)	178	79	41	(57)	145	59	22	(64)	263	114	27	(122)	110	45	10	(56)	262	98	19	(144)	274	125	25	(125)	192	78	0	(113)				
2007	**123**	56	15	(52)	**314**	147	32	(135)	**405**	192	69	(144)	**185**	88	45	(52)	**146**	65	24	(56)	**270**	127	30	(114)	**116**	50	10	(55)	**267**	109	21	(137)	**285**	139	27	(119)	**200**	87	0	(113)				
2008	**123**	62	16	(45)	**321**	163	35	(124)	**412**	214	74	(125)	**186**	98	48	(40)	**147**	73	26	(48)	**272**	141	32	(99)	**116**	56	11	(49)	**268**	121	22	(124)	**292**	154	29	(109)	**202**	97	0	(105)				
2009	**124**	69	17	(37)	**324**	182	37	(105)	**420**	238	80	(103)	**188**	109	52	(27)	**148**	81	28	(39)	**277**	157	35	(85)	**119**	62	12	(45)	**271**	135	24	(112)	**298**	172	31	(95)	**204**	108	0	(96)				
2010	**130**	77	19	(34)	**334**	202	40	(92)	**434**	265	86	(83)	**197**	122	56	(19)	**156**	90	30	(35)	**284**	174	37	(72)	**124**	69	13	(43)	**277**	150	26	(101)	**307**	191	34	(83)	**213**	120	0	(93)				
2011	**132**	86	20	(26)	**340**	225	44	(72)	**441**	294	93	(54)	**203**	135	61	(7)	**157**	100	33	(24)	**290**	194	40	(56)	**125**	77	14	(35)	**278**	167	28	(83)	**313**	212	36	(64)	**218**	134	0	(85)				
2012	133	95	22	(16)	344	250	47	(47)	452	328	101	(23)	208	150	66	9	158	112	35	(11)	295	216	44	(36)	126	85	15	(26)	280	186	30	(63)	323	236	39	(48)	221	149	0	(72)				
2013	146	108	24	(14)	430	314	51	(66)	579	433	109	(37)	261	194	71	3	213	149	38	(25)	350	254	47	(50)	144	107	16	(21)	355	207	33	(116)	399	297	42	(60)	273	208	0	(65)				
2014	148	120	26	(2)	446	349	55	(42)	603	482	118	(3)	270	216	77	22	220	166	41	(13)	364	282	51	(31)	148	119	18	(11)	368	230	36	(103)	414	330	46	(38)	282	231	0	(51)				
2015	149	134	28	12	453	388	59	(6)	616	536	127	47	278	240	83	44	224	185	44	5	369	314	55	0	151	132	19	0	372	256	38	(78)	424	368	49	(7)	291	257	0	(34)				
2016	151	149	30	28	461	432	64	35	633	596	137	101	285	267	89	72	226	206	48	28	376	349	59	33	152	147	21	15	374	284	41	(48)	433	409	53	29	295	286	0	(9)				
2017	154	165	32	44	475	480	69	75	649	663	148	163	289	297	97	104	228	229	52	52	383	388	64	69	154	163	22	32	378	316	45	(17)	445	455	58	68	302	318	0	16				
2018	156	184	35	63	485	534	75	125	666	738	160	231	296	330	104	138	233	254	56	77	389	432	69	112	155	182	24	50	383	352	48	17	458	506	62	110	309	354	0	45				
2019	157	205	38	85	495	594	81	180	688	821	173	306	304	367	113	176	236	283	60	107	398	481	75	157	157	202	26	71	388	391	52	55	472	563	67	157	315	394	0	79				
2020	159	228	41	109	506	661	87	242	711	913	187	388	310	409	122	220	241	315	65	139	408	535	81	207	161	225	28	92	392	435	56	100	488	626	72	210	323	438	0	115				
2021	162	253	44	135	521	735	94	309	737	1,016	201	480	319	454	131	266	245	350	70	176	418	595	87	263	163	250	30	117	397	484	61	148	510	697	78	264	332	487	0	155				
2022	162	253	44	135	521	735	94	309	737	1,016	201	480	319	454	131	266	245	350	70	176	418	595	87	263	163	250	30	117	397	484	61	148	510	697	78	264	332	487	0	155				
EIRR				2%				**0%**				**4%**				**9%**				3%				0%				0%				-10%				**0%**				-6%				
NPV	US$(=15000VND)			-265				**-740**				**-768**				**-257**				-312				-635				-294				-806				**-652**				-603				

4.5.3 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.

Table 4.6 Construction Cost Per Capita

Serial No.	System No.	Pop.	Construction Cost (Thou. US$)	Base Cost (Thou. US$)	Project Cost		Project cost per capita	
					(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	18	**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	8	**131**	**13**
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	7	**64**	**1**
16	D3-2	3,453	322	370	407	6	**118**	**10**
17	D4-1	6,901	544	626	689	13	**100**	**8**
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**

*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 4.1. Figure 4.1 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.

4.6 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 5.1.

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.

Table 4.7 Cost for the 13-System for the Implementation in 2003-2005

(1,000 US$)

Commune / no. of villages		Option at phase 1	Direct Cost	Base Cost	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**
Grand Total					**9,900**

Note: The marked commune of K3-1, K4-1 and D4-1 are facing in-sustainable finance condition.

Chapter 5 Approach to Information, Education and Communication (IEC)

5.1 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.

5.2 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.

5.2.1 Necessary Information for IEC

Necessary information to be distributed includes the following:

1) **Objectives** of the town meeting
2) The **water supply plan** including the drawings, project cost, maintenance cost and its implementation schedule
3) The **water quality data of the present water sources** and the benefits of safe and clean water
4) **Benefits** of safe and clean water should be emphasized using pictures and drawings
5) **Costs** 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.

The structure of the explored well 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.

5.3 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.

5.3.1 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 **town meeting of the people's committee is the most common and easiest to organise**. 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 co-operate.
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.

5.3.2 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.

5.3.3 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.

5.4 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.

Table 5.1 Tentative schedule for Soft Component activities

	Descriptions	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	M/M
A	**Overall Management Team**											
1	Team Leader											96
2	Capacity building specialist											36
3	Administrator											96
B	**Provincial and Commune Team**											
B1	Implementation Period of 5-system											
	(K2-3, G3-1, G2, D1, D2)					(construction)						
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)							(construction)				
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)									(construction)		
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)									(construction)		
1	Capacity building specialist											12
2	IEC activities by Promoters											96

Table 5.2 Necessary Activities for Target Communes

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

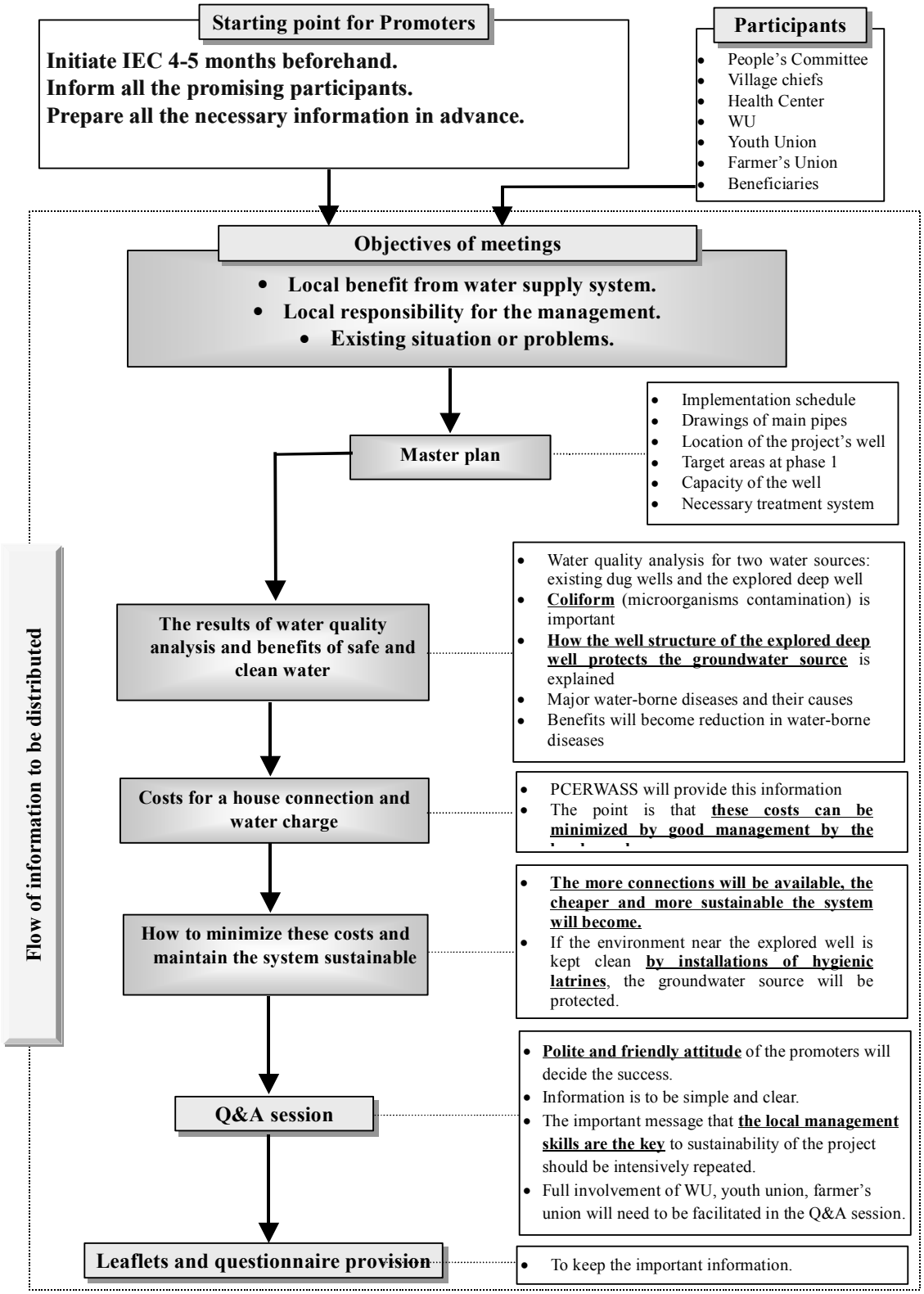


Figure 5.1 Information Flow at Town Meeting for Well-off Communities