STATE COMMITTEE ON WATER SYSTEMS
THE REPUBLIC OF ARMENIA

No.

THE STUDY
FOR
IMPROVEMENT OF RURAL WATER SUPPLY
AND
SEWAGE SYSTEMS
IN
THE REPUBLIC OF ARMENIA

FINAL REPORT

VOLUME I MAIN REPORT

MARCH 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

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Composition of the Final Reports

Volume	REPORT	Contents	Language
Volume I	Main Report	SUMMARY MAIN REPORT (Data book CD-ROM)	English
Volume II	Summary Report	OUTLINE OF THE STUDY SUMMARY	Japanese
Volume III	Summary Report	OUTLINE OF THE STUDY SUMMARY (Data book CD-ROM)	Armenian

PREFACE

In response to a request from Government of the Republic of Armenia (hereinafter referred to as “RA”), the Government of Japan decided to conduct a study on rural water supply and sewage systems and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr.Masato FUJINAMI of NIPPON KOEI Co., LTD. between February 2007 and January 2009.

The team held discussions with the officials concerned of the Government of RA and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of RA for their close cooperation extended to the study.

March 2009

Ariyuki MATSUMOTO,
Vice-President
Japan International Cooperation Agency

March 2009

Mr. Ariyuki Matsumoto
Vice President
Japan International Cooperation Agency

Letter of Transmittal

Dear Sir,

We have the pleasure of submitting to you the Final Report of "The Study for Improvement of Rural Water Supply and Sewage Systems in the Republic of Armenia " in accordance with the Scope of Work agreed upon between the Sate Committee on Water Systems (SCWS) and Japan International Cooperation Agency (JICA).

The Study was conducted by Nippon Koei Co., LTD. during the period from February 2007 to January 2009, through the discussions with the officials of the SCWS, aiming to formulate the water supply and sewage systems improvement plan for the rural area in Armenia.

In conducting the Study, we have examined the present situation of the rural water supply and sewage systems in Armenia and formulated the appropriate water supply and sewage systems improvement plan.

The Study team sincerely hopes that the study results would contribute to the implementation of the water supply and sewage systems improvement project for the rural area in Armenia.

Finally, we wish to express our deep appreciation and gratitude to the personnel concerned of your Agency and the Ministry of Foreign Affairs of Japan, as well as officials concerned of the Government of RA.

Sincerely yours,

Masato Fujinami
Team Leader,
The Study for Improvement of Rural Water Supply and Sewage Systems in the Republic of Armenia

PROJECT LOCATION MAP

THE STUDY FOR IMPROVEMENT OF RURAL WATER SUPPLY AND SEWAGE SYSTEMS IN THE REPUBLIC OF ARMENIA
FINAL REPORT
SUMMARY

1. INTRODUCTION

1.1 Background of the Study

After the independence of the Republic of Armenia (RoA) in 1991, the RoA did not pay sufficient attention to the maintenance, improvement and rehabilitation of the existing water supply and sewage systems constructed during the former political regime.

The 565 diverse rural communities located in mountainous areas have had little prospective of improvement/rehabilitation of the existing systems or installing new systems. The national and local governments do not allocate enough budget to rural water supply projects; therefore, support from donors is the only funding source available to realize the improvement and rehabilitation of water supply facilities.

The Poverty Reduction Strategy Paper (PRSP) prepared in 2003 has identified three priority programs for public investment in terms of poverty and inequality reduction; one of them is “A water supply program with the objective to enhance the provision of necessary drinking water”. It proposed to increase the access rate for safe water in rural areas from 45% in 2001 to 70% in 2015.

Under such situation, the RoA requested the Government of Japan (GoJ) to formulate a project for improvement of rural water supply systems consisting of rehabilitation of the existing water supply facilities.

It was confirmed that the water supply sector was a high priority in the discussions between JICA and the Government of Armenia (GoA) that were held in October 2005.

The GoJ dispatched the first preparatory study mission from 2 to 30 July, 2006 in order to confirm the project background, the present issues, and the Study area. GoJ dispatched the second mission from 29 October to 19 November, 2006 to finalize and sign the Scope of Work (S/W) after confirmation of the Study contents and its area.

1.2 Objectives of the Study

The objectives of the Study are as follows:

(1) To formulate an improvement plan for the water supply systems; the plan mainly consists of rehabilitation of the existing facilities and improvement of the operation and maintenance mechanisms;

(2) To transfer knowledge of the plan formulation to the Armenian counterparts through participation in the Study process.

1.3 Study Area

The Study area consists of 153 rural communities and a target population of 190 thousand in four marzes: (1) Aragatsotn Marz, (2) Shirak Marz, (3) Tavush Marz, and (4) Gegharkunik Marz.

2. NATURAL CONDITIONS

Armenia has an area of approximately 29,740 square kilometers. The country is approximately 400 km long in the northwest/southeast direction, and the narrowest section is around 26km wide. Average elevation of the country is around 1,800 masl (meters above sea level) and only 3 percent of the country lies below 650 masl. Mount Aragats is the highest point with an elevation of 4,090 masl and the lowest point is around 360 masl in the valley of the Debet River.

The geology in Armenia is divided into 9 geologic provinces. Surface geological composition begins in the Paleozonic period. Major surface geology is formed from crustal activity and volcanic activity in the Mesozoic and the Pliocene.

Most of the water resources in Armenia exist as groundwater in shallow strata and it can be used for most of the country. In many areas surface water is insufficient, particularly the northern and southern regions, and the areas northwest and south of Mount Aragats. River flow rate fluctuates by seasons. It is the largest from April to June when it produces around 50-75% of the annual flow rate, and smallest from December to March when it produces around 10-12%.

Annual mean temperatures of the sites range from -5.0 °C in January to 19.1 °C in August. Mean temperature falls below 0 °C from December to March.

Annual mean rainfall over the past ten years has been around 500mm. Khonav Range area, which lies at the border between Shirak and Lori Marz, has the heaviest rainfall per year at around 1,000mm. The areas along the borders with Turkey and Azerbaijan have around 300mm annual rainfall. Monthly rainfall volume is greatest in the period from April to July at 50mm–80mm/month, and the other months are mostly 20–30mm/month.

3. SOCIO-ECONOMIC CONDITIONS

3.1 Rural Administration

The Government appoints and dismisses regional governors who undertake defined duties with the assistance of regional administrations. These duties are primarily administrative, with no budgetary responsibilities, and include: implementation of the Government of Armenia's regional policy, coordination of the activities of regional administration agencies, mediation of

disputes between central and local governments, and the regulation of inter-community issues within their domain.

The second formal governing level in Armenia is the local self-government bodies. The Law of Local Self-Governments endows the local governments with the responsibility for the provision of public infrastructure. However, these responsibilities were delegated subsidy is not enough to ensure the availability of suitable financial resources to fulfill them. There are five potential sources of revenue for the community budget: centrally established taxes and duties; subsidies from the state budget; local duties and fees; land and property rent; and revenue from the sale of community property. But collection levels are low, so communities heavily depend on state budget transfers.

3.2 Demography

As for demographic trends, for the period of 2001-2008 the populations of Aragatsotn and Gegharkunik have increased by 1.6% and 1.0% respectively, whereas the population of Shirak and Tavush has decreased by 0.9% and 0.2% respectively, as shown in table below.

There is significant variation in fertility among the marzes with Aragatsotn Marz having the highest fertility rate (2.5 children per women), Gegharkunik being the second highest (2.1) in the country, and Shirak Marz having one of the lowest fertility rates in the country (1.2). Mortality rate is almost twice as high in Shirak Marz compared to Aragatsotn. Thus, relatively high mortality rate and low fertility rate are key factors contributing to population decrease in Shirak and Tavush marzes for the period 2001-2008.

Main Demographic Indicators in the Four Marzes

Unit: person

Marz	Sex	2008			2001	Pop. change in %	Infant mortality rate per 1,000 persons	Mortality rate per 100,000 persons	Fertility per woman
		Urban X1,000	Rural x1,000	Total x1,000	Total x1,000				
Aragatsotn	Male	16.2	53.6	69.8	68.7				
	Female	16.9	53.8	70.7	69.7	+1.6	6.3	34.3	2.5
	Total	33.1	107.4	140.5	138.4				
Shirak	Male	80.5	54.7	135.2	136.2				
	Female	89.6	56.2	145.8	147.2	-0.9	15.2	78.4	1.2
	Total	170.1	110.9	281.0	283.4				

Marz	Sex	2008			2001	Pop. change in %	Infant mortality rate per 1,000 persons	Mortality rate per 100,000 persons	Fertility per woman
		Urban X1,000	Rural x1,000	Total x1,000	Total x1,000				
Gegharkunik	Male	38.9	80.9	119.8	118.7				
	Female	40.6	79.7	120.3	119.1	+1.0	6.6	56.8	2.1
	Total	79.5	160.6	240.1	237.8				
Tavush	Male	25.0	40.1	65.1	65.3				
	Female	27.6	41.5	69.1	69.1	-0.2	11.3	39.6	1.6
	Total	52.6	81.6	134.2	134.4				

Source: National Statistical Service of Armenia, 2008

3.3 Infrastructure

The Law on Local Self-Governments endows local governments with the following responsibilities: water supply, sewerage, irrigation, gas, central heating systems, construction, maintenance and operation of roads, and construction and operation of irrigation systems within their jurisdiction. However, a lot needs to be done by the national and local governments to ensure the access of communities to basic infrastructure services. The table below presents brief information on the level of access of the communities in all four marzes to the main infrastructure services.

Access to Basic Infrastructure Services in the Four Marzes

Marz	Access to Drinking water		Access to Gas		Tele communications		Conditions of roads in %				Condition of electricity, number of communities			Irrigated land
	Community access	Household access	Community access	Household access	Community access	Household access	Good	Fair	Poor	Very Poor	Good	Fair	Poor	
Aragatsotn	85%	42%	8%	4%	65%	21%	2	26	65	7	6	76	32	11%
Shirak	97%	57%	17%	16%	53%	19%	0	17	62	21	0	60	59	7%
Gegharkunik	86%	44%	44%	34%	63%	31%	0	35	58	7	3	58	31	4%
Tavush	72%	42%	30%	8%	95%	48%	1	13	58	28	0	2	60	6%

Source: World Bank – Rural Infrastructure in Armenia: Addressing Gaps in Service Delivery, 2004

3.4 Regional Economy

(1) Aragatsotn Marz

Aragatsotn Marz benefited modestly from the high growth rates in the Armenian economy over

the past decade. According to the revised version of the Poverty Reduction Strategy Program (PRSP II, January 2008), the incidence of poverty in the marz declined from 60.5% in 1999 to 35.4% in 2005. As of 2006, Aragatsotn Marz was ranked 5-th by the level of poverty in the Armenia. The main economy branches of the marz are industry and agriculture. Industry is specialized in manufacture of food products and beverage, precious articles and exploiting of mines of building materials. The geographical position and climatic conditions of the marz are favorable for development of both plant growing (grain, potatoes, perennial grass, and forage crops) and cattle breeding. Agriculture is mainly specialized in plant growing and cattle breeding.

(2) Shirak Marz

Shirak Marz has the highest poverty level in the Republic of Armenia among all marzes and Yerevan. Despite the double-digit economic growth in the country during the last 5 years, the incidence of poverty in Shirak Marz is still very high (46.8% as of 2006). The leading branches of industry of RA Shirak Marz are production of food, including beverages and production of other non-metal mineral products. Tufa and pumice of Artik and Ani are well-known. The grain farming and cattle-breeding are the developed branches of agriculture.

(3) Gegharkunik Marz

Gegharkunik Marz is the third poorest region in Armenia. Despite recent economic growth in Armenia, in Gegharkunik Marz the poverty level remains high. Incidence of poverty in the marz, however, declined from 49.9% in 1999 to 39.7% in 2005. The leading branch of economy of the marz is agriculture, particularly production of grain, potato, vegetable and animal husbandry product. The marz of Gegharkunik is the main supplier of fresh fish to the population of the republic. Mining industry is the main trend of industry of the marz. Manufacturing is also of great importance, in which the following branches of industry have bigger share: building materials and food industry.

(4) Tavush Marz

Though the reduction of poverty level in Tavush Marz is modest, from 29.3% in 1999 to 29.1% in 2005, it has the second lowest poverty level in the country. The main branch of economy of the marz is manufacturing. The food industry and woodworking continue to be leading branches of industry. Wine, mineral waters, stone and wood products are exported to external markets.

3.5 Social Security

The main areas of concern for the socially vulnerable groups in Aragatsotn, Shirak, Gegharkunik and Tavush marzes are related to unemployment, agricultural problems, food

security, housing, housing condition, healthcare problems, education problems, drinking water problems, cultural problems, legal problems, social isolation, as well as emigration.

Socio-economic Characteristics of the Four Marzes in 2005

Marz	Level of poverty	GDP per capita in USD	Gross agric. Output		Labor resources, thousand persons*1			Lack of access to health care*2
			in billion AMD	% of share	Total	Of which employed	Empl. in %	
Aragatsotn	35.4%	1,277	35.5	7.2	91.6	64.8	70.7%	98.4%
Shirak	46.8%	1,070	49.3	14.1	201.2	89.6	44.5%	94.5%
Gegharkunik	39.7%	1,390	69.5	20.0	156.4	102.0	65.2%	97.1%
Tavush	29.1%	1,126	27.1	5.5	85.3	48.6	57.0%	97.2%

Source: PRSP II, 2008,

Note : *1: IMF, Republic of Armenia-Poverty Reduction Strategy Paper Progress Report, 2005,
*2 UNDP Human Poverty and Pro-Poor Police in Armenia 2005, For those who were sick but did not see a doctor due to afford the cost, remoteness, or lack of time

Problems of employment relate to joblessness, low wages, unfair distribution of jobs, and the unregulated nature of the private segments of the labor market. Farming problems relate to lack of access to, and high prices of, irrigation water, lack of land or poor quality of land, lack of access to, and unaffordable prices for, economic infrastructures. Problems in the education sector relate to lack of access to and quality of education, lack of access to secondary school textbooks, and lack of access to specialized education. These problems are particularly severe for socially vulnerable groups.

4. PRESENT CONDITIONS OF THE WATER SUPPLY SYSTEMS

4.1 General

The water supply systems survey was conducted in the target 153 rural communities consist of 61 in Aragatsotn Marz, 35 in Shirak Marz, 45 in Gegharkunik Marz, and 12 in Tavush Marz by local consultants during the period June to October, 2007. General features of a rural water supply system are as follows:

(1) Existing water supply facilities were mostly constructed in the Soviet Union period and those facilities have deteriorated,
(2) Springs are the major water sources,
(3) Water flows by gravity to residential areas, and
(4) A pipeline network has been almost installed in the rural community.

4.2 Aragatsotn Marz

(1) Field survey results

Water source is located far from the rural communities, long transmission pipelines exist in Aragatsotn Marz. Four rural communities have more than 25km transmission pipelines and

seven rural communities have less than 2km transmission pipelines. The general features of the water supply system in Aragatsotn Marz as table below.

General Features of the Aragatsotn Marz Water Supply System

Structures	Item	Average figures
1. Intake	Numbers	3 nos
2. Transmission pipeline	Length Diameter	7 km Between 100 and 150mm
3. Reservoir	Numbers Capacity	1 nos 250m^3
4. Distribution pipeline	Length Diameter	5km Between 100 and 150mm
5. House connections	Percentage	64%
6. Public tap	Numbers	12nos

Source: JICA Study Team, 2007

No.11 Arteni, No.18 Getap, No.28 Tlik, and No.33 Lusakn are included in the regional water supply pipeline system partially operated under Armwatersewerage CJSC. However, the water has not reached them yet due to huge water losses and the large amount of illegal water use.

(2) Project necessity

95% of the rural communities require the rehabilitation of the distribution pipelines and No.23 Yeghnik and No.32 Lusagyugh do not require the rehabilitation of the distribution pipelines. The rural communities, which do not require the rehabilitation of the transmission and distribution pipelines, constructed their pipelines within 10 years and they do not have much water leakage from them. A very high percent of each type of facility in the study area requires rehabilitation. It cay be considered that the project is necessary for most of the facilities in the study area.

(3) Project urgency

The survey finds that No.49 Shenavan and No.53 Jamshlu have a huge amount of water leakage from the transmission and distribution pipelines. No.37 Katnaghbyur and No.40 Hartavan have large quantities of asbestos cement pipes that are 5.9km and 7.2km. Project urgency of those rural communities is high among the 61 rural communities in Aragatsotn Marz.

4.3 Shirak Marz

(1) Field survey results

The water supply system in Shirak Marz is the smallest among the four marzes and it is a simple water supply system. No.23 Mest Sariar, No.24 Musaelyan, No.28 Jajur, and No.35 Poqr Sariar have more than 10km transmission pipelines. Conversely, a total of 13 out of the 35 rural communities have less than 2km transmission pipelines. The general features of the water supply system in Shirak Marz as table below.

General Features of the Shirak Marz Water Supply System

Structures	Item	Average figures
1. Intake	Numbers	2 nos
2. Transmission pipeline	Length Diameter	3.8 km Approximately 100mm
3. Reservoir	Numbers Capacity	1 nos 150m^3
4. Distribution pipeline	Length Diameter	3.6km Approximately 100mm
5. House connections	Percentage	57%
6. Public tap	Numbers	8 nos

Source: JICA Study Team, 2007

No.19 Mayisyan Kayaran, takes water from the water supply system being operated by Shirak Water Supply Company.

(2) Project necessity

97% of the rural communities requested rehabilitation of the intake structures. No.3 Ardenia is the only one rural community which does not require the rehabilitation of the intake because they constructed it in 2003. The rehabilitation necessities of the other structures are around 70~80%. Although the pipelines of No.15 Karmaraqar and No.22 Akhuryan Kayaran were constructed in 1961 and 1956 respectively, those do not require the rehabilitation. Rehabilitation necessity depends on the site conditions, the construction quality, and periodic maintenance.

(3) Project urgency

No.11 Lernaket and No.30 Jrarat show huge amount of water leakage for most of the distribution pipelines. Project urgency for those two communities is high. Also, No.24 Musaelyan, No.27 Pemzashen and No.33 Sizavet have the asbestos cement pipes and total length of the asbestos cement pipe is 16.65km. It also can be said that the project urgency is high.

4.4 Gegharkunik Marz

(1) Field survey results

Gegharkunik Marz has the largest water supply systems among the four marzes. Average lengths of both the pipelines are around 10km per system. Because the population served is the largest among the four marzes, the existing water supply facilities are also large scaled ones in comparison with the others. No.7 Artvanist, No.17 Zovaber, No.26 Tsovinar and No.43 Verin Getashen have more than 25km transmission pipelines. Conversely, four rural communities have less than 2km transmission pipelines. Some of long transmission pipelines' rural communities and short transmission pipelines' rural communities are nearby. It can say that the existing water supply facility scale is decided by the social situation that existed at the time that they were constructed. The general features of the water supply systems in Gegharkunik Marz are summarized as following table.

General Features of the Gegharkunik Marz Water Supply System

Structures	Item	Average figures
1. Intake	Numbers	2 nos
2. Transmission pipeline	Length Diameter	11.6 km Approximately 150mm
3. Reservoir	Numbers Capacity	2 nos 330m^3
4. Distribution pipeline	Length Diameter	9.3km Approximately 150mm
5. House connection	Percentage	52%
5. Public tap	Numbers	9 nos

Source: JICA Study Team, 2007

(2) Project necessity

The water supply systems in Gegharkunik Marz are generally aged as most of them were constructed in 1960 days. The field survey found that all of the water supply systems need to be rehabilitated partially or totally. Those may not be able to be used for future operation under the present conditions. A total of 97% of the rural communities requested the rehabilitation of the distribution pipelines in Gegharkunik Marz. No.36 Shatjreq is the only one rural community, which does not require distribution pipelines rehabilitation because they constructed the current pipelines in 2000. A total of 91% of the rural communities require the transmission pipelines rehabilitation and the five rural communities, No.12 Ddmashen, No.15 Yerenos, No.23 Tsoaghkunq No.30 Dzoragyugh, and No.43 Verin Getashen do not require the rehabilitation of the transmission pipelines. The requirements for the rehabilitation of the intakes and reservoirs are almost equal around 80% of the rural communities.

(3) Project urgency

A total of 42 out of the 45 rural communities of Gegharkunik Marz suffer a huge amount of water leakage from the transmission pipelines, 153km and distribution pipelines, 348.1km. The urgency of rehabilitation is high in view of the water leakage. No.10 Gegharkunik and No.34 Mats Marsarik leak water from the transmission and distribution pipelines 26.0km and 32.6km respectively. As for asbestos cement pipe, No.18 Tazagyugh and No.37 Shatvan have 15.0km and 17.0km asbestos cement pipelines which are the largest lengths in the target communities in Gegharkunik Marz.

4.5 Tavush Marz

(1) Field survey results

Tavush Marz does not have large transmission pipelines like in Aragatsotn and Gegharkunik Marz. No. 3 Getahovit and No.12 Navur have more than 10km of transmission pipelines each. The existing water supply facilities of each rural community are of similar scale in comparison to the other marzes. The general features of the water supply systems in Tavush Marz are summarized as table below.

General Features of the Tavush Marz Water Supply System

Structures	Item	Average figures
1. Intake	Numbers	3 nos
2. Transmission pipeline	Length Diameter	6.8 km Approximately 100mm
3. Reservoir	Numbers Capacity	2 nos 190m^3
4. Distribution pipeline	Length Diameter	6.3km Approximately 100mm
5. House connection	Percentage	61%
5. Public tap	Numbers	3nos

Source: JICA Study Team, 2007

Two rural communities, No.7 Itsakar and No.12 Navur, take water from the water supply system being operated by Armwatersewerage CJSC.

(2) Project necessity

More than 90% all the structures of all types require rehabilitation. The existing distribution pipelines were mainly installed between 1950 and 1980 and there were no rehabilitation works found from the survey results. Conversely, transmission pipeline have been rehabilitated in the several rural communities. Rehabilitation of the distribution pipelines is prioritized among the existing structures.

(3) Project urgency

The survey found that 11 out of the 12 rural communities, except No.5 Yenoqavan, own huge water leakage pipelines' sections at present. No.1 Aghavnavanq and No.3 Getahovit leak a large amount of water from the pipelines 13.5km and 27km respectively. No asbestos cement pipes exist in Tavush Marz.

4.6 On-going Water Supply Project

The survey illuminated the 14 on-going project plans as shown in the table below. Among those, Shirak Marz allocated local budget to a full scale rehabilitation of No.16 Kaqavasar, No.21 Dzorashen, and No.35 Poqr Sariar. UNDP also completed to a full scale rehabilitation of No.9 Lusadzor in Tavush in 2008. Another 10 project plans will conduct the partial rehabilitations. Therefore, these four communities that will have full scale rehabilitations will be excluded from the improvements proposed in this Study.

On-going Rural Water Supply Projects

Marz	Rural community	Fund source	Project cost	Component and situation
Aragatsotn	No.1 Akunk	World Vision	AMD 3.6 mil	700m distribution pipeline installation
	No.4 Ashnak	IFAT and community	USD 0.36 mil	12 km new distribution pipelines and 900m3 reservoir construction
	No.27 Ttujur	PRSP	AMD 12.8 mil	Whole distribution network reconstruction.
	No.35 Tsaghkashen	World Bank	AMD 21.0 mil	Replacement of 2450m distribution pipelines
	No.52 Chqnagh	World Vision	AMD 9.0 mil	Reconstruction of transmission and distribution pipes

Marz	Rural community	Fund source	Project cost	Component and situation
Shirak	No.12 Lernut	SPSA individual philanthropist	AMD 31.0 mil	New intake, pipelines, reservoir, and water meter installation for all houses
	No.16 Kaqavasar	Local budget		Rehabilitation of intakes, transmission and distribution pipes.
	No.21 Dzorashen	Local budget		Rehabilitation of intake, transmission pipe, reservoir and distribution pipes.
	No.35 Poqr Sariar	Local budget		Rehabilitation of intake, transmission pipe, reservoir and distribution pipes.
Gegharkunik	No.18 Tazagyugh	Social Fund and community fund	AMD 80.0 mil	Rehabilitation of 4.5 km transmission pipeline
	No.20 Lusakunq	Social Fund	AMD 40.0 mil	Rehabilitation of 4.6 km transmission pipeline
	No.43 Verin Getashen	Save the Children	AMD 12.0 mil	Rehabilitation of 1.25km transmission pipeline including asbestos cement pipes
Tavush	No.6 Teghut	UN World Food Program	AMD 7.0 mil	Construction of sewage collection system D=500-800mm.
	No.9 Lusadzor	UNDP	USD 0.24 mil	Rehabilitation of whole water supply system

Source: JICA Study Team, 2008

5. WATER SOURCES

5.1 General

The water source survey was conducted in the target 153 communities by local consultants during the period from June to September, 2007. A summery of the survey results are as follows.

(1) Most of the rural communities have enough volume of water from the water source, however, 50% of the rural communities feel that water is insufficient.

(2) Most of the water sources satisfy the chemical water quality as drinking water in accordance with both Armenian and WHO (2004) guidelines. Marginal amount of Mn, Ba, Be, Mo, and Pb are detected from 20 rural communities.

(3) Most of the rural communities contain bacteriological indicators, total bacteria, total coliform bacteria, and thermotolerant. Among them, thermotolerant is identified from the 14 rural communities.

5.2 Insufficient Water Supply as Against Demands

Insufficiency of water volume as against estimated demand occurs due to leakage from damaged water supply systems such as damaged intakes, transmission pipelines, distribution pipelines and taps. In addition, unsuitable practices of water usage such as leaving taps open are causes of water insufficiency. Rehabilitation of the systems is needed as well as rational water use to prevent wasting water.

Three (3) communities (No.36 Tsilkar of Aragatsotn; No. 23 Tsaghkunq, and No.24 Tsovagyugh of Gegharkunik Marz) do not have enough volume of water sources. Introduction of rational water use is recommended after rehabilitation of the present systems.

5.3 Water Quality

(1) Chemical quality

Marginal amount of chemical components of health significance are identified in water samples from communities as shown in table below.

Summary of Chemical Analysis

Measurement			Guideline Values	
			Armenia	WHO
Mn (mg/L)			0.1	0.4
Aragatsotn	No.7. Avshen	0.1	+	-
	No.21 Dian	0.1	+	-
	No.23 Eghnik	0.1	+	-
	No.24 Yernhatap	0.1	+	-
	No.25 Nor Yedesia	0.1	+	-
	No.38 Karmrashen	0.2	++	-
	No.57 Vardenut	0.1	+	-
	No.59 Tegher	0.1	+	-
Gegharkunik	No.37 Shatvan	0.1	+	-
Tavush	No.5 Yenokavan	0.1	+	-
Mo (mg/L)			0.25	0.07
Shirak	No.13 Tsaghut	0.10	-	++
	No.24 Musaelyan	0.09	-	++
Gegharkunik	No.20 Lusakunq	0.17	-	++
	No.44 Torfavan	0.17	-	++
Ba (mg/L)			0.1	0.7
Shirak	No.17 Krashen	0.11/0.13	+	-
	No.28 Jajur	0.29	++	-
	No.29 Jajur Kayaran	0.11	+	-
Pb (mg/L)			0.03	0.01
Shirak	No.28 Jajur	0.013	-	+
Gegharkunik	No.24 Tsovagyugh	0.012	-	+
Be (mg/L)			0.0002	n/a
Gegharkunik	No.11 Geghhovit	0.00021	+	-
++: Exceeding, +: marginal, -:not exceeding				

Source: JICA Study Team, 2007

Certain chemical items (Mn, Ba, Be) are observed to be present in quantities equal to or more than Armenian guideline values though well under WHO guideline values; whereas some others (Mo, Pb) exceed WHO guideline values though they are under Armenian guideline values. It is recommended to re-test the water in the communities concerned to verify/confirm the accuracy of the testing once implementation of rehabilitation works has been decided. Decisions have to be made through discussions on a national level, since it is a matter of health concerned.

(2) Bacteriological quality

It is observed that most of the water sources in the target communities, 149 out of 153 rural communities, are periodically inspected/tested for bacteriological contaminations by the State Hygiene and Anti-Epidemic inspectorate, Ministry of Health.

Although those indicators indicate that the water sources are contaminated to some extent, only

thermotolerant is an indicator of hazardous bacteria. The following 14communities where thermotolerant was detected shall immediately apply chlorination to their water for drinking.

Summary of Communities with Water Containing Thermotolerant

Aragatsotn	Shirak	Gegharkunik	Tavush
No.10 Arayi	No.31 Sarnaghbyur	No.06 Astghadzor	No.07 Itsakar
No.27 Ttujur	-	No.10 Gegharknik	No.12 Navur
No.32 Lusagyugh	-	No.35 Noraket	-
No.35 Tsaghkashen	-	-	-
No.40 Hartavan	-	-	-
No.45 Mulki	-	-	-
No.49 Shenavan	--	-	-
No.57 Vardenut	-	-	-

Source: Ministry of Health

Although thermotolerant has not been detected in other communities yet, it is recommended to apply chlorination to the water or to be prepared for immediate chlorination in case thermotolerant should be identified in water by the periodical inspections in the future

(3) Hardness

Some communities complain of 'hardness'. Though water indicating high value of hardness tastes and communities do not prefer such taste, hardness does not affect to human health. It does not have any water quality problem. Four (4) communities with water containing hardness more than 700 mg/L (Armenia Guideline value) are listed the following table.

Summary of Communities with Water Containing High Hardness

Marz	Community	Measurements (mg/L)
Aragatsotn	9 Aragacavan	970
	46 Nigavan	825
Gegharkunik	23 Tsaghkunk	810
Tavush	9 Lusador	715

Source: JICA Study Team, 2007

6. SOCIO-ECONOMIC CONDITIONS AND WATER USE OF THE 153 RURAL COMMUNITIES

6.1 General

General features of socio-economic conditions and water use of the communities are as follows:

(1) Agriculture is main industry and employment opportunity is limited,
(2) Community budget is insufficient and allocation for water supply maintenance is limited,
(3) Ownership of the existing water supply system belongs to community,
(4) Water fee is collected by flat rate without water meter,
(5) Residents do not have the appropriate skills or experience for management of rural water supply.

In order to formulate the water supply operation and maintenance plan for each rural community the Study shall collect information regarding the socio-economic and water use of each rural community.

6.2 Rural Community Interview Summary

(1) Population and demography

The total population in all 153 rural communities surveyed is almost 190 thousand according to the survey conducted as shown in the table below. Compared to 2001 Census results, there is a slight growth in overall number by approximately 4.2%. However, this is not the tendency everywhere. In most areas of Armenia, the rural population has not changed much or it has even declined slightly. For example in the communities surveyed in Aragatsotn Marz, a population decline was observed compared to 2001 (approximately 3.3%), whereas in the communities surveyed in Gegharkunik Marz the population increased by 10.3% compared to 2001. It should be noted that the average population per household is between 3 – 4 persons.

Composition of Population and Households

Marz	Number of Communities	Number of Households	Population	Average People per Household
Aragatsotn	61	15,176	57,919	3.8
Shirak	35	6,126	23,211	3.8
Gegharkunik	45	26,846	94,538	3.5
Tavush	12	4,276	13,849	3.2
Total	153	52,424	189,517	3.6

Source: JICA Study Team, 2007

(2) Community budgets

Insufficient budget is a major defect to proper management of water supply systems in most of the rural communities surveyed. The table below shows that only 44 % of the communities surveyed allocate regular budget for the drinking water sector, and the rest do not have proper budget allocations. Even the regular budget allocations are by far insufficient to properly cover the O&M costs of the systems.

Community Budget Allocation to Drinking Water Sector

Allocation from community budget to drinking water sector	Number of communities in marz				Total communities	% of total
	Aragatsotn	Shirak	Gegharkunik	Tavush		
Some regular allocation	32	11	18	6	67	43.8
No allocation at all	14	14	14	3	45	29.4
Irregular allocation	15	10	13	3	41	26.8
Total by marz	61	35	45	12	153	100

Source: JICA Study Team, 2007

(3) Social security indicators

The following table presents information on socially vulnerable groups for the 153 rural

communities surveyed. It is noted that 14.4 % are pensioners and approximately 25 % are grouped in 'Socially vulnerable groups", which may require special considerations on O&M of water supply systems to be rehabilitated.

Main Social Security Indicators

Social Security Group	Aragatsotn		Shirak		Gegharkunik		Tavush		Total	
	Number	% of total	Number	% of total	Number	% of total	Number	% of total	Number	% of total
Pensioners	8,561	14.8	2,982	12.9	13,300	14.1	2,408	17.4	27,251	14.4
Unemployed	1,903	3.3	124	0.5	6,186	6.5	1,611	11.6	9,824	5.2
Receiving benefits	1,912	3.3	1,163	5.0	4,752	5.0	1,926	13.9	9,753	5.1
Total	12,376	21.4	4,269	18.4	24,238	25.6	5,945	42.9	46,828	24.7

Source: JICA Study Team, 2007

As for the health sector, the most alarming and key issue of healthcare is the lack of access to healthcare services: medical care and medicines. Only three (3) rural communities have medical ambulance station, and in most of the other rural communities there are only first-aid posts. In 2006 several allegedly water-related health problems (diarrhea, kidney disease, dysentery, skin disease, stomach disease, colitis, typhus and others) occurred in 16 out of the 153 surveyed rural communities.

6.3 Sources of Income

The following table summarized the average monthly income per household in AMD in all the 153 rural communities surveyed.

Average Monthly Income per Household

Average monthly income per household	Number of communities in marz				Total communities	% of total
	Aragatsotn	Shirak	Gegharkunik	Tavush		
< AMD 10,000	7	5	3	1	16	10.5
AMD 10,001-30,000	41	18	25	8	92	60.1
AMD 30,001 – 50,000	10	7	13	3	33	21.6
AMD 50,001-100,000	2	2	4	-	8	5.2
> AMD 100,001	1	3	-	-	4	2.6
Total by marz	61	35	45	12	153	100

Source: JICA Study Team, 2007

In total, in 108 out of the 153 rural communities surveyed (or more than 70%) the average monthly income per household is less than AMD 30,000. There is rather lower average when compared to the average salary per family in Armenia which is now between AMD 80,000 and 90,000.

In most of the communities, agriculture is the main source of income for the population. Particularly, income is generated from the following sources: agricultural and livestock products (dairy products, eggs, and meat); vegetables (potatoes, cabbages, and cauliflower); cereal crops (wheat, and barley); fruits and wool.

6.4 Monthly Water Fee

(1) Monthly water fee

As seen from the table below, only less than 25% of the communities charge a fee for drinking water supply, and it is obvious that the existing rates are by insufficient for financing adequate operation and maintenance of water supply facilities in the respective communities. Thus, financing is one of the most serious issues for drinking water supply in the surveyed rural communities.

Monthly Water Fees

Drinking water monthly fee per household, in AMD	Aragatsotn		Shirak		Gegharkunik		Tavush		Total		
	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	
0 (no fee)	46	75.4	27	77.0	35	77.8	9	75.0	117	76.5	
< AMD 200	2	3.3	1	2.9	3	6.7	-	-	6	3.9	
AMD 201-500	7	11.5	1	2.9	1	2.2	2	16.7	11	7.2	
AMD 501-800	3	4.9	-	-	1	2.2	1	8.3	5	3.3	23.5
AMD 801-1000	3	4.9	3	8.6	2	4.4	-	-	8	5.2	
AMD 1001-1500	-	-	3	8.6	3	6.7	-	-	6	3.9	
Total	61	100	35	100	45	100	12	100	153	100	

Source: JICA Study Team, 2007

(2) O&M cost in 2006

Total O&M cost in 2006 vary from community to community because some communities undertook major repair works and the others did not. Estimated average monthly water fees, with an assumption that O&M costs needed in a community should be borne by all the household in the community, range from AMD 200 to 260 /month/household. It may be concluded that this range of monthly water fee per household is needed to maintain the present water supply systems at the present levels, where communities suffer from water shortage in winter and/or bacteriological contamination into water and so on.

(3) Coverage of Collected Fee against the O&M Cost Incurred

Out of the 36 Communities where water fees are collected in various forms, only eight communities replied that the water fees collected actually covered the O&M costs. A range from 40 % to 90 % (60% in average) of actual O&M costs are covered by revenue collected in the eight communities; communities using electricity for pumping collect an average of 70% of the actual O&M costs whereas communities using gravity systems collect an average of 52% of actual O&M costs. Calculation of collection rates based on the information obtained through interview surveys shows that collection rates range from 5 % to 50% (21% in average) in eight communities.

(4) System Maintenance

Responsibility for water supply in the locations, where water supply facilities are owned by the communities lies with the rural community heads. In 137 rural communities the rural community heads and local residents are mainly involved in repair works of the water supply facilities. In the remaining rural communities, repair works are being conducted by irrigation Water User Associations, local and international NGOs, and the Armenian Social Investment Fund. Six community heads claim that nobody is engaged in repair works of the water supply facilities in their communities. In a few cases (mostly related to renovation of pumps), specialists are hired from outside for repair works.

In almost all the rural communities surveyed there is no specialized organization in charge of the operation and maintenance of drinking water supply facilities. As for the preferred method of organization of operation and maintenance, 41% of community heads suggested that all costs should be covered by drinking water fees, whereas the 49% were in favor of residents participating in O&M works as much as possible and thus reducing the cost of O&M, taking into consideration the existence of socially vulnerably groups in those communities.

7. WILLINGNESS TO PAY SURVEY RESULT

7.1 General

The willingness to pay survey was conducted with 1,000 informants in the 24 rural communities by a local consultant during the period from June to August, 2007. General background of willingness to pay and affordable to pay is as follows.

(1) Most of rural communities do not collect any water fee or collect small amount of water fee.
(2) Average household incomes in rural communities are lower than urban areas.
(3) Some residents are not satisfied with present water services.

7.2 Survey Results

(1) Monthly average household income

Based on the survey of 1,000 informants, the average monthly household income was AMD 43,000. Monthly household income between AMD 10,000 and 30,000 is the modal figure in the willingness to pay survey as well as the socio-economic survey results. The majority of the 1,000 informants is distributed between AMD 10,000 and 50,000.

(2) Present water fee

Eight (8) out of the 24 target communities have collected water fees from the users. The eight communities adopt a “flat rate” charging system. Water fees of the eight communities range

from AMD 100 to 500 per month per household; there is not much difference in the water fees among the eight communities.

The remaining 16 rural communities, which do not collect monthly water fees, collect repair costs when their water supply systems needs to be repaired. A range of AMD 100~500 per household was collected in the past when needed, but only from the residents that could afford it. Water supply services in such communities are reportedly not satisfactory.

(3) Estimate of affordable water fees

Almost half of the informants replied that they are not willing to pay water fees. This is because the majority of informants can now use water without paying a fee though they sometimes complain about the water supply services. In other cases, some other informants express their willingness to pay if water supply services are made available all the time.

Based on the information from all informants including ones who are not willing to pay for water, the monthly affordable water fee could be estimated at around AMD 300 per month per household; whereas AMD 700 per month per household will be the estimated water fee based on information only from ones who are willing to pay for water. Most of the informants expressed that water fees should be collected according to water volume actually used by the users.

7.3 Affordable Water Fee

The affordable water fee ranges between AMD 300-500 per month per household. This corresponds well to a guideline for affordable water fees recommended by the World Bank: not more than 3 % of income per household.

8. ORGANIZATION AND INSTITUTIONAL STUDY OF RURAL WATER SUPPLY SYSTEMS

8.1 Administrative Framework for Rural Water Supply in the Republic of Armenia

(1) Institutional and policy framework

The legal and institutional structure of the water sector in Armenia is based on the National Water Code adopted in 2002. The Water Code defines three major functions in the water sector: (a) management of water resources, (b) management of water systems, and (c) regulation of water supply and wastewater services. Table below summarizes the main functions of the water sector management authorities in Armenia.

Main Functions of the Water Sector Management Authorities

	Water Resources Management and Protection	Tariff Regulation	Management of Water Systems
Responsible Agency	Water Resources Management Agency under the Ministry of Nature Protection	Public Services Regulatory Commission	State Committee on Water Systems under the Ministry of Territorial Administration
Main Functions	- Water resources monitoring and distribution - Strategic water management and protection	- Protection of consumer rights and tariff regulation for non-competitive water supply and wastewater treatment in the drinking, household and irrigation sectors	- Management of water systems under state ownership - Assistance to development of water user associations and water user federations - Organization of tenders on transfer of water systems' management
Enforcement Tools/ Mechanisms	Water use permits	Water systems use permits	Management contract

Source: JICA Study Team, 2008

After adoption of the Water Code, the legal framework in the water sector in Armenia was further developed through adoption of the Law on Fundamental Provisions of the National Water Policy in the Republic of Armenia and the Law on the National Water Program.

In addition to this, the Government of Armenia has adopted the Republic of Armenia Draft Law on Drinking Water, which will be discussed in the National Assembly (Parliament) in 2009. The purpose of this draft law is the definition of the state policy principles and mechanisms for regulating drinking water supply and the wastewater collection sector, as well as ensuring present and future provision of services for supply of necessary quantity, duration and quality of drinking water and wastewater collection, aimed at the well-being of the population.

(2) Role of key authorities and agencies

1) The Ministry of Nature Protection (MONP)

The MONP has a broad mandate of natural resources management and protection, which is fulfilled through various agencies of the MONP. The Water Resources Management Agency (WRMA) under the MONP is the state authorization for water resources management and protection. It is responsible for carrying out the RoA's water resources management and protection responsibilities under the Code. This entity is charged with estimating water availability and ensuring water use efficiency, through the permitting and planning processes. It is also responsible for management of competing water uses and for ensuring that environmental needs are met.

2) The Public Services Regulatory Commission (PSRC)

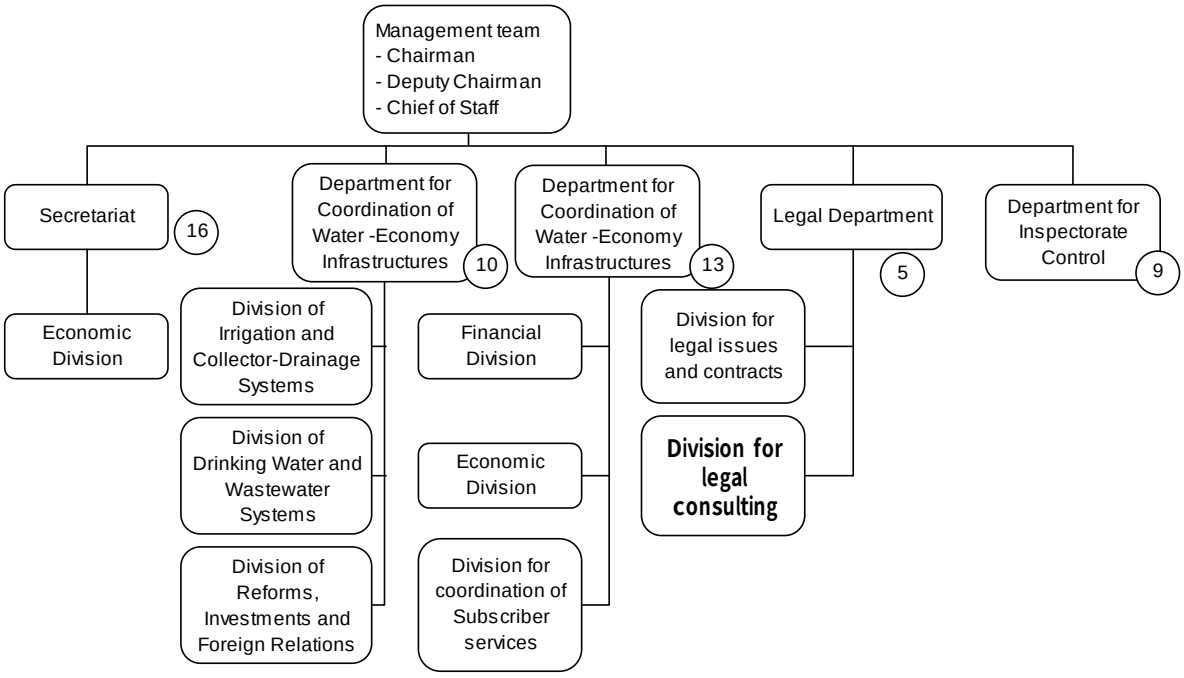
The PSRC is responsible issuing water system use permits, the monitoring of the quality of service provision and the setting of tariffs. The PSRC was established by the Water

Code on the institutional basis of the former Energy Regulatory Commission. The PSRC only recently became actively engaged in economic regulation in the water sector. Some of the functions of the PSRC in the water sector are not yet clearly defined by law or not yet appropriately interpreted by other agencies and organizations in the water sector.

3) The State Committee on Water Systems (SCWS)

The SCWS under the Ministry of Territorial Administration of the Republic of Armenia was established by the Government of Armenia Decision No.92 of February 9, 2001. According to the Charter, the Committee develops and implements the Government of Armenia policy on management and use of water systems under state ownership. The main objectives and goals of the SCWS include: (a) management and provision of safety of water systems under state ownership, (b) implementation of the National Water Program components under its jurisdiction, and (c) development and implementation of investment policy on water systems, as well as organization of expertise on investment programs.

The SCWS is managed by the Chairman of the SCWS, who is appointed and released from duties by the Prime Minister of the Republic of Armenia. The SCWS has 64 employees, and the organizational chart of the SCWS is provided in figure below.



Organizational Chart of SCWS

(Source: SCWS, 2008)

8.2 Water Supply Systems

(1) Water supply companies

There are currently five water supply and sewerage companies in the Republic of Armenia: Yerevan Water, Armenia, Lori, Shirak and Nor Akunk Water Supply and Sewerage Companies. As of 2007, 371 communities representing over 81.5% of the total population are served by the State water companies.

As seen from the table below, tariff levels and collection rates are still below what is needed to cover full operation and maintenance (O&M). Capital expenditures will continue to be unaffordable from utility revenue alone. Long-term financing from subsidies and donors will remain necessary until Armenia's average incomes are a multiple of current levels.

Combined Summary Information for the Five Water Supply Companies for 2007

	Yerevan Water	AWSC	LWSC	SWSC	NAWSC	Total
Communities served	28	279	17	35	12	371
Population	1,165,000	915,000	115,000	185,000	63,000	2,443,000
Water Customers	328,200	268,000	38,700	65,800	16,200	716,900
Water Meter Installation	91.4%	63.5%	81.9%	39.9%	96.6%	77%
Water tariff*1, AMD/m^3	172.8	140.0	121.16	120.14	150.20	-
Collection rate (%)	92	75	70	67	91	-
Net profit (loss) after deduction of profit tax, in thousand AMD, 2006 data	1,688,125	(1,002,610)	(12,677)	(37,516)	(183,852)	-

Source: Public Services Regulatory Commission, 2008
Note; *1: Water tariff consists of portable water supply, drainage and wastewater treatment fees

(2) Community-owned water supply systems

As of November 2007, there are 549 communities[1] in the Republic of Armenia not being served by any of the five water supply companies. The total population in those communities is approximately 550,000, or roughly 18.5% of the total population of the country. For the communities that operate their own systems there is no specialized organization in charge of operation and maintenance of those drinking water supply systems. In most cases, offices of the communities are in charge of O&M. However, in most cases they don't even have corresponding specialized staff.

8.3 Operation and Maintenance Arrangements

According to the law "On Local Self-governance", head of communities are responsible for providing water service within a community unless the water sources and facilities serve more than one community. If the water sources and facilities do serve multiple communities, one of five state-owned companies shall provide the water service. There are three types of operational arrangements for water supply systems in Armenia as shown in following table.

[1]) This number is approximate, since some communities include more than one settlement, and some other communities are just in the list of communities, and currently there is no population.

Main Operation Arrangements for Water Supply Systems

	Water Supply System		Owner of System	O&M	Assistance
Type 1	CJSC	Yerevan Water, AWSC	State	Foreign companies	World Bank
Type 2	CJSC	LWSC, SWSC, NAWSC	State and communities	State and communities	KfW
Type 3	Community-owned	Self-supply	Communities	Communities	None

Source: JICA Study Team, 2007

9. RURAL WATER SUPPLY PLAN

9.1 Strategies for the Improvement of Rural Water Supply and Sewage System

(1) Most water supply facilities have already deteriorated and water leakage is the most severe problem. It shall be necessary to completely rehabilitate water supply facilities in the rural communities.

(2) Water volume at the source is potentially sufficient judging from the Study Team's rough water availability and demand calculations. Water saving methods such as water meter installations are essential to improve the rural water supply systems.

(3) Once residents receive water 24 hours a day, they intend to pay the water fee continuously. It shall be indispensable that an organization manages the water supply system surely and safely. An operation and maintenance organization shall be established.

(4) SCWS should coordinate the implementation of rehabilitation of the rural water supply systems to avoid any duplication of the projects, since there are many rural water supply projects being implemented by various funding sources in Armenia. According to the study, 14 on-going rehabilitation projects by international donors/NGOs/social funds or local budgets are currently in progress. Of these, 4 rural communities should be excluded from the proposed rehabilitation plan (since the on-going projects that will rehabilitate the entire system) and for another 10 (being partially rehabilitated), the extent of on-going works should be taken into consideration.

9.2 Preconditions

The rehabilitation of water supply and improvement plan of this project is to be prepared according to the below-mentioned concepts:

(1) The water supply plan is for the rehabilitation and improvement of the existing water supply facilities. New water supply facilities are not designed in principle.

(2) The water supply plan does not consider the population growth and 2007 population is applied as baseline number of population served.

(3) The rehabilitation of water supply facilities shall be identified based on the field survey results in which the rural community requests for system rehabilitation.

9.3 Unit Water Demand Volume

(1) Applied guideline

The water supply plan shall follow the Armenian water supply criteria, Water supply transmission pipe and structures' construction norms and rules 2.04.02-84, and Water supply distribution network and structures' construction norms and rules 2.04.01-85. Most of the unit water demands are not specified in the Armenia water supply criteria. The Study applies the following figures taken from the past experience and other guidelines.

(2) Unit water demand volume

1) Unit water demand per person

The Study applied the unit water demand of 100 L /capita/day.

2) Factory water demand

Two factories are operating at Tsovagyugh with 50m^3/day in Gegharkunik and Norakert with 15m^3/day in Gegharkunik among 153 rural communities.

3) Water demand for Pupils, clinics and hospitals

The demands were estimated based on past study figures as shown in table below.

Unit Water Demand for School and Hospital

Item	Unit water demand
School	10 L/pupil/day
First aid health post	500 L/post/day
Medical ambulance station	1,200 L/station/day

Source :Empirical studies done under USSR administration

4) Unit water demand of livestock

Unit water demand of livestock is designed as 87 L/household/day taken each figure from "Agricultural Water Supply" by Mr. Karambirov N.A 1978.

(3) Unaccounted for water

On-going international water supply projects are planned and designed to reduce unaccounted for water ratio from existing water supply facilities' leakage level, which is estimated about 50~70%, up to 20~25%. The Study applies to 20% of the total water demand as unaccounted for water.

(4) Peak factors

Peak factors are adopted in accordance with the Armenian water supply criteria.

9.4 Water Supply Planning

Most of the rural communities have sufficient water sources. Twenty one rural communities

cannot satisfy the water demand under the present situation. Almost all rural communities can receive minimal water supply guideline (50L/capita/day) even in severe water supply conditions. Water supply rehabilitation plan will fulfill at least minimal water service guideline level. Water flows out from water taps continuously under present situation, however, residents feel water shortage. Realization of the rural water supply plan and saving water are highly required in order to conduct stable water supply service throughout a year.

9.5 Preliminary Water Supply Planning

(1) Intakes

The intake structure capacity shall be from 1 m^3 to 4 m^3.

(2) Pipelines

Polyethylene, polypropylene, and polyvinyl chloride pipe are chosen for the pipe material, due to reasonable price and in order to avoid rust. Transmission pipeline is designed to flow water 0.3~0.5m/sec. Distribution pipeline is applied to the same diameter as the existing ones.

(3) Reservoirs

Storage capacity shall be designed to provide 12 hours of maximum hourly water demand. Reservoir capacity is planned from 50m^3 to 600m^3 in 50m^3 intervals.

(4) House connections and public taps

House connections with water meter installation are to be provided to each household for future stable water supply. As for public taps, one public tap shall be provided for each up to one hundred households.

(5) Chlorination

Designed chlorination equipment shall be provided for all the rural communities.

(6) Drainage

Drainage construction shall be estimated for 40% amount of the distribution pipeline rehabilitation works.

9.6 Proposed Water Supply Plan

The total length of transmission pipes is planned to be 564.6km and of distribution pipes is 843.6km. The average rehabilitation length of both the transmission and distribution pipes is about 4.9km and 6.4km respectively. Total number of intakes is 248 which average to nearly 2 intakes for each community. The average number of reservoirs is approximately one for each

community. New house connections are estimated at about 21,900 and water meter installations at 51,900 households.

9.7 The Rural Water Supply System Improvement Project

(1) Phased Implementation of the Rural Water Supply Improvement Project

The total construction cost is estimated to be about USD 80.6 million. From a viewpoint of budgetary scale for a typical rural water supply project, this amount is too large to implemented as single project. On the other hand, since immediate implementation of the project is needed, it should not be divided into many phases and prolong the completion of the project. Therefore, it is suggested that the project implementation should be divided into two phases.

(2) Project Contents of Phase 1 and 2

Project contents of each phase are summarized in the following ables respectively:

Contents of the Project for Improvement of Rural Water Supply Phase 1

No.	Item	Unit	Gegharkunik	Tavush	Total
1	Intake: Capacity 1~4m^3	Place	57	19	76
2	Transmission pipe Dia.50~250mm	km	211.8	47.8	259.6
3	Reservoir: Capacity 50~600m^3	Place	54	22	76
4	Distribution pipe Dia.50~250mm	km	379.1	76.7	455.8
5	House connection	Place	12,970	1,336	14,306
6	Water meter installation	Place	26,748	4,126	30,874
7	Public tap	Place	287	45	332
8	Chlorine equipment	Place	68	18	86
9	Pump	Place	2	0	2
10	Drainage	km	151.6	30.7	182.3

Source: JICA Study Team, 2008

Contents of the Project for Improvement of Rural Water Supply Phase 2

No.	Item	Unit	Aragatsotn	Shirak	Total
1	Intake: Capacity 1~4m^3	Place	120	52	172
2	Transmission pipe Dia.50~250mm	km	238.1	69.0	307.1
3	Reservoir: Capacity 50~600m^3	Place	56	39	95
4	Distribution pipe Dia.50~250mm	km	300.9	89.1	390.0
5	House connection	Place	4,478	3,113	7,591
6	Water meter installation	Place	15,036	5,957	20,993
7	Public tap	Place	178	75	253
8	Chlorine equipment	Place	66	39	105
9	Pump	Place	3	0	3
10	Drainage	km	120.4	35.6	156.0

Source: JICA Study Team, 2008

9.8 Cost Estimates of Proposed Water Supply Plan

(1) Construction costs (direct cost)

Total construction cost is nearly USD 80.6million (AMD 24,600 million). The construction cost summary table of each phase by marz is shown in table below.

Summary of Construction Cost by Each Phase and Marz

Construction cost	AMD (x1,000)	USD (x1,000)	JPY (x1,000)	Cost per rural community USD (x1,000)
Phase 1				
Gegharkunik Marz	10,839,251	35,479	3,743,035	788
Tavush Marz	2,086,919	6,831	720,671	621
Sub-total	12,926,170	42,310	4,463,706	756
Phase 2				
Aragatsotn Marz	8,642,993	28,289	2,984,490	464
Shirak Marz	3,057,014	10,006	1,055,663	313
Total	11,700,007	38,295	4,040,123	412
Grand total	24,626,177	80,605	8,503,829	541

Source: JICA Study Team, 2008

(2) Project costs

Construction cost in the following table consists of the direct cost, price escalation, and physical contingency.

Total project is nearly USD 144 million (AMD 43,928 million). Project costs of each phase are shown in table below

Phase 1 and 2 Project Cost Summary

No.	Item	Phase 1		Phase 2		Total	
		USD (1000)	AMD (million)	USD (1000)	AMD (million)	USD (1000)	AMD (million)
Loan portion							
1	Construction cost	42,310	12,927	38,296	11,700	80,606	24,627
2	Price escalation (3.3% compound) of No.1	5,537	1,691	4,849	1,481	10,386	3,172
3	Physical contingency (5.0%) of No.1 and No.2	2,393	731	2,158	660	4,551	1,391
4	Consultant services (7.0% of item No.1-3)	2,730	834	2,730	834	5,460	1,668
5	Price escalation (3.3% compound) of No.4	158	50	158	50	316	100
6	Physical contingency (5.0%) of No.4 and No.5	144	46	144	46	288	92
	Sub-total	53,272	16,279	48,335	14,771	101,607	31,050
Armenian side expenses							
7	Administration cost (10% of loan portion)	5,327	1,631	4,834	1,479	10,161	3,110
8	Price escalation (3.3% compound) of No.7	679	207	595	181	1,274	388
9	Physical contingency (5.0%) of No.7 and No.8	301	91	271	82	572	173
10	VAT (20% of item No.1-No.9)	11,916	3,640	10,806	3,304	22,722	6,944
11	Loan interest (1% Average of existing projects' interests)	3,858	1,178	3,557	1,085	7,415	2,263
	Sub-total	22,081	6,747	20,063	6,131	42,144	12,878
	Total	75,353	23,026	68,398	20,902	143,751	43,928

Source: JICA Study Team, 2008

10. PROPOSED OPERATION AND MAINTENANCE ORGANIZATION

10.1 Options for Operation and Maintenance (O&M)

The following three options for O&M of water supply systems are studied for the rural communities within the JICA study area:

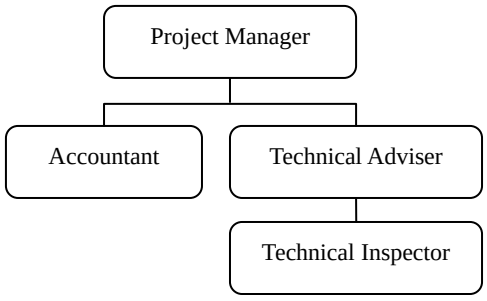
- Option 1 - Local Organizations in charge of O&M in each rural community,
- Option 2 - Establishment of the inter-community water utilities,
- Option 3 - Transfer of O&M functions to one of the existing Water supply companies (WSC).

10.2 Local Organization in Charge of O&M in Each Rural Community (Option-1)

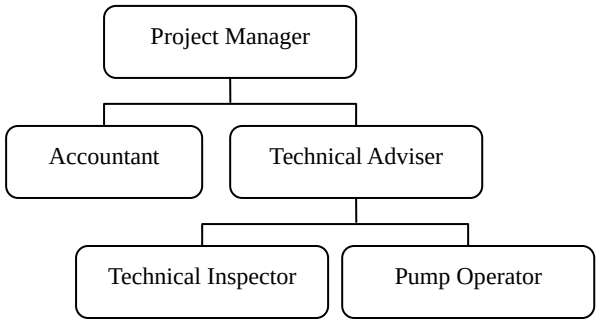
Under this option it is suggested that each community establish or utilize a local organization under rural community administration office, which will be in charge of O&M of the water supply facilities, and will be responsible for provision of drinking water for the community. Establishment and operation of independent organization will require significant financial resources. Such costs cannot be covered by water user fees. Thus, in order to be cost-efficient it is preferable to establish a small unit within gyughapetarans (offices of rural community administration).

The unit may consist of 4-5 employees, of which 2-3 positions are paid. The following organizational structure is suggested as O&M units in the rural communities:

For rural communities with gravity system



For rural communities with pumped system



Suggested O&M Organization in Option-1

(Source: JICA Study Team, 2008)

Project Manager (managing head of the O&M office) is a non-paid position, which will be responsible for overall management and oversight of the process. This can be either the head or deputy head of a respective community. Technical Inspector is a full time paid position, which will be in charge of all technical aspects of the water supply facilities, water meter readings,

billing and collection of water fee and chlorination. In addition the Project Implementation Unit (PIU) will assist those communities with responsibility for O&M of rural water supply systems, to prepare O&M plans to enhance sustainable long-term operations.

10.3 Establishment of the Inter-Community Water Utilities (Option-2)

Aragatston, Shirak, Gegharkunik, and Tavush marzes were governed by several counties in the Soviet Federation Era. The communities in the county can easily form the Inter-Community Water Utilities, since these are geographically adjacent to each other. At present, there are Water Users Associations (WUAs) was found at counties to address irrigation for Inter-Community Water Utilities in the rural areas of Armenia. The present WUAs in rural area were surveyed to determine considerations for the establishment of the Inter-Community Water Utilities related to O&M of rural water supply systems.

The Study Team surveyed Ararat Water Users Association in Ararat Marz and Ijevan Water Users Association in Tavush Marz as the case study. The following lessons can be learned through the survey:

- Existing WUAs were established through the support of World Bank and/or International Fund for Agricultural Development (IFAD) under the “Law on Water Users Associations (WUA) and Water Users Federations (WUF)”. The project aims at creating conditions for effective O&M of the irrigation infrastructure through institutional strengthening.
- Existing WUAs were established based on the Inter-Community Water Utilities at neighboring communities in the county level. Water sources of irrigation are common properties of the WUAs.
- WUA consists of ordinal members and selected staffs. The O&M of irrigation system is carried out by staffs. WUA collects the water fee from members for O&M of the irrigation system. It applies for subsidy to the Ministry of Finance through the SCWS which is used to cover the insufficient O&M cost.

10.4 Transfer of O&M functions into one of the existing WSC (Option-3)

Currently, Armenia Water Supply Company (AWSC) provides water supply services to Aragatsotn, Shirak, Gegharkunik and Tavush Marz and Shirak Water Supply Company (SWSC) serves to Shirak Marz. Establishment of new water supply companies in Aragatsotn, Gegharkunik, and Tavush Marzes for the JICA project increases further financial impacts even if the existing companies still rely on government subsidies. Under this option, it is suggested to transfer the O&M functions of the rural communities to one of the existing water supply companies in Armenia.

There are two approaches in this regard. For the first approach rural communities in the entire

JICA study area can be transferred to the service area of the AWSC. To do this, a signed agreement with the respective communities will be required, stating their willingness to join AWSC. Meanwhile, AWSC will manage the rural community water supply system through two types of contract agreement: a) compressive management, b) bulk water supply. Water tariff is set to AMD 115.65/m^3 for compressive management and AMD 51.49/m^3 for bulk water supply.

The second approach relates to transferring JICA study area is rural communities in Shirak Marz to the service area of the SWSC, while the remaining rural communities in Aragatsotn, Gegharkunik and Tavush marzes to AWSC. Water tariff meanwhile is set to AMD 73.98/m^3 in SWSC service areas.

Each approach has different means of managing the communities in Shirak Marz. For the first approach, the head office of AWSC, located in Yerevan will serve ten marzes including Shirak Marz. Meanwhile for the second approach, the head office of SCWS located in Gyumri, is actually the center city of Shirak Marz. SCWS will serve 35 communities including Gyumri, and the rural communities in Shirak Marz. SCWS thus works very closely with the heads of the rural communities. In addition, water fee of SWSC is lower than that of AWSC, hence it is more affordable for the water user. Therefore, it is more appropriate to transfer the rural water supply systems in Shirak Martz to SWSC.

10.5 Comparative Analysis of the Proposed Options

(1) Technical Aspects

There should be specialized technical staff for O&M in the water supply companies. A large company can employ staffs whose task will be exclusively O&M, while small firms may not be able to maintain such specialized technical staff within their organization. Large scale O&M organizations (Option-3) will have advantages in the technical aspects over small organizations.

(2) Accessibility to O&M Services

Users are generally generally more immediate and frequent services for their water supply facilities when repair teams (provided by small scale O&M organizations) are based and managed nearby. Meanwhile, large scale companies may only be able to provide minimum and limited services, particularly to remote communities. Hence, small scale O&M organizations (Options-1 and 2) will have advantages over large scale organizations with the aspect to accessibility to related services.

(3) Social/Political/Legislative Aspects

There is a possibility that some rural communities may not be willing to establish joint organizations for O&M with other communities, since the activities confined within such

communities may already be effective. This might be the case particularly for rural communities that already have efficient 24-hour water supply have no issues or troubles. Option-1 in this respect will have definite advantages over other options. In addition, introduction of Option 2 will require establishment of legal framework similar to irrigation WUA.

10.6 Management Arrangements for Rural Water Supplies

(1) Option-1 Local Organization

Surveyed 153 rural communities manage their own water supply systems through community efforts. However, there are no formal O&M systems. In order to achieve long-term sustainability of the proposed water supply systems, capacity building of the local organization needs to be implemented. The O&M management capacity would then increase in the future, and respond to the needs of rural water supply service. The following conditions are suggested for the establishment of O&M organization in rural communities.

- Small and medium scale service areas and service population: Existing community structures to be provided for suitable management; no social issues are anticipated.
- Remote areas which are far from existing WSC service areas: Management by WSC need to be more effective
- Gravity system: Simple maintenance without requiring experienced staff with technical skills
- Low Affordability: Small scale service population may not cover the O&M cost

(2) Option-2 Inter-Community Water Utilities

A rural water supply system has own water source and supply system in each community. Therefore, it is difficult for a large number of communities to participate in the rural water supply project in each county, and to establish the Inter-Community Water Utilities for provision of potable water supply. However, WUA still receives the subsidy from the government and implies that the Inter-Community Water Utilities are not financially sustainable In addition, the existing water supply company has already included a part of rural water supply in the service area. Therefore, option 2 O&M organization is not recommended for rural water supply project.

(3) Option-3 Water Supply Company

The following conditions are suggested in order to transfer the rural communities to the service areas of the existing WSC (AWSC, SWSC).

- Large scale service area and service population,
- Water sources management problems should concern communities that share same water sources,
- Proximity to existing WSC service area.

(4) Proposed O&M Options

The Proposed Operation and Maintenance Option is as shown in table below: basically, almost all communities are categorized under O&M Option-1, Local Organization. Option-2 is not proposed. Under Option-3, communities that have more than 3,000 populations and are located close to service areas of existing WSC are listed up. Six rural communities (Ashnak, Aragats, Arteni, Getap, Tlik, and Lusakn) in Aragatsotn marz are also categorized under O&M Option-3, due to management problems of water sources.

Summary of O&M Options

Operation and Maintenance Options	Communities	Number of communities	Population	House holds
Aragatsotn Marz				
Option-1	Studied communities except those adpoting Option-3	53	39,346	9,618
Option-3	14 Byurakan, 42 Dzoragyugh, 4.Ashnak, 9Aragats, 11Arteni, 18Getap, 28Tlik, 33 Lusakn	8	18,573	5,558
Shirak Marz				
Option-1	All studied communities in Shirak	35	23,211	6,126
Gegharkunik Marz				
Option-1	Studied communities excepts those already adopting Option-3	40	67,977	18,555
Option-3	1 Akunq, 11Geghhovit, 24 Tsovagyugh, 30 Dzoragyugh, 43 Verin Getashen	5	26,526	8,297
Tavush Marz				
Option-1	Studied communities excepts those adopting Option-3	11	10,009	3,026
Option-3	2.Gandzar	1	3,840	1,250

Source: JICA Study Team, 2008

10.7 Long-Term Vision

In the long-term (ten year or more), local organizations might not be the best for O&M of water supply systems since there will be a need for establishment of stringent standard for service quality, and improvement of the services. Moreover, replacement costs for pump and others will periodically arise, which the local organizations will not be able to bear. Thus, it is suggested to O&M of water supply facilities will be shifted from Option-1 to Option-3 in the future.

It was observed that there might be rural communities, which would prefer to remain as local organizations. These are particularly the communities that do not have major problems with water supply, i. e., generally utilize gravity flow, have sufficient drinking water sources, and supply 24-hour drinking water without seasonal variations. Considering above, a "Combined Approach" will be initiated based on the following principle:

(1) In the short-term, new local organizations are to be established

The existing 153 rural communities have no experience in organized water supply management. Therefore, the above-mentioned approach had been studied in terms of implementation of pilot project activities and monitoring in the rural communities of Apnagyugh (Aragatsotn Marz) and Lchavan (Gegharkunik Marz). The results are provided in Chapter 14 of the report.

(2) In the medium and long-term, O&M functions of local organizations will be transferred to Option-3 while the communities unwilling to participate, will continue functioning independently.

11. IMPLEMENTATION PLAN

11.1 Phased Development

Firstly, a "cluster" shall be defined as the smallest unit in the arrangement of component. Hence the Study Team suggests applying three clusters from different viewpoints such as "Cluster A" as Marz, "Cluster B" as Construction Zone, and "Cluster C" as District. Phasing shall be considered by combination of these clusters as table below.

Clusters and Component Groups

Cluster	Components and number of communities included
Cluster A: Marz (4)	Aragatsotn (61), Shirak (35), Gegharkunik(45) , Tavush (12)
Cluster B: Construction Zone (7)	Aparan (34), Talin (30), Gyumri (19), Amasia (13), Sevan (9), Martuni (31), Ijevan (17) : Listed cities / towns are centers of construction zones)
Cluster C : District (15)	Aragatsotn Marz : Ashtarak (9), Aparan (18), Aragats (13), Talin (21) Shirak Marz : Akhuryan (12), Amasia (9), Ashotzq (12), Artik (2) Gegharkunik Marz : Gavar (2), Krasnoselsk (9), Martuni (12), Sevan (6), Vardenis (16) Tavush Marz: Ijevan (10), Taush (2)

Source: JICA Study Team, 2008

In order to evaluate clusters from different viewpoints, practical aspects and indicators are needed. In this step, the following two aspects for characterizing clusters are selected: (a) urgency and (b) efficiency. Since the Project requires urgent rehabilitation, "urgency" shall be selected as the first priority. Total lengths of pipelines and asbestos cement pipes exhibiting excessive leakage are taken as evaluation indicators. As for "efficiency", the number of population served is considered as the indicator. In addition to above aspects, each cluster's investment cost shall be studied to adjust the balance of the total costs for each phase. Differences of total costs for each phase shall not exceed 10%. Therefore three alternatives for three different clusters are given in table below. In each alternative, a higher ranked component group in the cluster shall be included in the 1st phase preferably based on cost balancing of each phase.

List of Alternatives

Alternative 1	Alternative 2	Alternative 3
Cluster A Marz	Cluster B Construction Zone	Cluster C District

Source: JICA Study Team, 2008

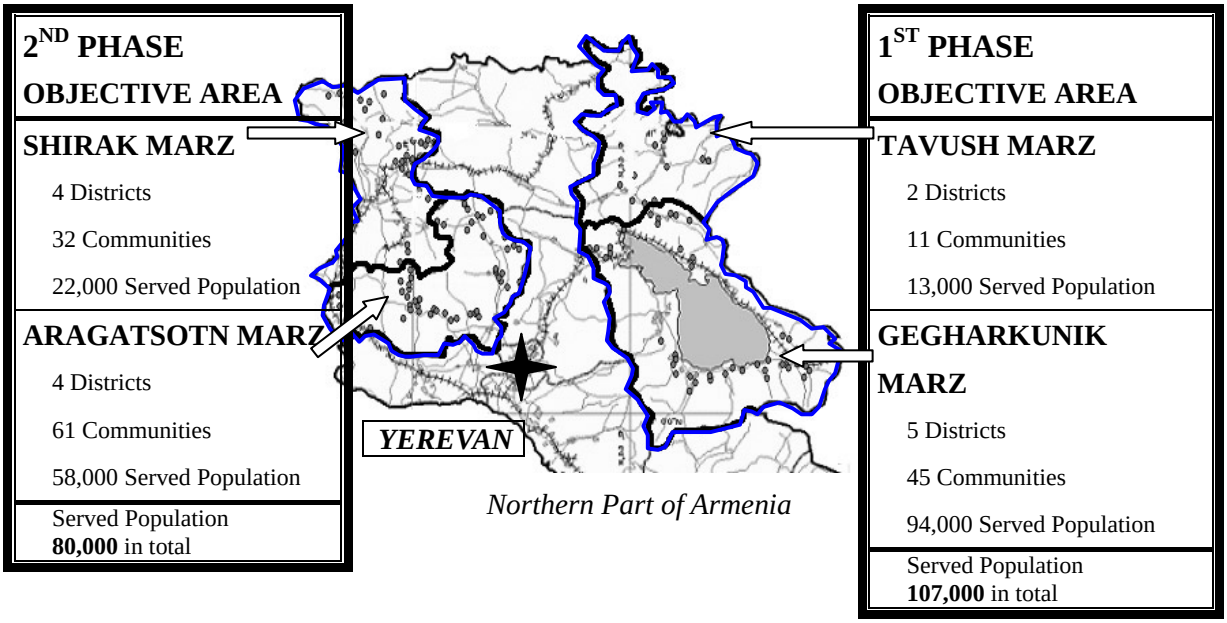
Based on the rating procedure, grouping results for Alternative 1 to 3 are indicated. After setting up the groups, ranking evaluation for the results of the 1st Phase group has been done. In addition to "urgency" and "efficiency" aspects, evaluations from an administrative and construction viewpoint are taken into consideration for each alternative. Summarized result of evaluation is shown in table below

Evaluation of Alternatives

	Alternative 1		Alternative 2		Alternative 3	
Cluster	Marz	Pt.	Construction Zone	Pt.	District	Pt.
Urgency	High	4	Low	2	Medium	3
Efficiency	High	4	Medium	3	Low	2
Investment Cost (1st Phase/2nd Phase)	53% / 47%		53% / 47%		54% / 46%	
Administrative	Excellent	4	Poor	1	Poor	1
Construction	Excellent	4	Good	3	Average	2
Result	**Adoption**	16	-	9	-	8

Note: Pt. means points. High or Excellent: 4points, Medium or Good: 3points, Low or Average: 2points, Poor: 1point.
(Source: JICA Study Team, 2008)

Based on comparative results above, Alternative 1 is found to be the best phasing for the Project. Each phase shall be divided according to combination of marzes. The phasing result is shown in figure below.



Objective Area of the 1st Phase and the 2nd Phase

(Source: JICA Study Team, 2008)

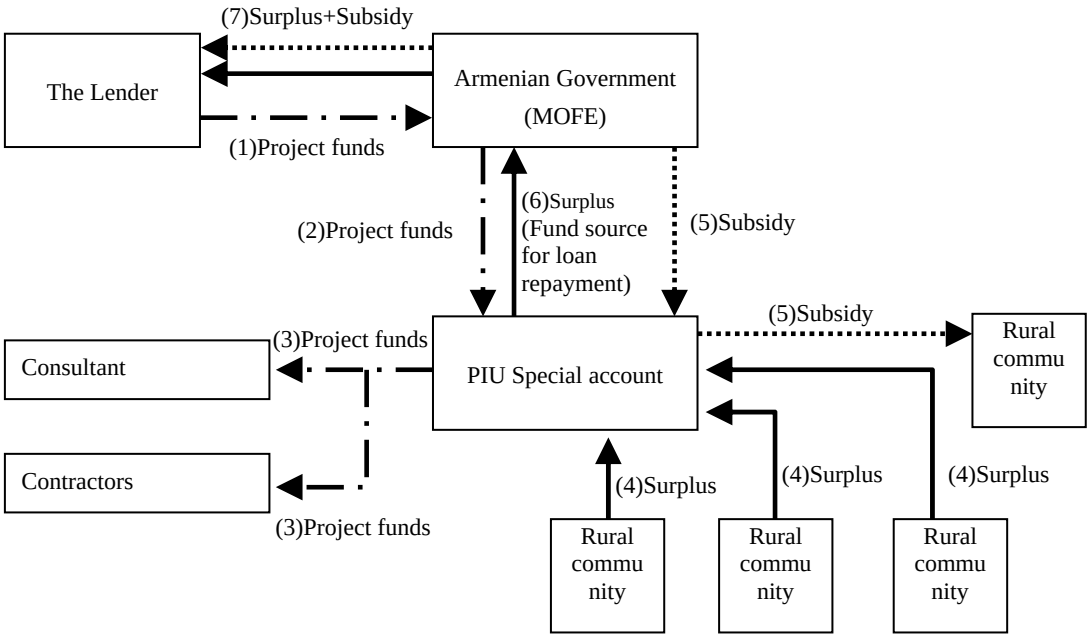
11.2 Sequence of the Project

A typical sequence of a loan project implementation is to be divided into four parts listed below;

(1) Preparation of the Loan Request,
(2) Donor's Appraisal and Loan Agreement,
(3) Project Implementation,
(4) Completion of the Project.

Item 1) ~ 7) shows the capital flow related to the project:

1) The Ministry of Finance and Economy acting as the Borrower, signs an agreement with the Lender, and receives the project funds.
2) PIU opens a special account for the project where funds will be transferred.
3) The project funds are used for the construction works and consulting services.
4) After the construction works, each rural community collects the water fees, deducts the O&M costs, and transfers surplus cash to the PIU special account.
5) Rural communities which do not cover O&M costs by the water fees, receive subsidy from the state government for carrying out related works.
6) The surplus cash transferred from rural communities will be the fund source for the loan repayment. PIU repays the project funds through the account of the Ministry of Finance and Economy.
7) The debt is repaid to the Lender. If the surplus cash is not enough as annual repayment amount, the state government provides subsidy in order for the Borrower to repay its due.

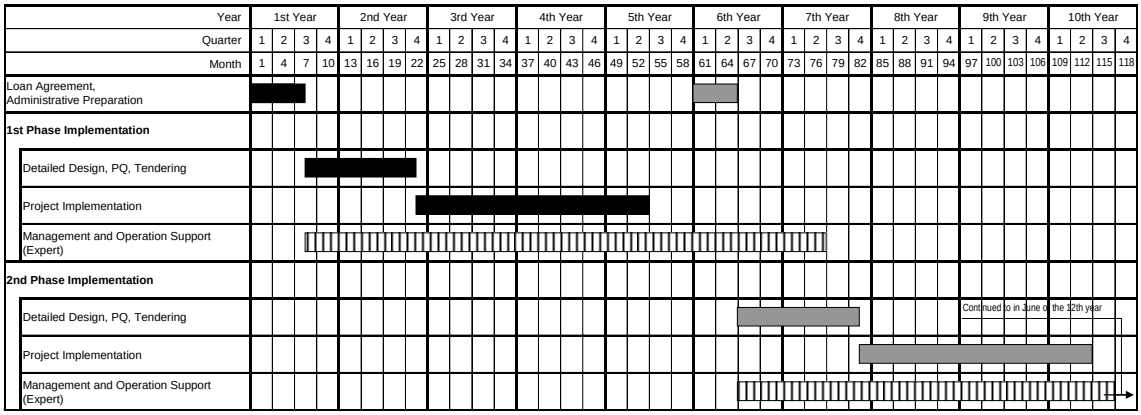


Capital Flow Related to the Project

Source: JICA Study Team, 2008

11.3 Implementation Schedule

The total estimated project duration is 114 months after the Loan Agreement for the 1st Phase. Both Phases will take 54 months respectively with an assumed interval of six months.



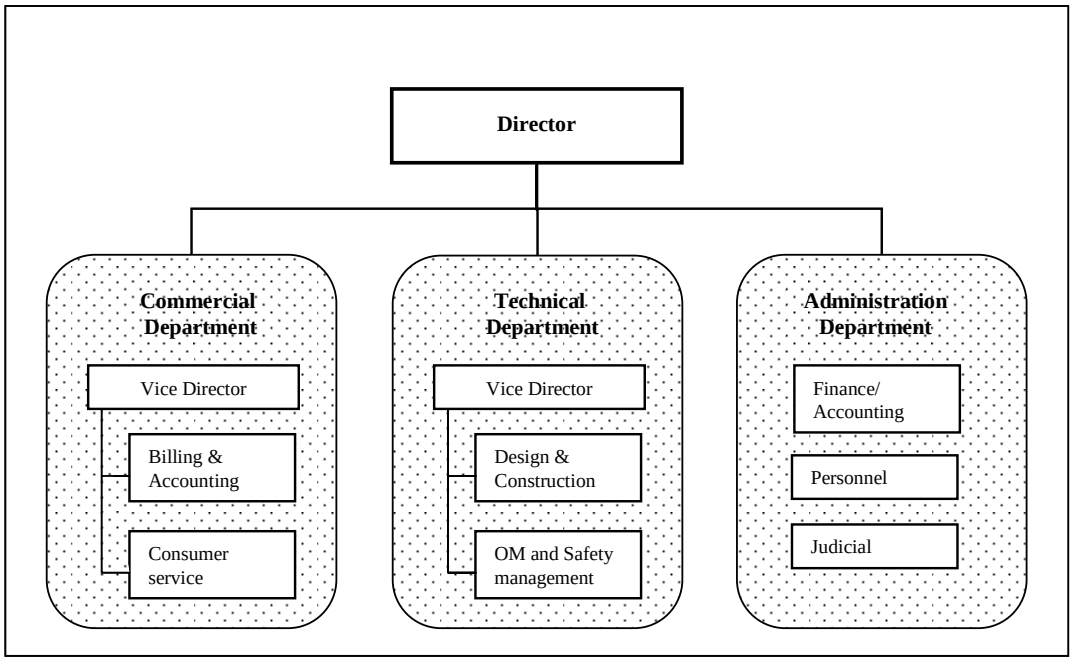
Project Implementation Schedule

Source: JICA Study Team, 2008

11.4 Project Implementation Organization

The organization acting as executing agency such as the employer for the project shall be defined as the PIU, which shall be established prior to the implementation of the project. PIU has two functions. One is to coordinate the project implementation and the other one is to supervise the O&M activities of each rural community. Its major tasks are listed as follows:

- Communicating with fund donor, including periodic reporting
- Coordination and negotiations with relevant organizations
- Monitor the Consultants' and Contractors' activities
- Financial control such as the payment requests from the Consultants and Contractors, and the disbursement requests to fund donor
- Management of the surplus from each rural community and facilitate its transfer to the Ministry of Finance and Economy
- Request subsidy from the Ministry of Finance and Economy in behalf of the rural communities which do not collect enough O&M costs and distribution to those rural communities
- Provide instruction to rural communities which have low water fee collection ratio
- Technical support to rural communities which require large repair works.



Source: JICA Study Team, 2008

Suggested PIU Organization

12. ENVIRONMENTAL EXAMINATION OF THE PROPOSED PROJECTS

12.1.1 Results of Initial Environmental Examination (IEE) Level Study

The project is classified as a small-scale rehabilitation project since water pipe diameter involved is less than 300 mm. From June to September 2007, a field survey was conducted by the designated subcontractor for the study. The JICA study team conducted an Initial Environmental Examination (IEE) level environmental and social considerations study in October 2007 for the proposed and pilot projects, in cooperation with SCWS and MONP. The results of the IEE-level study of five (5) social environmental items (cultural property, water rights and rights of common, public health conditions, waste, hazard (risk)) are categorized B as shown below.

(1) Cultural property

About 90% of the rural communities possess cultural properties. However, existing water pipes in the rural communities are located more than 5 meters from the cultural properties. Therefore, the rehabilitation works will not have any impact on the above mentioned cultural properties.

(2) Water rights and rights of common

Article 21 of Chapter 4 of the Water Code for the Republic of Armenia requires all water users to obtain permits (except for use that is determined negligible). Currently water use permits are

issued by the Water Resources Managing Agency (WRMA) under the MONP. The permits are inheritable and non-transferable to another party. Based on the Water Code, the National Water Program (NWP) was implemented on 27 November 2006. The permits obtained prior to said date were valid for a maximum of three years. Subsequently, the permits should be updated with the water basin management plan in accordance with NWP. These updated permits will be valid for a maximum of 25 years. Through a new permit application, its holder can then modify the terms of an existing permit.

(3) Public health conditions

In total, 22 communities have probable issues on public health conditions due to old asbestos cement pipes.

List of Communities where Old Asbestos Cement Pipes have been Installed

Marz	Community		
ARAGATSOTN			
	No.1 Akung	No.37 Katnaghbyur	No.43 Meliqgyugh
	No.10 Arayi	No.38 Karmrashen	No.50 Shgharshik
	No.16 Geghadir	No.39 Kaqavadzor	No.53 Jamshlu
	No.29 Irind	No.40 Hartavan	
SHIRAK			
	No.24 Musaelyan	No.27 Pemzashen	No.33 Sizavet
GEGHARKUNIK			
	No.7 Artsvanist	No.18 Tazagyugh	No.34 Mets Masrik
	No.10 Gegharkunik	No.20 Lusakunq	No.37 Shatvan
	No.14 Drakhtik	No.22 Tsaghkashen	

Source: JICA Study Team, 2007

(4) Wastes

No surplus soil will be produced since pipe diameter required is less than 300 mm. Old asbestos cement pipes will be left buried under the ground after new pipes.

(5) Hazard (Risks)

There are high level risks and/or hazard potential of landslide in some parts of the following rural communities.

The Summary of Hazards (Risks) Potential Communities

Marz	Community Landslide Risk Management Priority Code		Total
	A	B	
Aragatsotn	-	-	0
Shirak	-	-	0
Gegharkunik	-	No.3Aygut, No.13Dprabak, No.31Dzoravanq	3
Tavush	No.4Gosh, No.11Hovq,	No.2Gandzaqar, No.3Getahovit, No.5Yenoqavan, No.10Khachardzan, No.12Navur	7
Total	2	8	10

Source: JICA Landslide Study, 2006

The evaluation was referred to the landslide inventory of the JICA Study on Landslide Disaster Management in the Republic of Armenia, done in 2006. Evaluation categories of hazard/risk level and management priority are shown in table below.

Evaluation of Issues on Hazards (Risks)

Hazard Level Code	
I	Damages are progressing
II	Damages were reported or recognized in the past and effective countermeasures have not been performed
III	Landslide configuration are recognized, but damage has not been reported or recognized
Risk Level Code (Risk Object & Environmental/Economic Impact Level)	
H	Many houses, public facilities, or important infrastructures are at risk. Landslides could cause serious environmental impacts
M	Some houses, public facilities, or infrastructure are at risk. Landslides could cause serious environmental impacts
L	Landslides would have little impact on human activities

Risk Management Priority Code

Hazard Level	I	II	III
Risk Level H	A	B	C
Risk Level M	B	C	C
Risk Level L	C	C	D

Source: JICA 2006: Study on Landslide Disaster Management in the Republic of Armenia.

It is recommended that drains should be constructed in the communities as being at risk in the preceding table to reduce the hazard of landslide.

12.2 Possible Negative Impacts due to Rehabilitation Work

(1) Water pollution

Water source are protected at present from pollution. There is a possibility that construction materials and wastes generated during the rehabilitation works of intakes may cause negative impacts to the water sources.

(2) Soil erosion

No particular soil erosion is expected since no surplus water will be produced during the rehabilitation work.

(3) Noise and vibration

During construction work concerning the pipe trenches, major construction equipment required includes hand tools, such as pickax, hoe and shovel. The expected level of noise and vibration is not hazardous to the general health of the people since it is supposed that the level of noise is just similar to that induced while cultivation during farming.

12.3 Environmental Impact Expertise (EIE) Study by MONP

In accordance with the procedures stated in the law on EIE, SCWS will submit all plans subject to assessment of MONP based on the results of the IEE-level study, incorporating reports prepared in the study process. MONP shall scrutinize the plan and notify SCWS of the examination results.

This process will commence after completion of the Study reports.

12.4 Mitigation of the Social Environmental Impact

For, cultural properties, it will be able to avoid any impact to the cultural property by providing a work road during the construction period in order to be away from it.

For water rights and rights of common, it is critically important that 85 rural communities shall obtain water use permits as soon as possible. Since there are no competitive water problems in the study area, the communities will easily obtain Water Use Permits (WUP) once they apply to WRMA.

For public health conditions, the replacement of old asbestos cement pipes should be conducted as much as possible without cutting. Old asbestos cement pipes should be left buried under the ground after new pipes are installed to replace its function. If cutting of old asbestos cement pipe is necessary, workers should use masks as protection against fine particles and spray water on the construction site in order to keep it wet during construction.

For waste, old asbestos cement pipes should be left buried under the ground after new pipes are installed.

For hazard (risks), it is recommended that drains be constructed in the rural communities which have landslide potential.

For consideration for construction work, if wastes from construction materials are generated at water intakes, these must be removed and transported to a suitable place without causing water pollution during construction.

13. PROJECT EVALUATION

13.1 Preconditions for Project Evaluation

- Disbursement schedule of each phase is programmed based on the implementation plan. The implementation period of each phase is seven years, including the technical advisory services after completion of construction works. Loan interest payments are from 8th to 10th years.

Disbursement Schedule of the Projects

Unit: million AMD

Year	Phase 1				Phase 2			
	Eligible	Non-eligible	Total	1,000 USD	Eligible	Non-eligible	Total	1,000 USD
1st	211	74	285	926	211	74	285	926
2nd	165	57	222	727	165	57	222	727
3rd	6,212	2,171	8,383	27,432	6,339	2,216	8,555	27,998
4th	6,642	2,414	9,056	29,640	6,192	2,255	8,447	27,653
5th	2,989	1,202	4,191	13,715	1,804	773	2,577	8,426
6th	34	173	207	675	34	159	193	626
7th	26	170	196	642	26	156	182	593
8th~10th	0	486	486	1,596	0	441	441	1,449
Total	16,279	6,747	23,026	75,353	14,771	6,131	20,902	68,398

Source: JICA Study Team, 2008

- The local organization in charge of O&M works shall conduct the operation and maintenance works after completion of construction works. The annual O&M costs and the annual water tariff revenues to be generated are analyzed vis-à-vis the capacity to repay the initial investment. In addition, it is also analyzed how much the Project Management Unit (PMU) will be able to repay the loans from the funds generated from the water fee revenues.
- The annual operation and maintenance costs consist of: 1) O&M staff salaries, 2) chlorine, 3) electricity for pumps, and 4) pipe and pump repair costs. The O&M organization for each rural community is designed with the same structure as the pilot project. The monthly labor cost is calculated assuming the employment of technical inspector/s (one technical inspector assigned for every 500 households) and one pump operator managing all the facilities. The cost of electricity is AMD 25/m^3 based on the result of the pilot project. Also, the PMU headquarter operation cost is estimated after the completion of the project.

Unit Prices of Operation and Maintenance Costs

No.	Item	Price	Unit	Basis
1	Staff salary a) Technical inspector b) Pump operator	 20,000 20,000	 AMD/month AMD/month	Salary is paid to full time staff following the pilot project's case. Same as unit rate of pilot project
2	Chlorine	600	AMD/kg	Market price plus transportation to site Chlorine dosing volume is 5 g/m^3.

No.	Item	Price	Unit	Basis
3	Electricity for pump	25	AMD/m^3	Pilot project result
4	Repair cost a) Pump b) Pipe	 300,000 35,000	 AMD/year AMD/km	 Assumed USD 1,000 /year Estimated from socio-economic survey results
5	PMU head quarter operation cost	50,000,000	AMD/year	Estimated from the existing water supply companies' financial statements

Source: JICA Study Team, 2008

13.2 Financial Evaluation

(1) Cost recovery analysis

The cost recovery analysis is undertaken to determine whether the proposed water tariff can cover: 1) O&M cost, 2) the construction cost and O&M cost, and 3) full cost recovery including loan interest expenses. First, it was estimated whether the annual revenue can cover the O&M cost. In case when extra revenue is generated, the amounts were summed up to calculate how much of the investment cost can be repaid.

(2) Proposal of water tariff setting

Three water tariff schemes are set and financial viability is assessed for each scheme.

Proposed Water Tariffs

Case	Tariff Rate	Reason
1	AMD 40/m^3	Affordable monthly water tariff (AMD500/m) according to the willingness to pay survey result
2	AMD 70/m^3	3% of average household income (approx. AMD 30,000/m) from the socio-economic survey result (AMD 900/m)
3	AMD 115.65/m^3	Current AWSC water tariff

Source: JICA Study Team, 2008

(3) Calculation conditions

- Calculation period is 40 years, consisting of ten years grace period and 30 years loan repayment period;
- Water fee collection ratio is assumed to be 90% for each rural community;
- Water consumption is 100 L/capita/day;
- Water fee revenue is generated from the 3rd year. Annual water fee revenues from 3rd to 5th years are calculated by multiplying the assumed annual revenue based on construction progress, and the assumed annual revenue will continue after completion of the construction works until the 40th year;
- Price escalation is applied for water tariff rate and O&M costs;
- Depreciation cost is applied to construction cost and is generated from the 6th to the 40th year. Residual value is 5% of the construction cost.

(4) Cost recovery analysis results and necessity of the subsidy

Cost recovery analysis is calculated for the above 3 cases. In Phase 1, the investment cost can repay if the case 3 water tariff, AMD 115.65/m^3 is applied to, however, annual balance is deficit for 10 years. In Phase 2, the investment cost cannot repay for all cases. Taking into consideration the present water tariff rate, it is not practical to set higher price than Case 3. Thus, it is necessary to provide subsidy for the deficit from the government in case the project will be implemented to keep the same scale.

(5) Proposal of water tariff stream

Firstly, water tariff shall start from AMD 40/m^3 or a comparably low water tariff. Most households are currently not paying the water fee, but it will be required to pay after the installation of water meter. After the 7th year from the project commencement, the water tariff will be increased to AMD 70/m^3 and will be set to AMD 115.65/m^3 after the 11th year. For the rural communities which use pump, the rate will be AMD 120/m3 or the same as the pilot project case. This unit price will continue up to 11th year but price escalation will be applied after the 12th year

(6) Cost recovery analysis for each rural community

The calculation results of each community are presented in Table 13.2.3 in the main report and the cost recovery level for each rural community is summarized following table.

47 rural communities, or 32% of the total rural communities, can repay all the investment costs by the water fee collection. One hundred forty rural communities, or 94% of the target communities, can pay the annual O&M costs by water fee. It is judged that the operation of both phases can be sustained by the water fee revenues.

Project Cost Recovery Level by Water Fee Collection

Marz	Cannot cover O&M cost	Repay O&M cost	Repay up to construction cost	Repay up to loan interest	Total
PHASE 1					
Gegharkunik	1	23	0	21	45
Tavush	0	8	1	2	11
PHASE 2					
Aragatsotn	2	38	5	16	61
Shirak	6	16	2	8	32
Total	9	85	8	47	149

Source: JICA Study Team, 2008

The nine (9) rural communities cannot pay the operation and maintenance costs. Firstly, the rural population of these communities is too small so that water sales cannot cover for the estimated labor cost. Four rural communities in Shirak Marz (No.6 Bashgyugh, No.15

Karmaraqar, No.19 Mayisyan Kayaran, and No.22 Akhuryan Kayaran) are in this situation. Although four rural communities (No.8 Geghamabak in Gegharkunik Marz, No.21 Dian in Aragatsotn Marz, No.2 Aghvorik and No.10 Zorakert+Darik in Shirak Marz) can have enough water sales to pay for the labor cost, their water supply pipeline systems are relatively larger than their population scale. As a result, the estimated annual pipe repair costs exceed the estimated water sales and they cannot cover the annual O&M costs. In order to save on annual O&M costs of these eight rural communities, it is recommended that labor works for water meter reading, bill collection, and technical inspection works shall be done by unpaid volunteers. No.28 Tlik in Aragatsotn Marz plans to get their water from Chlkan regional water supply system. In addition, it uses pump facilities for extracting water from the river. From the financial and water quality perspectives, it is not sustainable to use pump permanently. Thus, it is perceived that the water supply from the pipeline system is necessary.

Rural Communities that cannot Cover the Annual O&M Costs

Unit: million AMD

No.	Rural community	Revenue (A)	Expenditure (B)				Cost recovery rate (A/B)
		Water fee	Labor cost	Pipe Repair	Others	Total	
	PHASE 1						
	Gegharkunik Marz						
1	No.8 Geghamabak	40.55	17.70	21.87	1.93	41.50	98%
	PHASE 2						
	Aragatsotn Marz						
2	No.21 Dian	36.89	17.70	17.53	1.76	36.99	100%
3	No.28 Tlik	38.58	35.40	19.75	62.35	117.50	33%
	Shirak						
4	No.2 Aghvorik	27.09	17.70	16.73	1.30	35.73	76%
5	No.6 Bashgyugh	17.78	17.70	12.59	0.89	31.18	57%
6	No.10 Zorakert+Darik	40.30	17.70	28.39	1.92	48.01	84%
7	No.15 Karmaraqar	15.32	17.70	1.47	0.74	19.91	77%
8	No.19 Mayisyan Kayaran	13.69	17.70	0.72	0.66	19.08	72%
9	No.22 Akhuryan Kayaran	4.70	17.70	3.70	0.27	21.67	22%

Source: JICA Study Team, 2008

(7) Cost recovery level for Phase1 and 2

The cost recovery analysis for Phases 1 and 2 is based on the results of each rural community cost recovery analysis.

- Taxes and duties are paid after the net income is surplus;
- PMU headquarter operation cost is disbursed from the total revenue;
- Subsidy is provided for the rural communities which have annual O&M costs deficit;
- Surplus transferred from each rural community are kept in a special account and is the source of funds for debt repayment. If surplus amount is not sufficient for the repayment amount of each year, subsidy is provided.

Followings can read from the cash flow statements.

1) Phase 1

- Subsidy is required for the O&M costs from 3rd to 10th year and 16th and 31st years (the pump replacement years);
- The total amount of subsidy used for the O&M costs is AMD 207.6 million. When the water tariff rate is AMD 40/m^3 from 3rd to 6th year, the subsidy amount is AMD 12.2 million and the annual average subsidy is approximately AMD 3.0 million. When it increases to AMD 70/m^3 from 7th to 10th year, the total subsidy amount is AMD 800,000 and the annual average subsidy is approximately AMD 200,000. The subsidies on the 16th and 31st year are AMD 74.1 and AMD 120.6 million, respectively;
- The total subsidy is about 2% (=AMD 207.6 million/ AMD 9878.5 million) of the total O&M costs;
- It is estimated that the water tariff revenues (AMD 17,145.7 million) can meet 85% of the total investment cost (AMD 20,098.6 million);
- Subsidy is required to repay the investment costs from 1st to 6th year (the project construction period) and from the start of investment costs repayment on the 11th year up, to 32nd year;
- The amount of subsidy used for the investment cost is AMD 3,689.3 million. The total subsidy from 1st to 6th year is AMD 230.5 million. The subsidies for the first two years are around AMD 2~3 million. It increases to AMD 28.6 million on the 3rd year and reaches AMD 100.1 million on the 6th year. The amount of subsidy between 11th and 32nd year is AMD 3,458.8 million. The largest is AMD 281.2 million on the 11th year. The subsidy decreases by about AMD 10 million per annum except on the pump replacement years.
- Surplus cash is generated during 7th and 10th year and after 33rd year;
- The total surplus amount is AMD 736.3 million. The surplus amount from 7th to 10th year is AMD 92.2 million. It is AMD 15.8 million on the 7th year and increases by about AMD 5.0 million per annum for three years. The surplus amount for eight years after the 33rd year is AMD 644.2 million. It is AMD 14.1 million on the 33rd year and increases by around AMD 20.0 million every year.

2) Phase 2

- Subsidy is required for the O&M costs for the whole period from the start of water fee collection on the 3rd year up to 40th year;
- The total amount of subsidy used for the O&M costs is AMD 202.2 million. The annual average subsidy is AMD 3.7 million. The subsidies on the pump replacement years on the 16th and 31st year are AMD 26.3 and 42.7 million, respectively.

- Subsidy occupies about 2% (= AMD 202.2 million / AMD 9,872.6 million) of the total O&M costs;
- It is estimated that the water tariff revenues (AMD 10,542.4 million) can meet 58% of the total investment cost (AMD 18,251.9 million);
- T Subsidy is required for the investment cost repayment for the whole period (40 years);
- The total amount of subsidy used for the investment cost is AMD 7709.6 million. The subsidies for the first two years are around AMD 2.0~3.0 million. It increases to AMD 44.5 million on the 3rd year and reaches AMD 128.3 million on the 6th year. When the water tariff rate is AMD 70/m^3, from 7th to 10th year, the subsidy is around AMD 50.0 million. It is the largest, AMD 363.9 million, on 11th year. The subsidy decreases about AMD 10 million per annum except the pump replacement years. The subsidy on 40th year is AMD 87.6 million.
- Surplus cash is not generated for 40 years.

(8) Financial Internal Rate of Return (FIRR)

1) Calculation of Weighted Average Cost of Capital (WACC)

The WACC is used as the discount rate in computing the present value of the financial costs and is an indicator to measure the viability of the Financial Internal Rate of Return (FIRR). The WACC in real term is 1.75%.

2) Calculation of FIRR

The FIRR of both phases are positive, 0.93% for Phase 1 and 0.48% for Phase 2. It is judged that the project may have financial viability based on the results of the calculation. However, the profitability is much lower compared to other general investment projects.

FIRR of each Phase

Phase 1	FIRR	Phase 2	FIRR
Whole project	0.93%	Whole project	0.48%
Gegharkunik	1.06%	Aragatsotn	0.28%
Tavush	0.22%	Shirak	0.98%

Source: JICA Study Team, 2008

3) Sensitivity Analysis

The sensitivity Analysis is conducted to check which parameter contributes to the project's sustainability. The following six cases, which consider capital investment increases, operation and maintenance cost increases, and water tariff revenue decreases with 10% and 20% of value changes, are analyzed:

- Capital investment cost increases by 10% and 20%.
- O&M cost increases by 10% and 20%.
- Water fee revenue decreases by 10% and 20%.

Among the three cases, the one which involves revenue reduction has the most serious impact to the FIRR values. In other words, a high ratio of water fee collection is required to keep the project's financial soundness.

13.3 Economic Evaluation

(1) Project Economic Benefit and Cost

There are several economic benefits to be received from the project. These are: 1) time savings for water collection and transportation; 2) reduction of drinking water purchasing costs; 3) reduction of medical expenses with provision of hygienic water; and 4) institutional strengthening of the water supply management. Economic benefits are quantified and estimated for Items 1, 2 and 3.

(2) Economic Internal Rate of Return (EIRR)

The EIRR of both phases are 15.71% in Phase 1 and 11.60% in Phase 2. Phase 1 exceeds the 12% discount rate while Phase 2 is nearly equal to 12%.

(3) Sensitivity Analysis

Phase 1 has more than 12% EIRR value except for case of 20% decrease of water fee collection rate. However, its value is almost equal to 12% under this calculation result.

13.4 Evaluation on the Organization Proposed by the Project

SCWS does not operate particular water supply company under their task. Another concrete organization, which operates the project, shall be required for the Project 1 and 2 implementation. Thus, establishment of the Project Implementation Unit (PIU) is appropriate in order to conduct the O&M works of the project. PIU will be the newly established organization, so that the management capacity of the PIU shall be developed during the project implementation stage.

The actual O&M works shall be the responsibility of the local organizations in charge of the O&M under rural community. The project will implement the management and operation support for two years after completion of the construction works. Each rural community will strengthen its management and operation capacity especially water fee collection and financial management under the support by PIU.

13.5 Conclusions

- It is confirmed that subsidy from the state government is necessary because the annual balances have deficit even if the project applies the highest water tariff rate (AMD 115.65/m^3).
- In case that O&M is carried out starting from AMD 40/m^3 up to AMD 115.6/m^3 on the 11th year, it is estimated that 140 rural communities can pay the annual O&M costs under the condition that the rural community takes charge of the O&M works. The subsidies required for the O&M costs are AMD 207.6 million in Phase 1 and AMD 202.2 million in Phase 2.
- It is estimated that the investment cost recovery ratio for 40 years is 85% in Phase 1 and 58% in Phase 2 applying to the above water tariff rate schedule. The subsidies required for the investment costs are AMD 3,689.3 million in Phase 1 and AMD 7,709.6 million in Phase 2.
- The surplus cash generated is AMD 736.3 million in Phase 1 but none in Phase 2.
- The financial benefits of Phase 1 and 2 are 0.93% and 0.48%, respectively, and their figures are positive.
- The economic benefits of Phase 1 and 2 are 15.71% and 11.60%, respectively, and their figures are almost equal to the EIRR (12%) which is normally applied to development projects.
- It is necessary to keep a high water fee collection ratio to ensure the project's viability, since water fee collection ratio is the most sensitive factor for the project's IRR values.
- The management and operation capacity of the PIU and each rural community shall be developed during the project implementation period.

14. PILOT PROJECT

14.1 Objectives and Verification Items of the Pilot Project

(1) Objectives

The objective of the pilot project is the verification of the operation and maintenance (O&M) organization (Option 1) and the effectiveness of the rehabilitation work of the rural water supply systems.

1) Verification items for technical aspects

- Contribution to the water supply volume/hour improvement
- Freeze protection methods
- Improvement of common practice of water usage by installation of water meters

2) Verification items for O&M

- Establishment of O&M organization and assignment of staffs
- Annual budget and cost for the O&M works
- Water tariff setting and fee collection
- Chlorination

(2) Selection of Pilot Projects Site and Verification Model

The basic criteria for selection of the pilot project communities were as follows

1) Scale which can be done in two months:

The maximum length should be 1km, maximum diameter should be 150mm, and approximately 100 households house connections.

2) Accessibility and location of the pilot projects:

Good accessibility for monitoring by the SCWS after completion of the construction is a priority criterion for selection. Neighboring communities are also same requirement of water supply system rehabilitation, considering know-how distribution of operation and maintenance of rural water supply projects model, as priority criteria.

3) An adequate quantity of water and "Water Use Permit"

Adequate water supply volume to the water demand at the reservoir, and possession of "water use permit" from the Water Resources Management Agency of the Ministry of Nature Protection, should be the requirement criteria.

(3) Verification Model of O&M for the Pilot Project

The pilot project has two sets of models to verify the operation and maintenance of the water supply system by metered water fee.

1) Model 1: The community authority applies metered rate transferring from flat rate
2) Model 2: The community authority applies metered rate transferring from free water use

(4) Outline of Project Sites

Major features of the rural communities of the pilot project are presented in table below.

Major Features of the Pilot Project Sites

Model	Model 1	Model 2
Marz	Gegharkunik	Aragatsotn
Community	No.19 Lchavan	No.12 Apnagyugh
1. Population	700	785
2. Number of households	104	140
3. Water demand (m^3/d)	96.4	100.3
4. Water supply rate (m^3/d)	129.6	518.4

Model	Model 1	Model 2
5. Existing water supply system	Pump Up	Gravity
1) Transmission pipe (m)	800	3,500
2) Distribution pipe (m)	4,000	3,150
6. Water fee	Flat rate	Free
7.O&M organization	No	No

Source: JICA Study Team, 2008

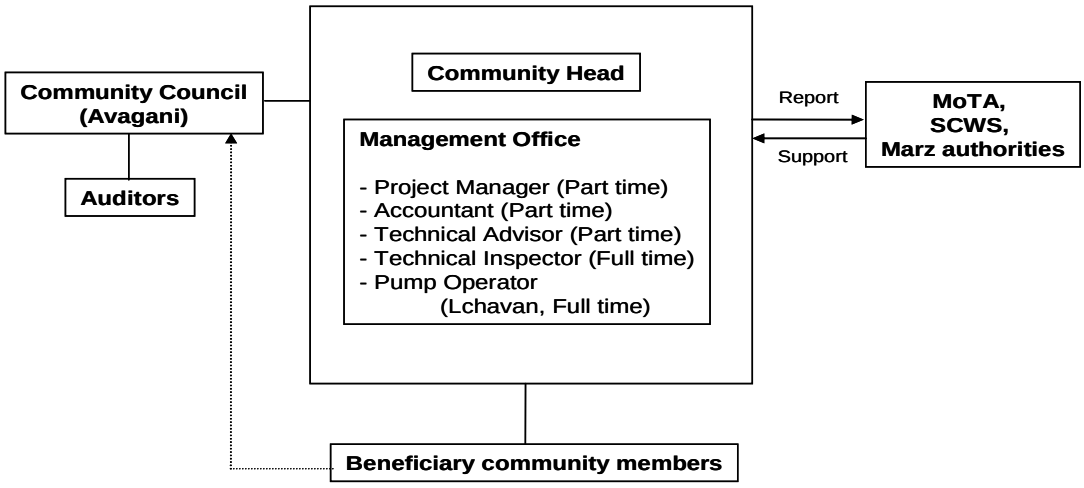
14.2 Activities of the Pilot Project

(1) Public Hearings

In order to identify the opinion of the local residents on the appropriateness of implementing the pilot project, public hearings were held in Apnagyugh and Lchavan rural communities. Questions and opinions were gathered from the participants of the public hearings.

(2) O&M Organization Setup

The O&M management offices in Lchavan and Apnagyugh were established in June 2008 under rural community administration with support of the Community Field Officer (CFO). The CFOs for the two pilot communities were appointed by JICA Study Team in May 2008 to support the establishment of local O&M organization and O&M planning. The organizational chart of the O&M organization on water supply systems is shown in following figure.



O&M Organization of the Pilot Project

Source: JICA Study Team, 2008

The O&M members of both communities were selected from the community staff and local residents based on joint discussions among the rural community and Avagani members, with the assistance of the CFOs. as shown in table below.

List of O&M Staff in Both Rural Communities

Lchavan		
Position of O&M Organization	Position in Community	Remarks
Project manager	Community head	Part-time without salary
Accountant	Community Accountant	
Technical Advisor	One from Community	
Technical Inspector	One from Community	Full-time with salary
Pump Operators	Two from Community	

Apnagyugh		
Position of O&M Organization	Position in Community	Remarks
Project manager	Community head	Part-time without salary
Accountant	Community Accountant	
Technical Advisor	One from Community	
Technical Inspector	One from Community	Full-time with salary

Source: JICA Study Team, October 2008

(3) Implementation of the Construction work

The construction works were conducted from July to September 2008. And the constructed facilities were handed over to the communities.

The facilities constructed and materials of the pilot project are summarized in table below.

Outline of Pilot Project Works

Community		Marz	Scope of Pilot Project	Work volume
19	Lchavan	Gegharkunik	1. Rehabilitation of distribution pipelines where house connection is not carried out.	
			1.1 Pipe diameter D=50mm with isolating material	600m
			1.2 Pipe diameter D=32mm with isolating material	850m
			2. Connection of service pipe to distribution pipelines for house connections	51 +32* units
			3. Construction of water meter chamber	100 unit
			4. Construction of chlorine equipment	1 unit
			5. Procurement works	
			5.1 PE pipe DN20mm for house connections	4,000m
			5.2 Isolating material for PE pipe	4,000m
			5.3 Chlorine agent	60kg
12	Apnagyugh	Aragatsotn	1. Rehabilitation of the distribution pipelines where house connection is not carried out	
			1.1 Pipe diameter D=50mm with isolating material	180m
			1.2 Pipe diameter D=32mm with isolating material	150m
			1.3 Pipe diameter D=25mm with isolating material	40m
			2. Connection of service pipe to distribution pipelines for house connections	62+37* units
			3. Construction of water meter chamber	136 units
			4. Construction of chlorine equipment	1 unit
			5. Procurement works	
			5.1 PE pipe DN20mm for house connections	3,000m
			5.2 Isolating material for PE pipe	3,000m
			5.3 Chlorine agent	60kg

*: The item 2 at Lchavan and Apnagyugh were executed in volumes more than the planned quantity due to the resident's request, by contractor's goodwill.

Source: JICA Study Team, 2008

(4) O&M training and Capacity Building

Trainings were provided to the administrative staff of the O&M organization by CFOs in August and September 2008. The training portfolio include the methods of water fees introduction, development of water use regulations, collection of water fees, banking and financing functions, proper operation of the water supply system, etc.

14.3 Monitoring of the Pilot Project

(1) Methodology of the Monitoring

A project monitoring survey was conducted in early November 2008 by interviewing the community head, O&M organization and 20 beneficiaries each from Lchavan and Apnagyugh. (Each community was subdivided into 20 blocks and one household was selected from each block.)

(2) Technical Aspects

1) Contribution to the water supply volume/hour improvement

Most beneficiaries in Lchavan responded that the water supply amount and supply time are increased significantly. Most beneficiaries in Apnagyugh responded that the water supplies amount and supply time have improved than before.

2) Freeze Protection Methods

Freeze protection methods were instructed to beneficiaries in both communities by yht community head and technical inspectors. It was decided that both communities will keep taps left slightly open in winter time to protect freezing of water taps during the winter season. They also instructed beneficiaries to cover the water meter chamber with appropriate materials such as dung and used clothing to protect freezing of pipes and water meters. However, protection of outside taps was not considered well in Apnagyugh, and not well done in Lchavan.

3) Improvement of Common Practice of Water Usage by Water Meters Installation

All the beneficiaries stop leaving their taps open when not in use.

(3) Operation and Maintenance (O&M)

1) Establishment of O&M organization and assignment of staff

Upon start of the pilot project, the O&M organization has been organized and activated. All staff has been working for operation and maintenance of water supply system since September 2008 in Lchavan.

In Apnagyugh, there are only three members of the O&M organization because the system is simple gravity-type water supply system. The main tasks of the technical inspector are repairing pipeline leakages, reading water meters and collecting water fees.

2) Annual budget for the O&M works

Budget and actual figures of Lchavan are shown in table below.

Budget and Actual Figures of Lchavan

Units: AMD

Items	Planned amount	Actual amount of initial month	+ / -	Remarks
Collected water fee	70,000	50,000	-20,000	Collected amount was as of September 2008, collection ratio was 96%
Monthly expenses	101,000	40,000	-61,000	Total of the following 3 items
Operation expenses	50,000	40,000	-10,000	All amount was spent for electricity
Maintenance expenses	15,000	0	-15,000	No amount was spent for maintenance
Salary	36,000	0	-36,000	Technical Inspector and Pump operator did not receive their salary in September
Balance	-31,000	10,000	41,000	It will be used for repairing the burst pipe in November

Source: JICA Study Team 2008

The actual money collected on the first month of operation was less than the planned amount and was used entirely to pay for pump electricity consumption. Therefore, no salary was paid to O&M staff. The money collected was deposited to the community account separately from the general community account.

Budget and actual figures of Apnagyugh are shown in table below.

Budget and Actual Figures of Apnagyugh

Units: AMD

Items	Planned amount	Actual amount of initial month	+ / -	Remarks
Collected water fee	50,000	28,000	-22,000	Collected amount was as of October 2008, collection ratio was 72%
Monthly expenses	70,000	5,000	-65,000	
Operation expenses	20,000	0	-20,000	Noting was spent
Maintenance expenses	20,000	5,000	-15,000	To buy some materials for repairing pipes
Salary	30,000	0	-30,000	Technical Inspector did not receive his salary in October
Balance	-20,000	23,000	43,000	Deposit was remained, which was entirely used in November deposit for replacement of one pipeline

Source: JICA Study Team, 2008

The amount of collected money was only AMD 28,000. The technical inspectors did not receive salary. The money collected was deposited to O&M account, and was entirely

used for the replacement in part of distribution pipeline in early November.

3) Water tariff and fee collection

The results of water tariff and fee collection are summarized in table below.

Summary of Water Tariff and Fee Collection

Item	Lchavan	Apnagyugh
Water tariff per m^3 (AMD)	120	20
No. of household/beneficiary	100	136
No. of household invoiced (water system usage in October 2008)	79	120
No. of household paid	76	87
Water fee collection ratio (%)	96	72
Total amount of collected fee (AMD) per month	50,000	28,000
Average amount of water used per household per month (m^3)	6.1	12.3
Average amount of water fee per household per month (AMD)	732	246
Average amount of water used per person per day (L)	38	67

Source: JICA Study Team 2008

a) Lchavan

Out of 100 households in Lchavan 79 households which had use the water service by October 20 were invoiced. The water fee was invoiced and collected by the technical inspector. Seventy-six households paid their bills or a collection ratio of 96%. The average amount of monthly water fee per household is about AMD 730. The O&M organization collected water fees amounting AMD 50,000 in September. The accountant treated the collected money as separate income of O&M and separated it from the general community account. The cost of electricity for the pump in September was paid by the accountant using the collected money after approval of the project manager (community head) of O&M organization. The average water consumption per day per person is 38.0 L while the average water consumption per month per household is 6.1 m^3.

b) Apnagyugh

Some beneficiaries did not agree because they had not closed the taps yet after the installation of water meter. Therefore, the technical inspector carried out the first reading on October 21, 2008 and the second reading was done on November 1, 2008. Finally, the amount of AMD 28,000 was collected as the three-fold amount of the 10-day fee as monthly payment in October.

Out of 136 households 120 households which used water service during the term were invoiced. Eighty-seven households paid during the two-week period and collection ratio was 72%. The average water consumption per day per person was 67.0 L while the average water consumption per month per household was 12.3 m^3.

(4) Chlorination

The following amounts of chlorine were finally decided to be suitable amounts for each water supply facility by several trials and analysis.

Both communities are putting the following amount of chlorine shown in table below for residual chlorine ranging between 0.1 and 0.4 ppm at water taps after the tests.

Amounts of Chlorination

Community	Amount of Chlorine (60% Calcium-hypochloride)	Remarks
Lchavan	90 to 100g / every other day	Equal to 18 to 20 tablets
Apnagyugh	110g / every other day	Equal to 22 tablets

Source: JICA Study Team, 2008

14.4 Evaluation and Analysis of the Pilot Project

(1) Contribution to water supply volume/hour improvement

Increase of water supply duration, pressure and quantity was observed in both communities after installation of the water meters. In Lchavan, the water supply duration was significantly increased from 2 hours/every other day to 15-24 hours/day. Even in Apnagyugh wherein the system is natural gravity flow, the water supply duration has improved from 8 hours to 24 hours per day. Therefore, it is evaluated that the installation of water meters and water taps at each household contributed to the increase of water supply duration and amount.

(2) Freeze protection methods

The actual effect of the methods used will be evaluated by SCWS in the future.

(3) Improvement of common practice of water usage by water meters installation

After installation of the water meters, almost all beneficiaries in both communities stopped leaving the taps open when not in use. It is evaluated that the water meter installation contributed to the change of residents' behavior in terms of water utilization.

(4) Establishment of O&M organization and assignment of staff

The O&M organizations have been established in both communities and have been effectively working in terms of meter reading and water fee collection. However, the record keeping arrangement of various O&M data is insufficient in Apnagyugh. They do not entirely appreciate and understood the importance of data recording and keeping for O&M organization.

(5) Annual budget for the O&M works and the entire project cost

Both communities planned their budget for O&M with the assistance of the Community Field Officers (CFOs) and the JICA Study Team with regards to the initial water fee collection.

However, the collected amount was less than planned. Therefore, the salaries for the technical inspector and pump operators were not paid in Lchavan. It is necessary to review and evaluate the planned budget and water tariff rate after three months, six months and one year. The Lchavan O&M organization has proposal of posting the balance of water fee collection and expenditures on the bulletin board of the community administration office.

(6) Water tariff and fee collection

The water tariff rate for each community was was decided by the respective community councils. In both communities, the first water fee collection was carried out in the beginning of November. Collection ratio in Lchavan and Apnagyugh was 84% and 66% respectively. The reason of unpaid water fee is shortage of money on the collection day. The collection ratio in Lchavan and Apnagyugh were increased up to 96% and 76%, respectively in mid November. It is evaluated that the beneficiaries of both communities recognized the obligation of payment through the explanation and guidance of their respective CFO and O&M organization.

(7) Chlorination

Both communities decided appropriate dosing quantity of chlorination supported by the JICA Study Team and CFO. The cost for chlorination is included in the O&M budget, and chlorine is available at neighboring cities.

(8) Comparison and Analysis between both Communities

1) Understanding of community members and leadership of community head

During the construction period, the community head in Lchavan provided close communication to each household. He participated in site confirmation works to the extent possible to explain to the concerned beneficiaries. In Apnagyugh, the work mainly depended on the technical inspectors and the community head who have little knowledge on the details of water fee collection. The reason might be due to the fact that there are no serious water supply issues in Apnagyugh compared to Lchavan.

2) Water fee collection rate

The water fee collection ratio in Lchavan reached up to about 96%. In the case of Apnagyugh, water fee collection ratio was only about 72%. The differences are based on the improvement of water supply conditions after installation of taps and water meters. The installation of household taps and water meters has been very convenient in both communities. The water supply duration in Lchavan has dramatically changed after the installation of taps and water meters.

3) Water consumption

The water consumption rate of Lchavan (38 L/c/d) is about 56% of Apnagyugh (67 L/c/d). It is presumed that the beneficiaries of Lchavan have less water consumption due to the fact that they are used to having insufficient water supply and hence, they are more economical in water use practice. In addition, the higher water tariff in Lchavan (AMD 120/m3) also contributed on the water consumption rate. The residents in Apnagyugh have not encountered any serious water shortage so that water consumption rate of Apnagyugh is reasonable for them.

14.5 Recommendations for O&M Organizations of the Proposed Rural Water Supply Project

It is recommended that the following programs be applied to the proposed rural water supply project to be managed by the local organization.

(1) Agreement for project preparation from community members

Most of the existing rural water supply systems are gravity flow systems without pump operation cost. The case of Apnagyugh (Model 2) should be considered for the implementation of O&M in these communities.

Public hearings and approvals of community councils were carried out at both communities within the pilot project. However, some residents in Apnagyugh did not understand the pilot project, since they were not bearing the operation cost and were satisfied with the existing condition. Some beneficiaries were against water fee collection after the project implementation. In the case of Lchavan (Model 1), residents understood and cooperated with the project, because they were facing shortage of water supply at that time.

Therefore, more certain methods are proposed, such as the community members submit agreement for the project and for water fee collection based on water meter record. When the submission of agreement reaches 80% of entire households, project implementation is to be started. This is the responsibility of the community head. If not reached the agreement of the 80% project should be suspended.

This is due to the fact that, the ratio of 80% is the minimum expected water fee collection ratio for operation and maintenance and repayment of loan amounts. The ratio will be increase by understanding of project effect as admitted by the pilot project. The guidance is the responsibility of PIU under the SCWS.

(2) Support for establishment of O&M organization by SCWS and marz

The management of the rural water supply is a responsibility of the community. However, there is no formal organization at present that manages the water service in any community. It is

being managed by the rural community head. To enable a long-term operation and maintenance of water supply facilities, it is proposed to establish an internal operation and maintenance organization in the community to maintain the water supply facilities and collect the water fee. And it was proven by the pilot project. The establishment of O&M organization is the responsibility of the community head and the community council.

(3) Training and capacity building of O&M organization

During the pilot of project, CFOs were appointed by the JICA Study Team to support the O&M organization activates. The CFO in Lchavan played a significant role in explaining to beneficiaries and supporting the O&M organization. He lives near Lchavan and has an experience in managing irrigation water user association (WUA).

The following requirements are recommended for selection of CFOs in future;

- He should have an experience in operation and maintenance of Water User Association (WUA) or a working experience in NGO and/or NPO for community development; and
- He should be familiar with the project site and residing near the community area.

(4) Securing Sustainable O&M

When wages of paid staff (technical inspectors and pump operators) are unpaid due to tight financial situation, the staff might not be motivated and O&M is no longer sustainable. In order to keep their motivation, the O&M organization should set a minimum monthly basic wage and percentage share that corresponds to collection ratio or total amount of collected water fee.

(5) Recommendation for Planning and management for rehabilitation works

After the installation of water taps, pouring water was decreased, water runoff on the road had also decreased, and erosion and muddy condition of gravel/earth road had improved. Furthermore, the decrease of pouring water may decrease landslide activities in landslide risk areas. These benefits may contribute to promoting the residents' participation and cooperation for the project.

In areas where the service pipes pass through agricultural fields, the works were postponed until after potato harvest season because some land owners did not allow the excavation. Planning of pipeline route should consider the land use in the area. If it is inevitable for water pipes to be installed on agricultural lands, construction work schedule for water pipes installation should take into consideration the timing of agricultural activities.

In Apnagyugh, some water chambers, near the area where there is pipe leakage, were filled with water and water cannot drain due to impervious soil condition. The leakage should be repaired first, but if it is difficult, chambers should be constructed far from the leakage portion or on the ground with banking

Chlorination facility should be installed at the intake tank of pump station for pumping systems when accessibility to distribution reservoir is difficult during snow/cold seasons such as Lchavan.

14.6 Environmental and Social Considerations of the Pilot Project

As a result of scoping of the pilot project, no impact was expected in Lchavan and Apnagyugh, except on "waste". This is due to the fact that the rehabilitation scale and work volume in the pilot projects in both communities are very small and the work items are similar. Summary of impacts due to pilot project, mitigation measures and monitoring plan are shown in the following tables.

(1) Lchavan

Mitigation and Monitoring Plan of the Pilot Project in Lchavan

Environmental Item	Waste
Rating	B
Impact	Generating waste soil from excavating the trench for pipe installation.
Conditions	• Distribution pipe diameter is less than 50mm, total length of distribution is 1,400m, • Service pipe diameter is 20mm, total length of service pipe is 4,000 m.
Mitigation measures	Excavated soil was used mainly as backfill material during construction work of trench for pipes.
Monitoring plan	Check the surface of excavated lines after construction, No surplus soil will be produced because pipe diameter is less than 50mm.

Source: JICA Study Team 2008

(2) Apnagyugh

Mitigation and Monitoring Plan of the Pilot Project in Apnagyugh

Environmental Item	Waste
Rating	B
Impact	Generating waste soil from excavating the trench for pipe installation.
Conditions	• Distribution pipe diameter is less than 50mm, total length of distribution is 370 m, • Service pipe diameter is 20mm, total length of service pipe is 3,000 m.
Mitigation measures	Excavated soil was used mainly as backfill material during construction work of trench for pipes.
Monitoring plan	Check the surface of excavated lines after construction, No surplus soil will be produced because pipe diameter is less than 50mm.

Source: JICA Study Team 2008

15. CONCLUSIONS AND RECOMMENDATIONS

15.1 Conclusions

(1) Out of 153 surveyed communities, 149 communities were selected for the proposed project -- 61 communities in Aragatsotn Marz, 32 in Shirak Marz, 45 in Gegharkunik Marz, and 11 in Tavush Marz. The estimated population to be served by the project is 190,000. The estimated daily average water demand for all communities is 19,000m^3/day.

(2) The majority of the existing rural water supply systems were constructed during the Soviet Union era. These are not properly maintained and water supply is inadequate. Pipelines are damaged in several places. In addition, water taps are not installed in most public and house connections resulting to water shortage for communities in the downstream areas. Therefore, rehabilitation works should be programmed as soon as possible .

(3) A project with the following components is proposed for immediate implementation in order to improve the present water supply conditions.

- Rehabilitation of existing systems: The old and deteriorated intakes, transmission pipes, reservoirs, and distribution pipes will be rehabilitated.
- Installation of house connections and water meters: The water supply taps and the water meters will be installed at all households to collect the water fee in the target communities. The operation and maintenance of water supply facilities and recovery of the project cost will be covered by the water fees.
- Installation of disinfection facilities: Chlorination facility will be introduced at each distribution reservoir according to the regulation of the Department of Health.

(4) The project cost estimates for Phase 1 and Phase 2 are as follows:

Component	Phase 1			Phase 2	
	AMD $x10^6$	USD $x10^6$		AMD $x10^6$	USD $x10^6$
Loan Portion	16,277	53.28		14,767	48.33
Local Portion	6,744	22.07		6,127	20.05
Total Cost	23,021	75.35		20,894	68.39

(5) Since the project communities are dispersed in four marzes and the total project cost estimates are large amounts, implementation in two phases is recommended. Phasing was done considering the urgency, efficiency, and cost balance between phases. As a result, the first phase consists of Gegharkunik Marz and Tavush Marz while Aragatsotn and Shirak Marz are included in the second phase.

(6) Water tariff rate schedules were calculated for the cost recovery analysis. The water rate starts from the willingness to pay result (AMD 40/m^3), increases up to 3% of the average household income (AMD 70/m^3) on the 7^{th} year and reaches the water tariff of the AWSC (AMD 115.65/m^3) on the 11th year. Based on the study, 140 rural communities (or 94% of total communities) can sustain the annual O&M costs while 47 rural communities (or 32%) can repay all the investment costs.

(7) Both phases require government subsidy of 2% of the total revenue to sustain the O&M costs. Phase 1 requires the government subsidy from 3^{rd} to 10^{th} year and on the pump replacement years amounting to AMD 207.6 million in total for 40 years. Phase 2

requires government subsidy for the whole calculation period amounting to AMD 202.2 million in total for 40 years.

(8) Phase 1 requires government subsidy of 15% of the total revenue for the investment costs. The government subsidy is required from 1st to 6th year and from 11th to 32nd year amounting to AMD 3,689.3 million in total. The surplus cash will be generated from 7th to 10th years and after 33rd year amounting to AMD 736.3 million in total. In Phase 2, the required subsidy is 42% of the total revenue for the investment costs. The government subsidy is required for the whole calculation period amounting to AMD 7,709.6 million in total. No surplus cash is generated over the 40-year cash flow projection.

(9) The FIRR for Phase 1 and Phase 2 have positive figures of 0.93% and 0.48% in the financial evaluation while the EIRR of Phase 1 and Phase 2 are 15.71% and 11.60% in the economic evaluation. EIRR values are almost equivalent to 12%, normally applying to other development projects.

(10) The water fee collection ratio has the most significant impact for the project's viability so that high water fee collection ratio is required during the project implementation.

(11) Ensuring reliable supply of safe water in adequate volume is a challenge to meet one of the basic human needs. However, water supply conditions in the study area are unsatisfactory. Therefore, the execution of the project foresees social and economic benefits to the residents in the communities.

(12) Each community is responsible for O&M of its own water supply facilities. However, there is neither an organization nor a system that manages the rural water supply facilities. It is managed according to the ability of the rural community heads. The water in majority of the villages is currently free of charge. The residents' awareness on the O&M of water supply facilities is very low.

(13) To enable a sustainable operation of water supply facilities, it was proposed to establish internal O&M organizations in the communities. The community head is responsible for managing the operation and maintenance of the rural water supply system.

(14) The O&M organization in the community is important for the project implementation. Therefore, verification of the roles and functions of management and the O&M organization was carried out by the pilot project.

(15) According to the pilot project, increased service hours, service pressure and quantity was confirmed in both communities after installation of the water meters. Especially in Lchavan, water supply duration was significantly increased from two hours per every other day to 15-24 hours per day. Even in Apnagyugh with natural gravity flow water supply system, duration was improved from eight hours to 24 hours per day. Therefore, it

is evident that the installation of water meters and water taps in all households contributes to the improvement of water supply service level.

(16) In both communities, the first water fee collection within the pilot project was carried out at the beginning of November. Collection ratio in Lcavan was 84% and was 66% in Apnagyugh. The reason of unpaid water fee is shortage of money on the collection day. The beneficiaries of both communities recognized the obligation of payment. Therefore, the collection ratios in Lchavan and Apnagyugh were increased to 96% and 72%, respectively in mid November.

It is recommended that the proposed project is implemented, considering the following recommendations.

15.2 Recommendations

The SCWS is responsible for the implementation of rural water supply services in Armenia. The community heads are responsible for their community under the direction and supervision of SCWS. The SCWS should clarify the role and the range of responsibility of SCWS and community heads prior to execution of the project.

(1) The SCWS should commence immediately the loan application procedures for project implementation.

(2) After completion of the Study, the SCWS should submit the Final Report to MONP for IEE level assessment of the Project

(3) The Project Implementation Unit (PIU) should be established in the SCWS for project implementation. When the project is executed, the implementing agency should be the SCWS under the Ministry of Territorial Administration.

(4) It is recommended that each household in the communities should submit agreement for the project and water fee collection according to water meter record after public hearings for arrangement of the project. When the submission of agreement reaches 80% of all households, project implementation should be started. If it does not reach the agreement of 80%, the project should be suspended.

(5) The O&M organization should be established during the detailed design stage in a community. It is necessary to understand the purpose of the project and cost bearing by beneficiaries when the project is executed. Based on the proposed operation and maintenance program, there must be a properly established and recognized O&M organization of water supply facilities in a community, responding directly to a community head.

(6) The training and capacity building of O&M organization of communities should be carried out by Community Field Officers (CFOs) to be appointed by the PIU. The following requirements are recommended for selection of CFOs:

- He should have an experience in operation and maintenance of Water User Association (WUA) or a working experience in NGO and/or NPO for community development; and
- He should be familiar with the project site and residing near the community area.

(7) It is recommended that the regulations governing the water supply management at each community should be established to ensure the community based operation and maintenance works.

(8) The residents and related local agencies (marz and community) should show self-help efforts for the establishment of management and O&M organization.

(9) The PIU and its consultant should review the conditions of the existing facilities in each community at the beginning of the detailed design stage. There are no available proper drawings of the existing facilities in the communities.

THE STUDY
FOR
IMPROVEMENT OF RURAL WATER SUPPLY AND SEWAGE SYSTEMS
IN
THE REPUBLIC OF ARMENIA

FINAL REPORT
VOLUME I MAIN REPORT

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ABBREVIATIONS

Organizations

AWSC	Armenia Water Supply and Sewerage Company
BMO	Basin Management Organization
CJSC	Closed-Joint Stock Company
CIS	Commonwealth Independent States
EU	European Union
FWUA	Federation of Water Users Association
GoA	Government of Armenia
GoJ	Government of Japan
JSC	Joint Stock Company
JICA	Japanese International Cooperation Agency
ICWU	Inter-Community Water Utilities
IFAD	International Fund for Agricultural Development
KfW	Kridietanstalt fur Wiederaufbau (German Bank for Reconstruction and Development)
LWSC	Lori Water supply and Sewerage Company
MONP	Ministry of Nature Protection
NOFE	Ministry of Finance and Economy
MOTA	Ministry of Territorial Administration
NATO	North Atlantic Treaty Organization
NGO	Non-governmental Organization
NPO	Nonprofit Organization
NAWSC	Nor Akunk Water supply and Sewerage Company
OECD	Organization for Economic Cooperation and Development
OSCE	Organization on Security and Cooperation in Europe
PIU	Project Implementation Unit
PMU	Project Management Unit
PSRC	Public Services Regulatory Commission
RoA	Republic of Armenia
SCWS	State Committee on Water Systems
SEI	State Environmental Inspectorate
SHAEI	State Hygiene and Anti-Epidemiological Inspectorate
SIDA	Swedish International Development Agency
SPSS	Social Protection Systems Strengthening Project by USAID Armenia
SWSC	Shirak Water supply and Sewerage Company

UMCOR	United Methodist Committee on Relief
UNDP	United Nations Development Program
USAID	United States Agency for International Development
WB	World Bank
WHO	World Health Organization
WRMA	Water Resources Management Agency
WSC	Water Supply Company
WUA	Water User Associations

Water Supply Plan

CAD	Computer Aided Design
DRR	Daily Regulatory Reservoir
DN	Nominal Diameter
PE	Polyethylene
GPS	Global Positioning system
PVC	Polyvinyl Chloride
RC	Reinforced Concrete

Project Implementation

C/S	Construction Supervision
D/D	Detailed Design
F/F	Fact Finding
F/S	Feasibility Study
FIDIC	International Federation of Consulting Engineers
ICB	International Competitive Bidding
L/A	Loan Agreement
NCB	National Competitive Bidding
OJT	On the Job Training
P/Q	Pre-qualification
S/W	Scope of Work
TOR	Terms of Reference

Environment

EIA	Environmental Impact Assessment
EIE	Environmental Impact Expertise
IEE	Initial Environmental Examination
NWP	National Water Program
WUP	Water Use Permits

Project Evaluation

EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate of Return
VAT	Value Added Tax
WACC	Calculation of Weighted Average Cost of Capital

Others

AHI	Average Household Income
APPH	Average People Per Household
CFO	Community Field Officer
GDP	Gross Domestic Product
HH	Household
MCA	Millennium Challenge Account
MDG	Millennium Development Goal
MN	Million
O&M	Operation and Maintenance
PRSP	Poverty Reduction Strategy Paper

UNITS

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer

Area

cm^2	=	square centimeter
m^2	=	square meter
ha	=	hectare
km^2	=	square kilometer

Volume

cm^3	=	cubic centimeter
m^3	=	cubic meter
L	=	liter

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram

Time as denominator

/s or /sec	=	per second
/m or /min	=	per minute
/hr.	=	per hour
/d	=	per day
/month	=	per month

Derived measures

L/cap/day		
or lpcd	=	Liter per capita per day
m^3/s	=	Cubic meter per second
m^3/d	=	Cubic meter per day
mg/L	=	milligram per liter

Others

%	=	percent
°C	=	Celsius degrees
masl	=	Meter above sea level

Currency

JPY	Japanese Yen
USD	US Dollar
AMD	Armenian Dram

Exchange Rate as of the 31st of May 2008
USD 1.0 = AMD 305.52 = JPY 105.50

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

After the independence of the Republic of Armenia (RoA) in 1991, the ROA did not pay sufficient attention to the maintenance, improvement and rehabilitation of the existing water supply and sewage systems constructed during the former political regime. Closed Joint Stock Companies (CJSC) have been established under the coordination of the State Committee of Water Systems (SCWS), which is in charge of water supply administration, with assistance from the World Bank and the German KfW. Improvement and/or installation of water supply and sanitation systems in major cities and other areas by CJSC are in progress.

The 565 rural communities located in mountainous areas have had little prospective of improvement/rehabilitation of the existing systems or installing new systems. The national and local governments do not allocate enough budget to rural water supply projects; therefore, support from donors is the only funding source available to realize the improvement and rehabilitation of water supply facilities. The water supply facilities in these areas are mainly gravity water supply systems, for which springs are the water sources. They are maintained by local residents at this moment. They are deteriorated and maintained improperly; water faucets of the public taps are left open or are damaged so that a large volume of water leakage is common in these facilities. The leakage causes water shortages in many rural communities and sometimes is a cause of land slides in some areas. Improvement of the drainage facilities is also required urgently.

The Poverty Reduction Strategy Paper (PRSP) prepared in 2003 has identified three priority programs for public investment in terms of poverty and inequality reduction; one of them is “A water supply program with the objective to enhance the provision of necessary drinking water”. It proposed to increase the access rate for safe water in rural areas from 45% in 2001 to 70% in 2015.

Under such situation, the RoA requested the Government of Japan (GoJ) to formulate a project for improvement of rural water supply systems consisting of rehabilitation of the existing water supply facilities.

It is confirmed that the water supply sector was a high priority in the discussions between JICA and the Government of Armenia (GoA) that were held in October 2005.

The GoJ dispatched the first preparatory study mission from 2 to 30 July, 2006 in order to confirm the project background, the present issues, and the Study area. GOJ dispatched the second mission from 29 October to 19 November, 2006 to finalize and sign the Scope of Work (S/W) after confirmation of the Study contents and its area.

1.2 Objectives of the Study

The objectives of the Study are as follows:

(1) To formulate an improvement plan for the water supply systems; the plan mainly consists of rehabilitation of the existing facilities and improvement of the operation and maintenance mechanisms;

(2) To transfer knowledge of the plan formulation to the Armenian counterpart through participation in the Study process.

1.3 Study Area

The Study area consists of 153 rural communities and a target population of 190 thousand in four Marzes: (1) Aragatsotn Marz, (2) Shirak Marz, and (3) Tavush Marz, and (4) Gegharkunik Marz.

CHAPTER 2 NATURAL CONDITIONS

2.1 Topography

Armenia has an area of approximately 29,740 square kilometers. The country is approximately 400 km long in the northwest southeast direction, and the narrowest section is around 26km wide. Average elevation of the country is around 1,800 masl (meters above sea level) and only 3 percent of the country lies below 650 masl. Mount Aragats is the highest point with an elevation of 4,090 masl and the lowest point is around 360 masl in the valley of the Debet River.

2.2 Geology

The geology in Armenia has complicated structures as shown in Figure 2.2.1. It is divided into 9 geologic provinces. Surface geological composition begins in the Paleozonic period. Major surface geology is formed from crustal activity and volcanic activity in the Mesozoic and the Pliocene.

2.3 Hydrology

Armenia has approximately 18.4 billion m^3 of water per year falling as precipitation, and of this approximately 6.2 billion m^3 is converted to surface runoff. Most of the water resources in Armenia exist as groundwater in shallow strata and it can be used for most of the country. In many areas surface water is insufficient, particularly the northern and southern regions, and the areas northwest and south of Mount Aragats. Annual average river water flow is around 6.2 billion m^3, which includes 1.5 billion m^3 of groundwater volume. River flow rate fluctuates by the season. It is the greatest in the period from April to June, which produces around 50-75% of the annual flow rate, and smallest from December to March, which produces around 10-12%. Armenia has water rights to use 1.2 billion m^3 of water per annum from the Aras and Akhurian Rivers.

2.4 Meteorology

Table 2.4.1 shows the average monthly temperature and rainfall of major towns in 4 marzes and Figure 2.4.1 shows the relationship between temperature and elevation.

Annual mean temperatures of the sites range from -5.0 °C in January to 19.1 °C in August. Mean temperature falls below 0 °C from December to March. In Armenia, towns above 900 masl cool to below zero in the winter time judging from Figure 2.4.1.

Annual mean rainfall over the past ten years has been around 500mm as shown in Figure 2.4.2. Khonav Range, which lies at the border between Shirak and Lori Marz, has the heaviest rainfall per year at around 1,000mm. The areas along the border with Turkey and Azerbaijan have around 300mm rainfall per year. Monthly rainfall volume is greatest from April to July at 50mm–80mm/month, and the other months are mostly 20–30mm/month.

2.5 Natural Conditions of Each Marz

(1) Aragatsotn Marz

Aragatsotn Marz occupies the western part of Armenia. It has borders with Turkey in the west and, with Armavir Marz in the south, Yerevan in the south-east, Kotayk Marz in the east, and Lori and Shirak marzes in the north. The area of Aragatsotn Marz (marz center - Ashtarak) is 2,753 km^2, with 136,667 ha of agricultural land, including 55,771 ha of arable land. The marz has 3 urban communities, 111 rural communities, and 117 village settlements. Total forest cover in the marz is 12,600 ha, or 4.6% of the area of the marz.

(2) Shirak Marz

Shirak Marz occupies the northwest part of Armenia. It has borders with Georgia in the north and Turkey in the west, with Aragatsotn Marz in the south, and with Lori Marz in the east. The area of Shirak Marz (marz center - Gyumri) is 2,681 km^2, with 165,737 ha of agricultural land, including 84,530 ha of arable land. It has 3 urban communities, 116 rural communities, and 128 village settlements. Total forest cover in the marz is 5,200 ha, or 1.9% of the area of the marz.

(3) Gegharkunik Marz

Gegharkunik, the largest marz in Armenia, occupies the eastern part of Armenia. It has borders with Azerbaijan in the east, with Vayotz Dzor Marz in the south, with Kotayk and Ararat marzes in the west, and with Tavush Marz in the north. The area (including Lake Sevan) of Gegharkunik Marz (marz center - Gavar) is 5,348 km^2, with 240,033 ha of agricultural land, including 95,148 ha of arable land. It has 5 urban communities, 87 rural communities, and 93 village settlements. Total forest cover in the marz is 33,700 ha, or 6.3% of the area of the marz.

(4) Tavush Marz

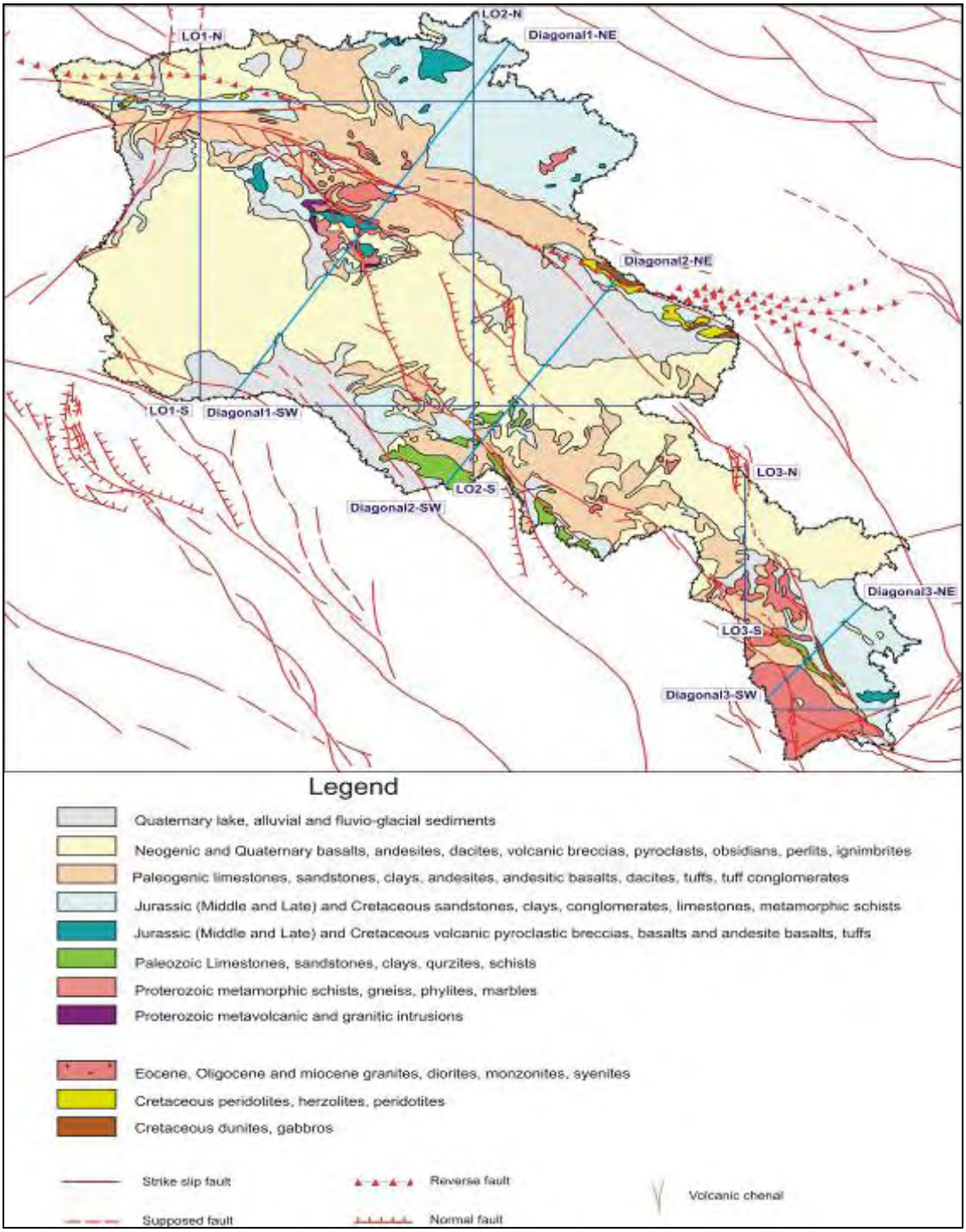
Tavush Marz occupies the northeast part of Armenia. It has borders with Georgia in the north and Azerbaijan in the east, with Gegharkunik and Kotayk marzes in the south, and

Lori in the west. The area of Tavush Marz (marz center - Ijevan) is 2,704 km^2, with 93,574 ha of agricultural land, including 27,294 ha of arable land. It has 4 urban communities, 58 rural communities, and 61 village settlements. Total forest cover in the marz is 145,000 ha, or 53.6% of the area of the marz.

Table 2.4.1 Average Temperature and Rainfall of Major Towns in Four Marzes

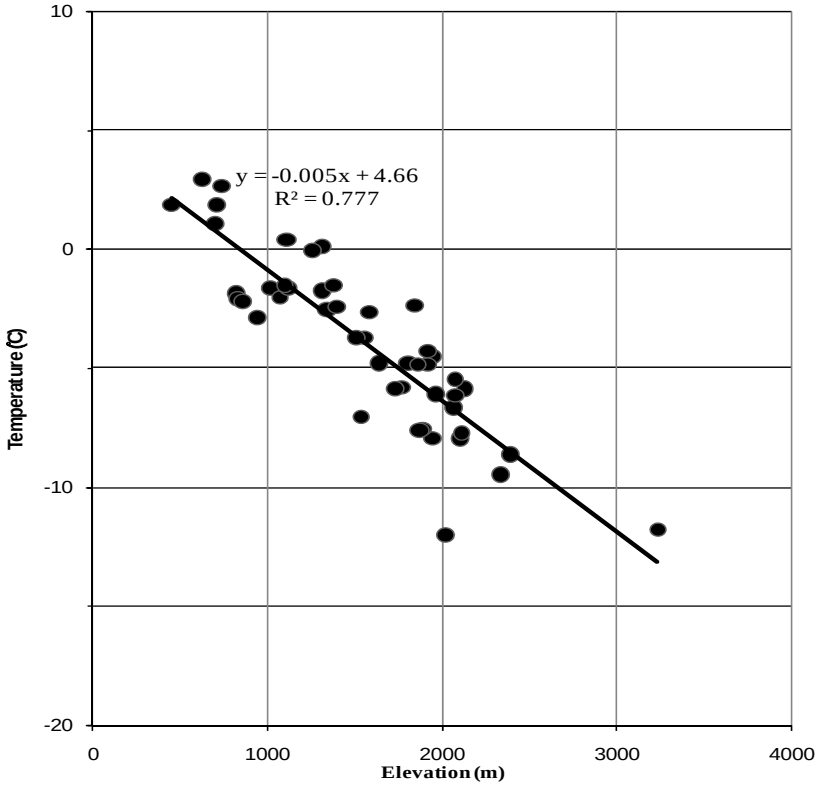
Stations	Elevation	Item	1	2	3	4	5	6	7	8	9	10	11	12	
Yerevan(agro)	942	temp.	-2.8	-0.3	5.5	13.1	17.4	22.3	26.0	26.3	21.0	13.9	5.7	-0.7	12.3
		rainfall	17.0	20.5	28.4	44.6	44.8	26.8	19.2	6.3	9.6	21.7	23.1	17.9	279.9
ARAGATSOTN MARZ															
Ashtarak	1,092	temp.	-1.5	0.3	5.6	12.1	16.6	21.4	25.1	25.2	20.6	14.3	6.7	0.3	12.2
		rainfall	23.9	27.7	34.5	58.0	59.8	31.8	25.2	10.4	14.1	29.9	29.5	31.2	375.9
Verin Talin	1,637	temp.	-4.8	-4.4	1.3	7.5	12.2	16.8	21.0	24.3	16.9	11.3	4.0	-3.2	8.6
		rainfall	15.4	14.6	30.3	41.7	71.9	34.6	27.4	24.4	20.7	23.3	31.8	15.3	351.5
Hamberd	2,071	temp.	-6.1	-5.7	-2.4	4.2	9.8	14.4	18.5	19.2	14.5	8.4	1.1	-4.0	6.0
		rainfall	36.0	41.0	51.4	64.5	95.3	42.2	33.3	19.3	21.8	46.8	44.6	45.1	541.5
Aragats mount,	3,227	temp.	-11.7	-11.2	-8.8	-4.6	-0.2	4.7	9.6	10.1	5.9	0.2	-6.1	-10.2	-1.9
		rainfall	36.2	52.0	67.1	61.8	33.9	31.1	39.4	23.9	26.2	34.6	39.9	29.6	475.8
Tsahkahovit	2,101	temp.	-7.9	-7.3	-3.1	3.9	8.4	12.2	15.5	15.9	11.6	6.4	-0.2	-5.7	4.1
		rainfall	11.7	23.1	46.9	59.5	87.2	77.5	68.8	45.9	40.7	34.1	31.8	18.7	546.0
Aparan	1,889	temp.	-7.5	-6.7	-2.2	5.0	9.7	13.6	17.2	17.9	12.9	7.3	0.3	-4.9	5.2
		rainfall	29.1	44.8	82.0	94.9	111.6	64.4	74.3	67.0	32.3	40.3	36.2	45.7	722.4
SHIRAK MARZ															
Gyumri	1,528	temp.	-7.0	-6.3	-0.1	7.6	12.5	16.7	20.6	20.8	15.9	9.8	2.2	-4.3	7.4
		rainfall	15.4	18.4	36.6	60.7	83.6	54.5	44.1	29.7	30.4	43.8	27.8	23.0	467.9
Artik	1,724	temp.	-5.9	-5.3	-0.6	6.7	11.1	14.8	18.8	19.2	14.4	8.6	1.8	-3.4	6.7
		rainfall	14.4	25.9	36.5	59.8	82.4	58.9	41.4	25.2	36.6	34.4	26.7	16.7	458.8
Amasia	1,866	temp.	-7.6	-7.0	-2.7	4.6	9.4	13.3	17.0	17.3	12.7	7.3	0.4	-5.2	5.0
		rainfall	23.1	34.9	47.9	76.2	90.0	71.8	52.4	36.4	28.6	50.1	27.4	34.2	572.9
Ashotsque	2,012	temp.	-12.0	-11.5	-5.8	2.7	8.5	12.4	15.8	16.5	11.9	6.3	-1.1	-9.2	2.9
		rainfall	48.2	62.1	69.2	108.6	182.7	161.0	123.2	125.7	72.3	87.3	50.7	52.9	1143.8
GEGHARKUNIK MARZ															
Gavar	1,960	temp.	-6.1	-5.8	-1.6	5.5	9.8	13.5	16.6	17.1	12.8	8.0	1.4	-4.3	5.6
		rainfall	16.3	19.2	33.0	49.6	66.7	73.0	66.3	50.3	24.0	24.5	22.4	23.0	468.1
Yanih	2,334	temp.	-3.0	-9.5	-5.6	2.0	7.4	11.2	14.5	15.3	11.1	6.2	-4.7	-3.4	3.5
		rainfall	16.7	40.8	9.6	36.6	54.0	42.1	35.2	12.0	16.6	40.5	101.8	16.7	422.5
Martuni	1,943	temp.	-4.5	-4.4	-0.8	5.6	9.9	13.8	16.7	17.1	13.5	8.8	2.4	-5.2	6.1
		rainfall	15.9	26.5	44.6	59.3	75.3	62.3	50.2	20.8	34.1	35.1	34.7	34.2	492.9
Masrick	1,939	temp.	-7.9	-7.4	-2.7	5.0	9.3	13.7	16.7	17.3	13.0	7.8	0.9	-9.2	4.7
		rainfall	16.0	17.1	31.9	38.1	63.1	85.5	41.5	28.2	38.6	41.4	19.1	52.9	473.4
Hrazdan	1,765	temp.	-5.8	-4.9	-0.6	6.0	10.8	15.1	18.4	18.8	14.5	9.1	1.8	-4.3	6.6
		rainfall	30.2	64.3	76.1	94.7	93.6	64.3	47.4	38.7	22.0	62.7	49.9	23.0	666.8
Shorzha	1,917	temp.	-4.8	-4.1	-0.8	5.1	9.1	12.9	16.2	17.5	13.2	8.2	2.3	-3.4	5.9
		rainfall	8.3	7.4	13.5	20.9	43.1	35.3	26.1	20.7	14.8	15.7	13.2	16.7	235.5
Sevan lake	1,917	temp.	-4.2	-4.2	-0.7	5.3	9.7	14.0	17.0	17.7	14.1	9.2	2.8	-5.2	6.3
		rainfall	16.3	24.5	40.4	67.8	90.1	75.9	61.6	40.5	31.3	42.8	29.4	34.2	554.8
Chambarak	1,853	temp.	-4.8	-4.5	-0.1	4.5	9.7	12.9	15.5	16.0	13.1	7.8	2.4	-9.2	5.3
		rainfall	5.2	11.7	24.8	26.5	72.9	52.4	49.5	45.4	11.6	28.9	5.4	52.9	387.2
Semyonovka	2,104	temp.	-7.1	-7.7	-3.3	3.3	7.5	10.6	14.1	13.9	9.6	5.3	0.9	-3.6	3.6
		rainfall	10.6	27.2	33.3	39.0	61.8	51.9	16.7	29.1	12.4	28.0	22.3	9.5	341.5
TAVUSH MARZ															
Ijevan	732	temp.	2.7	3.4	6.4	11.7	15.8	20.0	23.2	23.5	18.9	13.6	7.7	4.5	12.6
		rainfall	16.0	27.4	46.1	62.2	86.2	79.0	49.9	37.7	39.1	43.1	33.0	21.3	540.9
Dilijan	1,256	temp.	-0.1	0.5	3.7	9.0	12.6	16.3	19.5	19.7	15.8	10.9	5.4	1.3	9.5
		rainfall	23.5	18.5	40.6	61.9	98.5	86.4	53.3	53.7	34.9	43.4	33.2	10.5	558.3
Berd	695	temp.	1.1	2.8	5.7	11.5	16.0	21.1	22.6	23.0	18.3	14.0	7.5	3.8	12.3
		rainfall	22.2	13.3	29.5	32.5	55.9	44.5	22.0	15.1	28.3	30.3	9.5	14.6	317.7
Bagratashen	451	temp.	1.9	3.1	7.1	12.7	17.2	21.5	24.6	25.1	20.5	14.6	7.6	3.2	13.3
		rainfall	14.4	15.8	37.5	44.0	64.2	40.3	32.8	20.4	25.4	35.7	25.0	16.4	371.7
Mean figure		temp.	-5.0	-4.4	-0.1	6.5	11.0	15.1	18.5	19.1	14.6	9.1	2.5	-2.8	7.0
		rainfall	20.4	27.9	43.0	58.4	79.8	61.4	47.0	34.6	28.2	38.7	30.2	24.6	494.2

Source :JICA Land Slide Study in 2004



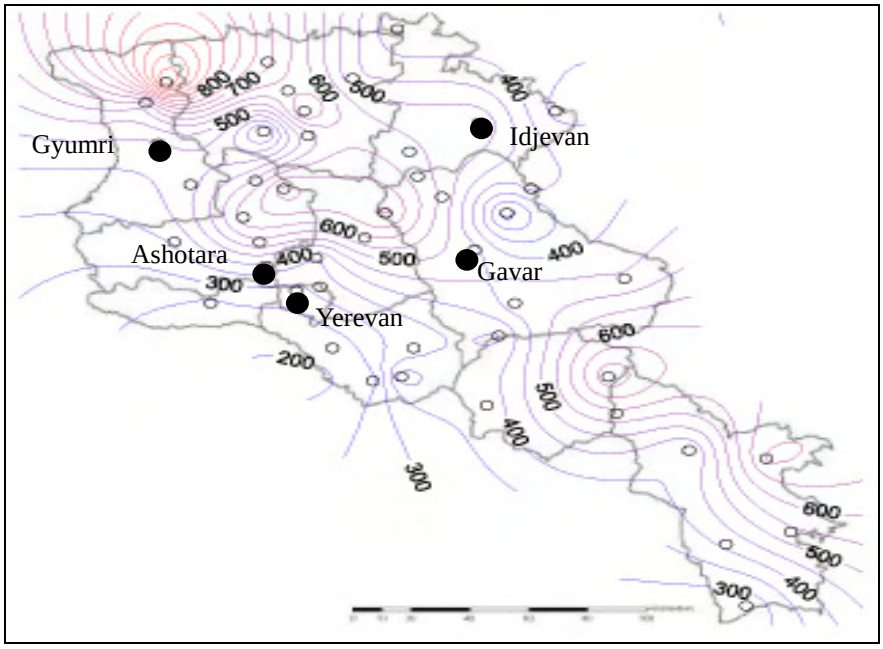
Source: JICA Land Slide Disaster Management Study

Figure 2.2.1 Geologic Province and Active Fault Map



Data source: JICA Land Slide Disaster Management Study

Figure 2.4.1 Relationship between Temperature and Elevation



Date: JICA Land Slide Disaster Management Study

Figure 2.4.2 Distribution of Average Annual Rainfall (mm/year)

CHAPTER 3 SOCIO-ECONOMIC CONDITIONS

3.1 Rural Administration

The Government appoints and dismisses regional governors who undertake defined duties with the assistance of regional administrations. These duties are primarily administrative, with no budgetary responsibilities, and include: the implementation of the Government of Armenia's regional policy, the coordination of the activities of regional agencies of state administration, the mediation of disputes between central and local governments, and the regulation of inter-community issues within their domain.

The second formal governing level in Armenia is the local self-government bodies. The constitution of the Republic of Armenia, adopted by referendum on November 27, 2005, explicitly addresses the issue of regional and local self-governments at the community level and clarifies the responsibilities between the two parties. According to Armenian law, the central government has the authority to decide on over twenty spheres of local government interest including the allocation of budgetary loans, credits and guarantees, establishing procedures for the collection and distribution of local taxes, and confirming community property.

The Law of Local Self-Governments endows the local governments with the responsibility for the provision of public infrastructure. However, these responsibilities were delegated subsidy is not enough to ensure the availability of suitable financial resources to fulfill them. The community budget is used, primarily, for current expenditures, and covers, mainly, administration, pre-school education, maintaining housing stock, and public utilities. In many rural communities, administration expenditures comprise the greatest part of budget expenditures, with capital expenditures forming only 2-3% of the total budget.

There are five potential sources of revenue for the community budget: centrally established taxes and duties; subsidies from the state budget; local duties and fees; land and property rent; and revenue from the sale of community property. But collection levels are low, so communities heavily depend on state budget transfers. These typically comprise over 50% of local budget revenues, up from, approximately, 20% in 1999. Of these types of central government transfers, subventions, for specific projects, and subsidy, or what is known as equalization subsidy, is by far the most important.

3.2 Demography

As for demographic trends, for the period of 2001-2008 the populations of Aragatsotn and Gegharkunik have increased by 1.6% and 1.0% respectively, whereas the population of Shirak and Tavush has decreased by 0.9% and 0.2% respectively, as shown in Table 3.2.1.

Infant mortality rate is almost twice as high in Tavush Marz and 2.5 times as high in Shirak Marz compared to Aragatsotn and Gegharkunik marzes. There is significant variation in fertility among the marzes with Aragatsotn Marz having the highest fertility rate (2.5 children per women), Gegharkunik being the second highest (2.1) in the country, and Shirak Marz having one of the lowest fertility rates in the country (1.2). Mortality rate is almost twice as high in Shirak Marz compared to Aragatsotn. Thus, relatively high mortality rate and low fertility rate are key factors contributing to population decrease in Shirak and Tavush marzes for the period 2001-2008. The figures on population composition and main demographic indicators for Aragatsotn, Shirak, Gegharkunik and Tavush marzes as summarized in Table 3.2.1 below.

Table 3.2.1 Main Demographic Indicators in the Four Marzes

Marz	Sex	2008			2001	Pop. change in %	Infant mortality rate per 1,000 persons	Mortality rate per 100,000 persons	Fertility per woman
		Urban x1,000	Rural x1,000	Total x1,000	Total x1,000				
Aragatsotn	Male	16.2	53.6	69.8	68.7				
	Female	16.9	53.8	70.7	69.7	+1.6	6.3	34.3	2.5
	Total	33.1	107.4	140.5	138.4				
Shirak	Male	80.5	54.7	135.2	136.2				
	Female	89.6	56.2	145.8	147.2	-0.9	15.2	78.4	1.2
	Total	170.1	110.9	281.0	283.4				
Gegharkunik	Male	38.9	80.9	119.8	118.7				
	Female	40.6	79.7	120.3	119.1	+1.0	6.6	56.8	2.1
	Total	79.5	160.6	240.1	237.8				
Tavush	Male	25.0	40.1	65.1	65.3				
	Female	27.6	41.5	69.1	69.1	-0.2	11.3	39.6	1.6
	Total	52.6	81.6	134.2	134.4				

Source: National Statistical Service of Armenia, 2008

3.3 Infrastructure

3.3.1 Policy and Regulatory Framework

The policy and regulatory framework for the infrastructure sectors is stipulated by the relevant sectoral laws, such as the Energy Law for electricity and gas supply, the Water Code for drinking water and irrigation, the Transport law, and the Telecommunication law, which define the key policy objectives, the roles and responsibilities for policy-making, regulation and operation of the different infrastructure services.

The Law on Local Self-Governments endows local governments with the following responsibilities: water supply, sewerage, irrigation, gas and central heating systems, construction, maintenance and operation of roads, bridges and other engineering structures within their jurisdiction, and construction and operation of irrigation systems.

However, a lot needs to be done by the national and local governments to ensure the access of communities to basic infrastructure services. Table 3.3.1 presents brief information on the level of access of the communities in all four marzes to the main infrastructure services.

Table 3.3.1 Access to Basic Infrastructure Services in the Four Marzes

Marz	Access to Drinking water		Access to Gas		Tele communications		Conditions of roads in %				Condition of electricity, number of communities			Irrigated land
	Community access	Household access	Community access	Household access	Community access	Household access	Good	Fair	Poor	Very Poor	Good	Fair	Poor	
Aragatsotn	85%	42%	8%	4%	65%	21%	2	2	65	7	6	76	32	11%
Shirak	97%	57%	17%	16%	53%	19%	0	17	62	21	0	60	59	7%
Gegharkunik	86%	44%	44%	34%	63%	31%	0	35	58	7	3	58	31	4%
Tavush	72%	42%	30%	8%	95%	48%	1	13	58	28	0	2	60	6%

Source: World Bank – Rural Infrastructure in Armenia: Addressing Gaps in Service Delivery, 2004

3.3.2 Drinking Water and Sewerage Sector

By law, local mayors are responsible for providing water service within a municipality unless the water sources and facilities serve more than one municipality. If the water sources and facilities do serve multiple municipalities, one of the five State-owned water companies provides the water service. As of November 2008, approximately 300 municipalities and rural communities representing over 80% of the population were served by the State water companies. The remainder of the population is served from approximately 565 small municipal systems and numerous rural community based organizations.

3.4 Regional Economy

3.4.1 Aragatsotn Marz

Aragatsotn Marz benefited modestly from the high growth rates in the Armenian economy over the past decade. According to the revised version of the Poverty Reduction Strategy Program (PRSP II, January 2008) the incidence of poverty (% of poor and very poor people) in the marz declined from 60.5% in 1999 to 35.4% in 2005. Rural areas in Aragatsotn Marz benefited the least, despite the fact that overall growth in Armenia resulted in a sharp decline in poverty – with overall poverty falling from over 77% of the population to one third between 1999 and 2005. As of 2006, Aragatsotn Marz was ranked 5-th by the level of poverty in the Republic of Armenia.

In 2006 the share of economy main branches of RA Aragatsotn Marz in total volume of correspondent branches of the republic comprised: industry 1.1%, agriculture 7.4%, construction 1.8%, trade and services 1.3%. The main economy branches of the marz are industry and agriculture. Industry is specialized in manufacture of food products and beverage, precious articles and exploiting of mines of building materials. The geographical position and climatic conditions of the marz are favorable for development of both plant growing (grain, potatoes, perennial grass, and forage crops) and cattle breeding. Agriculture is mainly specialized in plant growing and cattle breeding.

3.4.2 Shirak Marz

Shirak Marz has the highest poverty level in the Republic of Armenia among all marzes and Yerevan. Despite the double-digit economic growth in the country during the last 5 years, the incidence of poverty in Shirak Marz is still very high (46.8% as of 2006).

The leading branches of industry of RA Shirak Marz are production of food, including beverages and production of other non-metal mineral products. Tufa and pumice of Artik and Ani are well-known. The grain farming and cattle-breeding are the developed branches of agriculture. Freight and passenger transportations in the marz are implemented by road transport, railway and air transport (the airport is situated in the marz that provides air connection with CIS countries and has a facility to receive any type plane). In 2006 the share of economy main branches of the marz in total volume of correspondent branches of the republic comprised: industry 2.1%, agriculture 10.2%, construction 1.3%, trade and services 4.1%.

3.4.3 Gegharkunik Marz

Gegharkunik Marz is the third poorest region in Armenia. Despite recent economic growth in Armenia, in Gegharkunik Marz the poverty level remains high. Incidence of poverty in the marz, however, declined from 49.9% in 1999 to 39.7% in 2005.

In 2005 the share of economy main branches of RA Gegharkunik Marz in total volume of correspondent branches of the republic comprised: industry 1.8%, agriculture 14.4%, construction 1.8%, trade and services 2.1%. The leading branch of economy of the marz is agriculture, particularly production of grain, potato, vegetable and animal husbandry product. The marz of Gegharkunik is the main supplier of fresh fish to the population of the republic. Mining industry is the main trend of industry of the marz. Manufacturing is also of great importance, in which the following branches of industry have bigger share: building materials and food industry.

3.4.4 Tavush Marz

Though the reduction of poverty level in Tavush Marz is modest, from 29.3% in 1999 to 29.1% in 2005, it has the second lowest poverty level in the country.

In 2006 the share of economy main branches of RA Tavush Marz in total volume of correspondent branches of the republic comprised: industry 0.7%, agriculture 5.5%, construction 1.0%, trade and services 1.7%. Marz is pronounced agricultural districts of the republic. In animal husbandry the main branches are cow and pig breeding and in plant growing the most developed branches are grain and grape growing. During last years beekeeping develops too. The main branch of economy of the marz is manufacturing. The food industry and woodworking continue to be leading branches of industry. Wine, mineral waters, stone and wood products are exported to external markets.

3.5 Social Security

The main areas of concern for the socially vulnerable groups in Aragatsotn, Shirak, Gegharkunik and Tavush marzes are related to unemployment, agricultural problems, food security, housing, housing condition, healthcare problems, education problems, drinking water problems, cultural problems, legal problems, social isolation, as well as emigration.

Table 3.5.1 Socio-economic Characteristics of the Four Marzes in 2005

Marz	Level of poverty	GDP per capita in USD	Gross agric. Output		Labor resources, thousand persons[1]			Lack of access to health care[2]
			in billion AMD	% of share	Total	Of which employed	Empl. in %	
Aragatsotn	35.4%	1,277	35.5	7.2	91.6	64.8	70.7%	98.4%
Shirak	46.8%	1,070	49.3	14.1	201.2	89.6	44.5%	94.5%
Gegharkunik	39.7%	1,390	69.5	10	156.4	102.0	65.2%	97.1%
Tavush	29.1%	1,126	27.1	5.5	85.3	48.6	57.0%	97.2%

Sources: PRSP II, 2008

Table 3.5.1 summarized the socio-economic characteristics of the four marzes. Problems of employment relate to joblessness, low wages, unfair distribution of jobs, and the unregulated nature of the private segments of the labor market. Farming problems relate to lack of access to, and high prices of, irrigation water, lack of land or poor quality of land, lack of access to, and unaffordable prices for, economic infrastructures. Problems in the education sector relate to lack of access to and quality of education, lack of access to secondary school textbooks, and lack of access to specialized education. These problems are particularly severe for socially vulnerable groups.

3.6 Public Health and Hygiene

The Poverty Reduction Strategy Paper (PRSP) for Armenia has successfully incorporated strategies and the corresponding pro-poor growth, which are universal in nature and are mainly aimed to protect the health of the entire population. A number of programs for socially vulnerable groups are also envisaged. Millennium Development Goals (MDGs) are also incorporated into the corresponding sections of the PRSP, which allows us to conclude that PRSP health policies and programs include strategies for achieving MDGs, to the extent that they are relevant to country's realities.

Funding for PRSP health policies is secured, since they are included in the medium term expenditure framework of the Government of Armenia. Moreover, annual increases of their funding are also planned.

[1] Source : IMF Republic of Armenia – Poverty Reduction Strategy Paper Progress report, 2005

[2] Source : UNDP Human Poverty and Pro-Poor Policy in Armenia 2005, For those who were sick but did not see a doctor due to inability to afford the cost, remoteness, or lack of time

Table 3.6.1 Programmatic Indicators of State Budget Expenditures under PRSP in the Health Sector

	2006	2009	2012	2015	2021
Total expenditures of the Health Sector, (AMD billion)	39.5	67.6	106	162.6	374.2
Including:					
Current expenditures, % of total	90.6	90.0	92.0	92.0	94.0
Capital expenditures, % of total	11.4	10.0	8.0	8.0	6.0
Total expenditures of the Health Sector in percent to GDP	1.5	1.7	1.9	2.2	3.1
Total expenditures of the Health Sector in percent to state budget expenditures	6.9	6.9	7.9	8.8	11.5

Source: PRSP II, 2008

A stable increase in the ratio of state expenditures in the health sector to the GDP is also planned. In 2006-2021, State expenditures in the health sector will increase by 1.6 of a percentage point of the GDP, ensuring the target indicator of 3.1 percent of GDP in 2021 as shown in Table 3.6.1. Priorities within the health sector for state expenditures are primary, i.e. ambulatory-polyclinic, healthcare services, mother and child care and combating diseases posing serious threat to the public. It is planned to increase the proportion of primary healthcare in the total expenditures in the health sector to 50 percent by 2021.

CHAPTER 4 PRESENT CONDITIONS OF WATER SUPPLY SYSTEM

4.1 General

General features of a rural water supply system are described and illustrated as follows.

(1) Existing water supply facilities were mostly constructed in the Soviet Union period and those facilities have deteriorated,

(2) Springs are the major water sources,

(3) Water flows by gravity to residential areas, and

(4) A pipeline network has been already installed in the rural community.

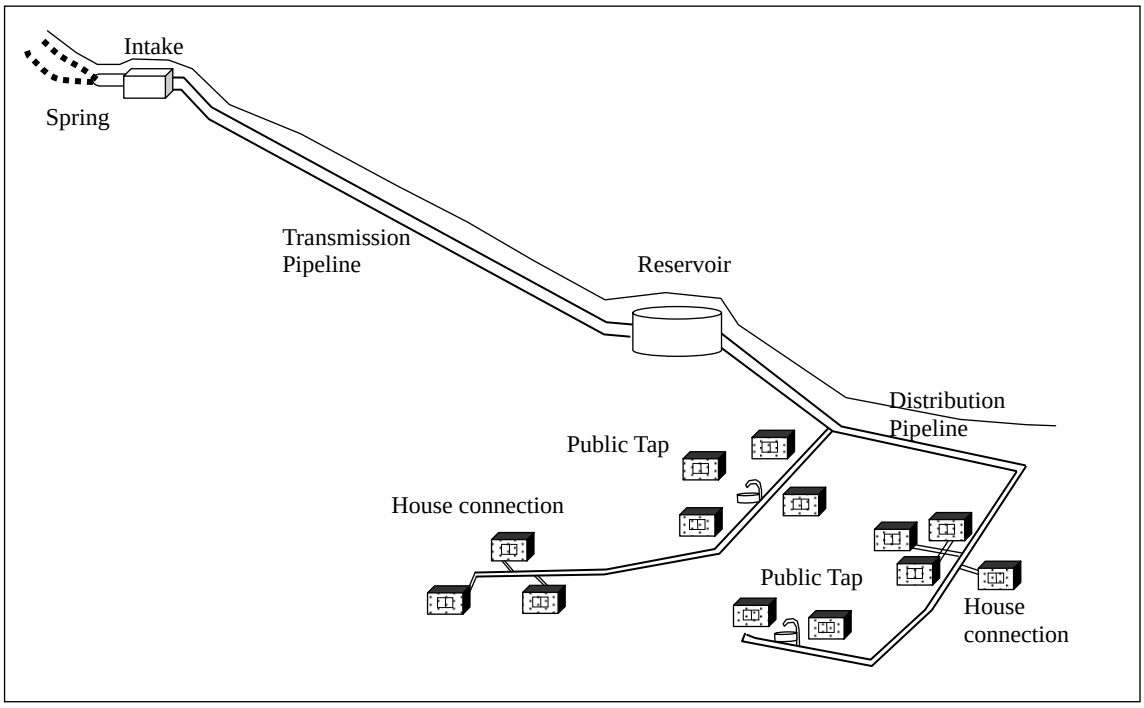


Figure 4.1.1 General Rural Water Supply System in the Project Area

Source: JICA Study Team 2007

The target of the Study is 153 rural communities, each of which has its own characteristics. In order to formulate the water supply plan for each rural community the Study shall collect information regarding the existing water supply facilities of each rural community and identify the places which rehabilitation shall be necessary. Therefore, present conditions of the existing water supply facilities were surveyed.

4.2 Methodology

The field survey with questionnaire sheet was applied to the existing water facilities survey. The survey was carried out by a local consultant. The survey team visited each rural community office and had them fill out a questionnaire sheet. Afterward, they went to major water supply facilities to survey the coordinates by GPS and inspected the structures' conditions. The questionnaire shall be used to determine the scale of each water supply and drainage facility, construction year, present conditions including the leakage level of the pipelines, and necessity of rehabilitation. The survey commenced in June and finished in October 2007. The survey results are summarized in Table 4.2.1 and each rural community's result is attached to the DATA BOOK.

4.3 Aragatsotn Marz

4.3.1 Field Survey Results

A total of 61 rural communities were surveyed in the course of the Study. General features of the water supply systems in Aragatsotn marz are tabulated in Table 4.3.1. The system known as No.8 Aratats has the largest existing water supply facilities in Aragatsotn marz for supplying 3,800 rural population. No.2 Aghdzg and No.8 Aragats have eight (8) intake structures and five (5) rural communities No.14 Byurakan, No.22 Yeghipartush, No.30 Lernapart, No.34 Tsaghkahovit, and No.54 Saralanj have five (5) intake structures to supply water to the rural community. A total of 15 rural communities supply water using one (1) intake structure. Four rural communities, No.8 Aragats, No.11 Arteni, No.14 Byurakan, and No.31 Lernarot, have more than 25km of transmission pipeline installed. On the other hand, seven (7) rural communities, No.6 Avtona, No.9 Aragats, No.23 Yeghnik, No.36 Tsilkar, No.45 Mulqi, No.54 Saralanj, and No.58 Verin Sasunik have less than 2km transmission pipeline installed. The Study Team visited four (4) rural communities which have more than 25km transmission pipeline. Three rural communities are more than 3,000 population, however, No.31 Lernarot is rather small with 420 population. Existing long transmission pipeline lengths are decided by water sources availability that the original water supply plan was formulated. Of the four marzes, the number of public taps is the largest in Aragatsotn marz. Particularly, No.8 Aragats and No.20 Derek provide more than 100 public taps. The general features of the water supply system in Aragatsotn marz are summarized in Table 4.3.1.

Table 4.3.1 General Features of the Aragatsotn Marz Water Supply Systems

Structures	Item	Average figures for one rural community
1. Intake	Numbers	3 nos
2. Transmission pipeline	Length Diameter	7 km Between 100 and 150mm
3. Reservoir	Numbers Capacity	1 nos 250m^3
4. Distribution pipeline	Length Diameter	5 km Between 100 and 150mm
5. House connection	Percentage	64%
6. Public tap	Numbers	12nos

Source: JICA Study Team 2007

No.58 Verin Sasunik was constructing the water supply facilities taken water from a spring in No.5 Avan rural community. Those facilities were completed in October 2007.

No. 11 Arteni and No.33 Lusakn are included Irind regional water supply system and No.18 Getap and No.28 Tlik are included Chlkan regional water supply system. They are partially operated under Armwatersewerage CJSC. However, the water has not reached them yet due to huge water losses and the large amount of illegal water use.

No.25 Nor Yedesia takes water from the existing water main pipeline through the Kosh pump station. The Kosh pump station operates once every three days. As a result, No.25 Nor Yedesia receives the domestic water once in every three days and stores the water in the 800 m^3 reservoir for three (3) days. No.9 Argats, No.11 Arteni, No.17 Gegharot, No.18 Getap, No. No.28 Tlik, No.45 Mulki and No.48 Norashen also have the pump to supply water to the rural community. Among them, No.18 Getap and No.28 Tlik do not operate the pump due to bad water quality.

Two rural communities, No.16 Geghadir and No.42 Dzoragyugh take water from the water supply system being operated by Armwatersewerage CJSC.

Seven rural communities answer that they have drainage system. Among them, No.25 Nor Yedesia and No.34 Tsaghkahovit have drainage systems collecting wastewater from households, rainwater, and snow melting water. It is discharged 2~3km downstream from the rural community.

4.3.2 Project Necessity

The survey found that distribution pipelines have the highest rehabilitation works' necessity among facilities. Approximately 90% of the rural communities require

rehabilitation works. Only two (2) rural communities, No.23 Yeghnik 0.3km constructed in 1999 and No.32 Lusagyugh 4.4km constructed in 2006 do not require distribution pipeline rehabilitation. Their distribution pipelines are relatively new facilities and water leakage is not very serious. Eleven rural communities do not require transmission pipeline rehabilitation. Transmission pipelines of those rural communities were mainly constructed or rehabilitated within the last ten years and some have been laid since 2000 so that they do not have much water leakage from them. As for the reservoirs, 14 rural communities do not require rehabilitation. A very high percent of each type of facility in the study area requires rehabilitation. It can be considered that the project is necessary for most of the facilities in the study area.

Table 4.3.2 Percentage of Each Type of Facility Requiring Rehabilitation (Aragatsotn Marz)

Construction Necessary	Existence of facility	Intake	Transmission pipeline	Reservoir	Distribution pipeline	Public tap
Yes	Yes	90%	82%	56%	95%	89%
	No	1%	-	22%	2%	0%
No	-	9%	18%	22%	3%	11%
Total		100%	100%	100%	100%	100%

Source: JICA Study Team 2007

The following rehabilitation and replacement works shall be prioritized in case that implementation plan will be limited.

(1) Rehabilitation and replacement of the distribution pipelines,

(2) Rehabilitation and reconstruction of the intake structures,

(3) Rehabilitation and replacement of the transmission pipelines, and

(4) Rehabilitation and reconstruction of the reservoirs.

4.3.3 Project Urgency

Water leakage interrupts the stable water supply and asbestos cement pipes affect human health when it breaks. Therefore, the leakage level and asbestos cement pipe sections used to measure the project urgency. Field survey asked about the leakage level of pipelines and it is taken as an indicator. A total of 26 rural communities, which are shown in Table 4.3.3, own the pipeline sections which have a huge quantity of water leakage. Among them, six communities have a huge amount of water leakage from all the transmission pipelines and seven communities have a huge amount of water leakage from all the distribution pipelines. Further, two communities, No.49 Shenavan, with a total of 23km of pipe, and No.53 Jamshlu, with 7km, have a huge amount of water leakage from the both transmission and distribution pipelines.

Table 4.3.3 Sections of Pipelines with Excessive Leakage (Aragatsotn Marz)

Unit: m

Community	Transmission pipeline		Distribution pipeline	
	Total length	Huge leakage section	Total length	Huge leakage section
No.1 Akunq			6,230	150
No.8 Aragats			36,100	36,100
No.9 Aragats	1,800	1,800		
No.11 Arteni			18,000	15,000
No.16 Geghadir	10,510	10,510		
No.17 Gegharot			5,700	1,000
No.22 Eghipatrush	17,000	14,000		
No.27 Ttujur			3,590	3,420
No.30 Lernapar	6,900	2,900		
No.32 Lusagyugh	5,280	930		
No.34 Tsaghkahovit			11,000	7,000
No.35 Tsaghkashen			6,920	6,760
No.36 Dsilqar	1,650	950	500	500
No.37 Katnaghbyur	7,200	5,200		
No.38 Karmrashen	6,700	800		
No.39 Kaqavadzor	4,500	4,500		
No.40 Hartavan	6,700	6,700	5,770	4,700
No.45 Mulki			6,000	6,000
No.46 Nigavan			3,762	235
No.48 Norashen			6,000	2,900
No.49 Shenavan	11,050	11,050	12,350	12,350
No.51 Vosketas			4,550	4,550
No.53 Jamshlu	4,500	4,500	2,500	2,500
No.57 Vardenut			4,750	2,100
No.60 Orgov			10,000	10,000
No.61 Ortachya	3,500	3,100		

Source: JICA Study Team 2007

Eleven out of 61 rural communities own the asbestos cement pipeline with 33.04km lengths as shown in Table 4.3.4. Among the communities that have them, No.40 Hartavan installs the longest asbestos cement pipes, 7.2km and No.37 Katnaghbyur follows with the asbestos cement pipe length 5.9km. The existing asbestos cement pipes were installed mostly 30 year ago. The pipes have already deteriorated. Thus, those sections shall be replaced urgently.

Table 4.3.4 Asbestos Cement Pipeline Sections (Aragatsotn Marz)

Rural community	Section	Length (km)	Diameter (mm)	Year
1. Akunq	Distribution	0.64	150	1950
10. Arayi	Transmission	0.8	300	1963
	Distribution	0.3	100	1975
16. Geghadir	Transmission	2.3	150, 200	1975
29. Irind	Transmission	0.7	100, 150	1968
	Distribution	1.4	100	1955
37. Katnaghbyur	Transmission	5.2	100, 200	1960, 1963
	Distribution	0.7	100, 150	1963
38. Karmrashen	Transmission	0.8	150	1955
39. Kaqavadzor	Transmission	0.8	200	1997
	Distribution	2.5	200	1970
40. Hartavan	Transmission	6.2	100	1953
	Distribution	1.0	100	1953

Rural community	Section	Length (km)	Diameter (mm)	Year
43 Meliqgyugh	Transmission	0.9	150	1960
	Distribution	1.6	100, 150	1960
50. Shgharshik	Transmission	2.0	200	1950
	Distribution	0.5	200	1973
53. Jamshlu	Transmission	4.5	150, 250	1957
	Distribution	0.2	100	1957
Total		33.04	100~300	-

Source: JICA Study Team 2007

4.4 Shirak Marz

4.4.1 Field Survey Results

A total of 35 rural communities were surveyed in the survey of existing water supply facilities. The water supply system in Shirak marz is the smallest among the four marzes and it is a simple water supply system. No.28 Jajur has the largest existing water supply facilities in Shirak marz. Three rural communities have five intake structures; No.14 Kamo, No.23 Mets Sariar, and No.30 Jajur. All the others have from one to three intake structures. A total of 18 rural communities have one intake structure and they represent the majority in Shirak marz. There are four (4) rural communities which have more than 10km of transmission pipeline. They are No.23 Mets Sariar, No.24 Musaelyan, No.28 Jajur, and No.35 Poqr Sariar. A total of 13 out of the 35 rural communities have less than 2km of transmission pipeline. Though they are all located along Pambak Range, each water source is different and they are independent from each other. There is no clear relationship between the transmission pipeline length and community location. Existing transmission pipeline lengths are decided by water source availability when the original water supply plan was formulated. As for public tap numbers, No.33 Sizavet has 60 public taps in the community and this is quite large in comparison with the others. The general features of the water supply systems in Shirak marz are summarized in Table 4.4.1.

Table 4.4.1 General Features of the Shirak Marz Water Supply Systems

Structures	Item	Average figures for one rural community
1. Intakes	Numbers	2 nos
2. Transmission pipeline	Length Diameter	3.8 km Approximately 100mm
3. Reservoirs	Numbers Capacity	1nos 150m^3
4. Distribution pipeline	Length Diameter	3.6km Approximately 100mm
5. House connections	Percentage	57%
6. Public taps	Numbers	8nos

Source: JICA Study Team 2007

All rural communities have the same water supply system consisting of taking water through an intake, passing through pipelines, and distributing to each household or public tap. No.19 Mayisyan Kayaran takes water from the water supply system being operated by Shirak Water Supply Company CJSC.

Nine rural communities, No.4 Arpeni, No.11 Lernakert, No.14 Kamo, No.17 Krachen, No.18 Krasar, No.22 Akhuryan Kayaran, No.23 Mets Sariar, No.27 Pemzashen, and No.28 Jajur reply that they have a drainage system. Their drainage system collects mainly rainwater and water from melting snow and other rural communities have same drainage system as well. Drainage systems are also used as irrigation canals.

4.4.2 Project Necessity

Rehabilitation of the intake structures shall be required for more than 90% of the rural communities. No.3 Ardenia's intake is the only intake structure for which rehabilitation is not required. The intake structure of No.3 was constructed in 2003 and it is in good condition. Therefore, rehabilitation work is not required. Around 70~80% of the other types of structures will require rehabilitation. Seven rural communities will not require rehabilitation of the transmission and eight for distribution pipelines. The transmission pipeline of No.15 Karmraqar and No.22 Akhuryan Kayaran were constructed in 1961 and 1956 respectively, however those do not require rehabilitation. Rehabilitation necessity does not depend on the structure's age. It depends on the site conditions, the construction quality, and periodic maintenance. Reservoir rehabilitation work is required for 31 rural communities, equivalent to 89% of 35 rural communities, as shown in Table 4.4.2.

Table 4.4.2 Percentage of Each Type of Facility Requiring Rehabilitation (Shirak Marz)

Construction Necessary	Existence of facility	Intake	Transmission pipeline	Reservoir	Distribution pipeline	Public tap
Yes	Yes	97%	80%	55%	77%	80%
	No	0%	-	34%	-	-
No	-	3%	20%	11%	23%	20%
Total		100%	100%	100%	100%	100%

Source: JICA Study Team 2007

The following rehabilitation and replacement works shall be prioritized in case that implementation plan will be limited.

(1) Rehabilitation and replacement of the intake structures,

(2) Rehabilitation and reconstruction of the reservoirs,

(3) Rehabilitation and reconstruction of the transmission pipelines, and

(4) Rehabilitation and replacement of the distribution pipelines

4.4.3 Project Urgency

The three rural communities mentioned below own the pipeline sections which have a huge amount of water leakage. All communities suffer distribution pipeline water leakage. All the distribution pipelines in No.11 Lernakert leak a huge amount of water and No.30 Jrarat has a huge amount of water leakage from 6,000m or 80% of the 7,700 m of distribution pipelines, as summarized in Table 4.4.3. Project urgency of these two rural communities is high in view of the water leakage.

Table 4.4.3 Sections of Pipelines with Excessive Leakage (Shirak Marz)

Unit: m

Community	Transmission pipeline		Distribution pipeline	
	Total length	Huge leakage section	Total length	Huge leakage section
No.11 Lernakert			3,000	3,000
No.28 Jajur			9,000	4,000
No.30 Jrarat			7,700	6,000

Source: JICA Study Team 2007

Three rural communities, No.24 Musaelyan, No.27 Pemzashen, and No.33 Sizavet use asbestos cement pipe in their water supply system and the total length of the asbestos cement pipe is 16.65km as shown in Table 4.4.4. In No.24 Musaelyan and No.27 Pemzashen asbestos cement pipe sections occupy 91% and 84% of the total distribution pipeline length respectively. Those asbestos cement pipes were installed more than 40 years ago, and they should be replaced urgently.

Table 4.4.4 Asbestos Cement Pipeline Sections (Shirak Marz)

Rural community	Section	Length (km)	Diameter (mm)	Year
24. Musaelyan	Transmission	10.0	150	1950
27. Pemzashen	Distribution	4.65	100~200	1955
33. Sizavet	Transmission	2.0	160	1965
Total		16.65	100~200	-

Source: JICA Study Team 2007

Additionally, the field survey found that the intake structures of No.1 Alver, No.2 Aghvorik, No.6 Bashgyugh, No.9 Zarishat, No.18 Krasar, No.25 Shaghik, No.34 Tzoghamarg, and No.35 Pork Sariar have deteriorated. Water quality worsens because of these intakes and it is not suitable for drinking purposes. The Sanitary and Epidemiological Center does not allow the use of these waters as drinking water. Urgent rehabilitation or replacement of the intakes shall be required.

4.5 Gegharkunik Marz

4.5.1 Field Survey Results

A total of 45 rural communities were surveyed in the existing water supply facilities survey. Gegharkunik marz has the largest water supply systems among the four marzes. Although the water supply facilities in Gegharkunik marz are the largest among four marzes, its average of two intake structures per system, is less than the average of three intakes per system in Aragatsotn marz. No.16 Zolaqar has 15 intakes because they use borehole located in the rural community as domestic water. Four (4) rural communities have four or more intakes. No.6 Astghadzor has five (5) intakes, and other three, No.2 Aghberq, No.3 Aygut, and No.9 Geghamavan have four intakes. A total of 20 rural communities, which represent 44% of the target communities, have one (1) intake. It is said that water is generally abundant in Gegharkunik. Average lengths of both the transmission and distribution pipelines are around 10km per system. This is because the population served is the largest among the four marzes, therefore, the existing water supply facilities are also large scaled ones in comparison with the others. Four rural communities, No.7 Artsvanist, No.17 Zovaber, No.26 Tsovinar, and No.43 Verin Getashen have more than 25km of transmission pipeline. Among them, No.26 Tsovinar is the largest and it has 41km transmission pipeline length for supplying a population of 5,180. On the other hand, four (4) rural communities, No.1 Akunq, No.19 Lchavan, No.32 Madina and No.45 Pokr Masrik have less than 2km of transmission pipeline. No.32 Madina, is close to No.43 Verin Getashen, and also No.45 Pokr Marsarik is close to No.34 Mets Marsarik which has 20km transmission pipelines. It can say that the existing transmission pipeline scale is decided by the social situation like water source availability that they were constructed. No.26 Tsovinar and No.34 Mets Marsarik each have 40 taps, the largest number of the public taps of all the communities. Other rural communities have less than 20 public taps. General features of the water supply systems in Gegharkunik marz are summarized in Table 4.5.1.

Table 4.5.1 General Features of the Gegharkunik Marz Water Supply Systems

Structures	Item	Average figures for one rural community
1. Intakes	Numbers	2 nos
2. Transmission pipelines	Length Diameter	11.6 km Approximately 150mm
3. Reservoirs	Numbers Capacity	2 nos 330m^3
4. Distribution pipelines	Length Diameter	9.3km Approximately 150mm
5. House connections	Percentage	52%
6. Public taps	Numbers	9nos

Source: JICA Study Team 2007

A total of 42 out of the 45 rural communities have similar water supply systems consisting of intake, transmission pipeline, reservoir, distribution pipeline, house connections and public taps. Two (2) rural communities, No.19 Lchaven and No.35 Norakert use the pump to lift the spring water to the reservoir. Three rural communities, No.6 Astghadzor, No.16 Zolakar, and No.41 Vaghashen, supply water from plural boreholes using pumps. Four (4) rural communities, No.1 Geghahovit, No.22 Tsaghkashen, No.38 Shorza, and No.45 Pork Sariar also use one borehole to supply water to the rural population.

Four rural communities, No.6 Astghadzor, No.11 Geghhovit, No.15 Yerenos, and No.26 Tsovinar reply that they have a drainage system. Their system collects rainwater and water from melting snow, they do not collect wastewater. Though other rural communities reply they do not have drainage systems, they have same type of drainage as well. Drainage systems are also used as irrigation canals.

4.5.2 Project Necessity

The water supply systems in Gegharkunik marz are generally aged as most of them were constructed in 1960 days. The field survey found that all of the water supply systems need to be rehabilitated partially or totally as summarized in Table 4.5.2. They have already deteriorated so that the current water supply facilities may not be able to be used for future operation under the present conditions. The survey found that the rehabilitation of the distribution pipelines is required for 97% of the rural communities in Gegharkunik marz. No.36 Shatjreq is the only rural community which does not require distribution pipeline rehabilitation. Their distribution pipeline was constructed in 2000 so that it is still in good condition. Rehabilitation of most of the transmission pipelines is also necessary, with 91% of the systems needing rehabilitation. Five communities, No.12 Ddmashen, No.15 Yerenos, No.23 Tsaghkunq, No.30 Dzoragyugh, and No.43 Verin Getashen do not require transmission pipeline rehabilitation. Three of them, No.12, 15, and 30 were rehabilitated in 1997, 1998, and 2004 respectively. Those pipelines are also still in good condition. Transmission pipelines of No.23 Tsaghkunq and No.43 Verin Getshen were constructed in 1950 and 1990, however, rural community replied that leakage level was little. It assumes that they maintain the transmission pipelines properly. The requirements for the rehabilitation of the intakes and reservoirs are almost equal, with each needing rehabilitation in around 80% of the rural communities. Eleven (11) rural communities do not require the intake rehabilitation and thirteen (13) rural communities do not require the reservoir rehabilitation.

Table 4.5.2 Percentage of Each Type of Facility Requiring Rehabilitation (Gegharkunik Marz)

Construction Necessary	Existence of facility	Intake	Transmission pipeline	Reservoir	Distribution pipeline	Public taps
Yes	Yes	76%	89%	51%	97%	80%
	No	0%	-	20%	-	0%
No	-	24%	11%	29%	3%	20%
Total		100%	100%	100%	100%	100%

Source: JICA Study Team 2007

The following works shall be prioritized in case that implementation plan will be limited.

(1) Rehabilitation and replacement of the distribution pipelines,
(2) Rehabilitation and replacement of the transmission pipelines,
(3) Rehabilitation and reconstruction of the intake structures, and
(4) Rehabilitation and reconstruction of the reservoirs.

4.5.3 Project Urgency

A total of 42 out of the 45 rural communities own a huge amount of water leakage of the transmission distribution pipelines' section as summarized in Table 4.5.3. Total lengths of badly leaking sections are: transmission pipelines, 153km, and distribution pipelines, 348.1km, so that the urgency of rehabilitation is high for those pipelines in view of the water leakage. Six rural communities, No.5 Antaramej, No.8 Geghamabak, No.10 Geghhovit, No.14 Drakhtik, No.31 Dzoragyugh, and No.34 Mets Marsarik suffer a huge amount of water leakage from all the transmission and distribution pipelines. The pipeline lengths of No.10 Gegharkunik and No.34 Mets Marsarik are 26.0km and 32.6km respectively. Urgent project implementation is required for those rural communities.

Table 4.5.3 Sections of Pipelines with Excessive Leakage (Gegharkunik Marz)

Unit: m

Community	Transmission pipeline (m)		Distribution pipeline (m)	
	Total length	Huge leakage section	Total length	Huge leakage section
No.1 Akunq			11,500	11,500
No.2 Aghberg			8,000	8,000
No.3 Aygut	8,000	6,500	22,000	22,000
No.4 Ayrk	0	0	4,000	4,000
No.5 Antaramej	4,500	4,500	1,500	1,500
No.6 Astghadzor			38,000	38,000
No.7 Artsvanist			7,000	5,500
No.8 Geghamabak	5,000	5,000	3,500	3,500
No.9 Geghamavan			6,000	6,000
No.10 Gegharkunik	20,000	20,000	6,000	6,000
No.11 Geghhovit	17,000	14,000	39,000	35,000
No.12 Ddmashen			15,000	15,000

Community	Transmission pipeline (m)		Distribution pipeline (m)	
	Total length	Huge leakage section	Total length	Huge leakage section
No.13 Dprabak	7,500	5,000	8,000	7,000
No.14 Drakhtik	3,500	3,500	800	800
No.15 Yeranos	13,000	13,000	24,500	15,500
No.16 Zolakar			16,700	16,700
No.17 Zovaber	32,000	12,000	10,000	2,000
No.18 Tazagyugh	18,000	13,500	17,000	17,000
No.19 Lchavan			4,000	4,000
No.20 Lusakunk			4,500	2,000
No.21 Khachaghbyur			5,050	4,550
No.22 Tsaghkashen	3,700	1,000	3,000	2,000
No.23 Tsaghkunq			500	500
No.24 Tsovagyugh			7,000	7,000
No.25 Tsovak	18,000	6,000	9,200	9,200
No.26 Tsovinar			11,000	11,000
No.28 Barepat	3,500	1,500	2,000	2,000
No.29 Karchaghbyur			12,000	12,000
No.30 Dzoragyugh			20,000	20,000
No.31 Dzoravank	4,900	4,900	2,500	2,500
No.32 Madina			6,000	6,000
No.33 Maqenis			1,800	1,800
No.34 Mets Masrik	20,600	20,600	12,000	12,000
No.35 Norakert			6,000	6,000
No.37 Shatvan	18,700	17,000		
No.38 Shorzha	11,000	5,000		
No.39 Jaghatzadzor			150	150
No.41 Vaghashen			9,000	2,000
No.42 Vardadzor			8,100	3,800
No.43 Verin Getashen			20,000	20,000
No.44 Torfavan			3,000	3,000
No.45 Pokr Masrik			3,600	1,600

Source: JICA Study Team 2007

Eight rural communities use asbestos cement pipe in their water supply system and total length of the asbestos cement pipe is 53.5km as shown in Table 4.5.4. No.37 Shatvan has the longest asbestos cement pipeline, 17km length, and No.18 Tazagyugh follows, 15.0km length. Asbestos cement pipes have been mainly installed in the 1950s and 1960s, more than 40years ago. It can be said that urgency of rehabilitation of the systems in these rural communities is high at this point.

Table 4.5.4 Asbestos Cement Pipeline Sections (Gegharkunik Marz)

Rural community	Section	Length (km)	Diameter (mm)	Year
7. Artsvanist	Transmission	6.0	150	1952
10. Gegharkunik	Transmission	3.5	100	1976
14. Drakhtik	Transmission	1.5	150	1960
18. Tazagyugh	Distribution	15.0	100, 150	1960
20. Lusakunq	Distribution	2.5	75,100	1947
22. Tsaghkashen	Transmission	1.0	150	1958
34. Mets Marsarik	Transmission	7.0	100	1952
37. Shatvan	Transmission	17.0	100	1960
Total		53.5	100~150	

Source: JICA Study Team 2007

Further, the intake structures of No.9 Gegharkunik, No.22 Tsaghkashen, and No.38 Shorzha have already deteriorated extremely and water quality worsens by use of the present intake structures. The Sanitary and Epidemiological Center does not allow using these waters as drinking water. Urgent rehabilitation or replacement shall be required in view of water quality.

4.6 Tavush Marz

4.6.1 Field Survey Results

A total of 12 rural communities were surveyed in the survey of the existing water supply facilities. Tavush marz does not have large transmission pipelines like in Aragatsotn and Gegharkunik marz. No.3 Getahovit has the largest existing water supply facilities among the target rural communities in Tavush marz. They supply water for 2,500 people. No.1 Aghavnavanq has six (6) intakes and No.11 Hovq have four (4) intakes. Three (3) rural communities, No.6 Teghut, No.7 Itsakar, and No.10 Khachardzan have one (1) intake. The longest transmission pipeline is No.3 Getahovit, which is 12.5km in length. No.12 Navur is another rural community which has more than 10km of transmission pipeline, 11.8km. There is no rural community which has less than 2km of transmission pipeline. No.10 Khachardzan is the shortest transmission pipeline, which is 2km in length. In general, the existing water supply facilities of each rural community are of similar scale in comparison to the other marzes. Eight (8) rural communities do not have public taps at present. The general features of the water supply systems in Tavush marz are summarized in Table 4.6.1.

Table 4.6.1 General Features of the Tavush Marz Water Supply System

Structures	Item	Average figures for one rural community
1. Intakes	Numbers	3 nos
2. Transmission pipelines	Length Diameter	6.8 km Approximately 100mm
3. Reservoirs	Numbers Capacity	2 nos 190m^3
4. Distribution pipelines	Length Diameter	6.3km Approximately 100mm
5. House connections	Percentage	61%
6. Public taps	Numbers	3 nos

Source: JICA Study Team 2007

All rural communities have similar water supply systems consisting of intake, transmission and distribution pipelines, house connections and public taps. Four rural communities do not have a reservoir.

Two rural communities, No.7 Itsakar and No.12 Navur take water from the water supply system being operated by Armwatersewerage CJSC.

Four rural communities, No.3 Getahovit, No.5 Yenoqavan, No.6 Teghut, and No.12 Navur, reply that they have drainage system. Their system is to collect rainwater and water from melting snow, they do not collect wastewater. Remaining rural communities also have drainage system for collecting rainwater. Drainage systems are also used as irrigation canals.

4.6.2 Project Necessity

More than 90% all the structures of all types require rehabilitation as summarized in Table 4.6.2. Although several structures have been constructed or rehabilitated within the last 10years such as the transmission pipeline of No.2 Gandzakar, which was constructed in 2001 and 2003, and the intake structure and transmission pipeline of No.10 Khachardzan, which was constructed in 2000, they still need to be rehabilitated. It is supposed that construction quality of the existing structures is not appropriate so that the structures have deteriorated rapidly.

Table 4.6.2 Percentage of Each Type of Facility Requiring Rehabilitation (Tavush Marz)

Construction Necessary	Existence of facility	Intake	Transmission pipeline	Reservoir	Distribution pipeline	Public taps
Yes	Yes	92%	100%	67%	100%	75%
	No			33%		
No	-	8%	0%	0%	0%	25%
Total		100%	100%	100%	100%	100%

Source: JICA Study Team 2007

The existing distribution pipelines were mainly installed between 1950 and 1980. Two distribution pipelines, No.7 Itsakar and No.10 Khachardzan were installed in the 1990s. It is noted that there were no distribution pipeline rehabilitation works found in the survey even though several transmission pipelines have been rehabilitated. Therefore, rehabilitation of the distribution pipelines is prioritized in comparison with the transmission pipeline rehabilitation. Currently, four rural communities, No.6 Teghut, No.8 Lusahovit, No.9 Lusadzor, and No.11 Hovq do not have a reservoir. The need for a reservoir is high for the above communities. The following works shall be prioritized when the step wised project implementation plan by the facilities will be prepared.

(1) Rehabilitation and replacement of the distribution pipelines,

(2) Rehabilitation and replacement of the transmission pipelines,

(3) Rehabilitation and reconstruction of the reservoirs, and

(4) Rehabilitation and reconstruction of the intake structures.

4.6.3 Project Urgency

According to the survey results, 11 out of the 12 rural communities own the pipeline section which have huge water leakage as summarized in Table 4.6.3. No.5 Yenoqavan is the only rural community which does not have huge water leakage pipelines. 11 communities are shown the huge water leakage of the distribution pipelines section and total pipe lengths are 66km. No.3 Getahovit has the longest huge water leakage pipeline section with 27.0km and No.1 Aghavnavanq follows having 13.5km huge leakage pipeline section. Urgent pipeline rehabilitation is expected for those rural communities in view of water supply efficiency.

Table 4.6.3 Sections of Pipelines with Excessive Leakage (Tavush Marz)

Unit: m

Community	Transmission pipeline		Distribution pipeline	
	Total length	Huge leakage section	Total length	Huge leakage section
No.1 Aghavnavanq	7,000	4,500	9,000	9,000
No.2 Gandzaqar			6,100	3,500
No.3 Getahovit	12,500	8,000	23,500	19,000
No.4 Gosh			11,000	11,000
No.6 Teghut			4,700	4,700
No.7 Itsakar			2,500	2,500
No.8 Lusahovit			3,000	3,000
No.9 Lusadzor	3,100	2,100	1,400	1,400
No.10 Kachardzan			1,600	1,600
No.11 Hovq	7,600	600	2,250	2,250
No.12 Navur			9,000	9,000

Source: JICA Study Team 2007

There is no rural community in Tavush marz that has asbestos cement pipe. Therefore, project urgency does not arise because of asbestos cement pipe.

The survey found that No.3 Gatahovit intake and transmission pipeline are deteriorated so that water quality worsens when they take water from the present intake. The Sanitary and Epidemiological Center does not allow using water from those intakes for drinking water. Urgent rehabilitation or replacement should be required.

4.7 On-going Water Supply Project

The survey illuminated the 14 on-going project plans shown in Table 4.7.1. Shirak Marz allocated local budget to the rural water supply projects of No.16 Kaqavasar, No.21 Dzorashen, and No.35 Poqr Sariar. UNDP completed to a full scale rehabilitation of No.9 Lusador in Tavush in 2008. Therefore, these four rural communities that will have full scale rehabilitation will be excluded from the improvements proposed in this Study.

Table 4.7.1 On-going Rural Water Supply Projects

Marz	Rural community	Project name	Fund source	Project cost	Component and situation
Aragatsotn	No.1 Akunk	Recovery of distribution water supply network in western district	World Vision	AMD 3.6 million	700m distribution pipeline, including asbestos cement pipes, will be replaced. 30% of the works is completed.
	No.4 Ashnak	New construction of intake, pipelines, and reservoir	IFAD and community	USD 0.36 million	12 km new distribution pipelines and 900m3 reservoir was constructed. Project is the final stage.
	No.27 Ttujur	Construction of distribution network	Poverty Reduction Strategy Program	AMD 12.8 million	Whole distribution network will be reconstructed. 70% of work has been done.
	No.35 Tsaghkashen	Rehabilitation of distribution network	World Bank	AMD 21.0 million	2450m distribution pipelines will be replaced. 65% of work has been done.
	No.52 Chqnagh	Replacement of distribution network	World Vision	AMD 9.0 million	Distribution network has been reconstructed. Transmission pipeline was reconstructed earlier.
Shirak	No.12 Lernut	New construction of intake, pipelines, reservoir, and water meters	SPSA individual philanthropist	AMD 31.0 million	New intake, pipelines, and reservoir have been constructed. Water meters have been installed for all the houses.
	No.16 Kaqavasar	Rehabilitation of the existing water supply facilities	Local budget		Rehabilitation of intakes, transmission and distribution pipelines is necessary.
	No.21 Dzorashen	Rehabilitation of the existing water supply facilities	Local budget		Rehabilitation of intake, transmission pipeline, reservoir and distribution pipelines is necessary.
	No.35 Poqr Sariar	Rehabilitation of the existing water supply facilities	Local budget		Rehabilitation of intake, transmission pipeline, reservoir and distribution pipelines is necessary.
Gegharkunik	No.18 Tazagyugh	Rehabilitation of transmission pipeline	Social Fund and community fund	AMD 80.0 million	4.5 km transmission pipeline has been rehabilitated.
	No.20 Lusakunq	Rehabilitation of transmission pipeline	Social Fund	AMD 40.0 million	4.6 km transmission pipeline has been rehabilitated.
	No.43 Verin Getashen	Replacement of transmission pipelines	Save the Children	AMD 12.0 million	1.25km transmission pipeline has been rehabilitated. Asbestos cement pipelines have been replaced.
Tavush	No.6 Teghut	Construction of sewerage system	UN World Food Program	AMD 7.0 million	Sewage collection system has been constructed. D=500-800mm.
	No.9 Lusadzor	Rehabilitation of water supply system	UNDP	USD 0.24 million	Whole water supply system will be rehabilitated. Construction started in Nov/07 and completed as of Jun/08.

Source: JICA Study Team 2008

Table 4.2.1 Existing Water Supply Facilities (1/8)

ARAGATSOTN MARZ

No.	Community	Intake					Transmission Pipe					Reservoir					Chlorination	Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate l/s	Necessity (nos)	L km	dia mm	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity m^3	Necessity (nos, m3)		L km	dia mm	Material	Year	Necessity (km)	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
1	Akunq	1	Masonry	1947	2.5	O					-	2	RC	Rectangular	400	O	O	6.2	50~200	Steel, wood, AsbestosCement	1950	O 6.2	3	1950	O	X	O		
																		0.6	150	Asbestos cement section									
2	Aghdzq	8	Masonry, Concrete	1972, 1981	9.5	O	2.7	150	Steel	1972, 1985	O	2	RC	Circle, Rectangular	250, 500	O	X	7.4	25~100	Ductile iron, Steel	1972	O	5	1984	O	O	O		
3	Antarut	2	Steel, RC	1996, 2000	3.0	O	4.3	80~150	Steel, Ductile iron	1986, 1991	O	2	Steel, RC	Circle	4.5, 60	O	X	1.9	50~100	Steel	1985	O	0		-	X	O		
4	Ashnak	4	RC	2006	16.5	X	8.8	50~150	Steel, PE	2006	O 0.1	3	RC	Rectangular	300	O 2nos, 300m3	O	15.5	100, 150	PE	1975	O	4	1975, 2006	O	X	O		
5	Avan+Khnusik	4	Masonry, Concrete	1921~ 2000	38.5	O 1nos	4.0	150	Steel	1967	O	1	RC	Rectangular	100	O	X	13.0	50~200	Steel	1970	O	7	1946, 1970	O	X	O		
6	Avtona	1	Concrete	1997	2.0	O	0.1	80	Steel	1997	X	1	Steel	Circle	60	X	X	1.7	25, 32	Steel, PE	1998	O 1.5	4	1998	O	X	O		
7	Avshen	4	RC	1959~ 1968	1.3	O	5.8	80, 100	Steel, Cast iron	1968, 1985	O	1	RC	Circle	75	O	X	2.0	32~100	Steel, Cast iron	1958, 1968	O	11	1958, 1968	O	X	O		
8	Aragats	8	RC	1978, 2002	17.5	O 6nos	34.0	100~200	Steel	1978, 2002	O 7.5	2	RC	Rectangular	400, 800	O 1nos 400m3	O	36.1	50~150	Steel	1960, 1975	O	150	1975, 2001	O	X	O		
9	Aragats	3	Steel	1970~ 2004	20.0	O	1.8	200	Cast iron	1960	O	3	RC	Circle, Rectangular	150, 500	O	X	16.7	100, 150	Steel, Cast iron	1964	O	15	1964	O	O	O	2nos	O
10	Arayi	3	RC	1963~ 2005	9.0	O 2nos	7.2	100~300	Steel, Asbestos cement	1963~ 1990	O			X		O	X	6.8	25~100	Steel, PE, Asbestos cement	1975 ~2001	O	50	1975, 1985	O	X	O		
							0.8	300	Asbestos cement section	1963								0.3	100	Asbestos cement section	1975								
11	Arteni	2	RC, Steel	1956, 1973	17.5	X	25.0	150	Steel	2003	X	1	RC	Rectangular	500	X	X	18.0	65~150	Cast iron, Steel, PE	1975, 2002	O 15.0	0		-	X	O	1nos	X
12	Apnagyugh	2	Concrete, Steel	1952, 2001	6.0	O 1nos	4.2	100~150	Steel	2004	X	1	RC	Rectangular	250	X	X	3.2	50~100	Steel	1976	O	15	1976, 1998	O	X	O		
13	Baysz	2	RC	1970	4.5	O	4.5	50~100	Steel	1975	O	1	RC	Rectangular	25	O	O	0.7	50	Steel	1970	O	5	1970, 1980	O	X	O		
14	Byurakan	5	Concrete	1950~ 1997	86.5	O 3nos	39.9	150~300	Steel	1970~ 1997	O	2	RC	Rectangular	150, 400	O	O	14.5	50~150	Steel, Ductile iron, PE	1950, 2000	O 10.5	22	1950, 1996	O	X	O		
15	Garnahovit	3	Concrete	1952~ 1958	5.8	O	2.2	50~150	Steel	1952~ 2001	O 1.6	1	RC	Rectangular	50	O	X	1.8	50, 80	Steel	1953, 2001	O	2	1953	O	X	O		
16	Geghadir	2	Concrete Ground	1975	103.0	O	10.5	150~250	Steel, Asbestos cement	1975	O	2	RC	Circle	100	O	O	5.0	50, 100	Steel	1975	O	4	1975	O	X	O		
							2.3	150, 200	Asbestos cement section																					
17	Gegharot	4	RC, Steel, Concrete	1948~ 2001	2.2	O 3nos	5.5	50~150	Steel	1948, 2001	O 2.5	1	RC	Rectangular	200	X	X	5.7	50~100	Steel	1950	O	20	1990	O	X	O	1nos	O
18	Getap	2	Steel	1972, 1996	0.0	O	6.3	80, 150	Steel, Ductile iron	1972	O			X		O	O	1.9	50~150	Steel, Ductile iron	1972 ~1998	O 1.9	6	1972, 1998	O	X	O	1nos	X
19	Davtashen	2	RC, Masonry	1957, 2002	12.0	O	6.6	80~150	Steel	1976, 2002	O 3.7	1	RC	Rectangular	300	O	X	6.4	80~150	Steel	1976	O	3	2004	X	X	O		
20	Derek	1	RC	1976	12.0	O	2.0	125, 150	Cast iron	1976	O			X		O	X	3.8	65~125	Cast iron, Steel	1976	O	120	1976, 1987	O	X	O		
21	Dian	2	RC	1970	4.5	O	6.0	65, 100	Steel	1975	O			X		O	O	0.7	50, 100	Steel	1975	O	2	1975	O	X	O		
22	Yeghipartush	5	RC, Steel	1966, 1988	6.2	O 3nos	17.0	50~150	Steel, PE	1965~ 1990	O 16.0	1	RC	Rectangular	250	O	O	6.3	25~150	Steel, Cast iron	1968	O 6.2	15	1968, 1990	O	X	O		
23	Yeghnik	1	Concrete	1999	0.5	X	1.7	100~150	Steel	1999	X			X		O	X	0.3	100	Steel	1999	X	1	1981	X	X	O		

Source: JICA Study Team 2007

Table 4.2.1 Existing Water Supply Facilities (2/8)

ARAGATSOTN MARZ

No.	Community	Intake					Transmission Pipe					Reservoir					Chlorination	Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate l/s	Necessity (nos)	L km	dia mm	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity m^3	Necessity (nos, m3)		L km	dia mm	Material	Year	Necessity (km)	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
24	Yernjatap	3	Masonry, Steel	1936~1991	9.3	O 1nos	11.7	100~150	Steel	1970, 1995	O	2	RC	Rectangular	100	O	X	10.8	50~150	Steel, PE	1979, 1995	O	10	1970, 1995	O	O	O		
25	Nor Yedesia	1	Steel	1978	3.0	O	11.0	150	Steel	2004	X	1	RC	Rectangular	800	X	O	5.1	100, 150	Steel	1970	O	0		-	O	O	1nos	X
26	Zovasar	3	Concrete	1916, 1977	12.0	O	6.5	80~200	Steel	1987	X	1	Steel	Circle	18	X	X	3.1	50~200	Steel	1977	O	2	1968, 1977	O	X	O		
27	Ttujur	2	Concrete, Ground	1953, 1988	3.5	O	10.5	100~150	Steel	1973, 1988	O	1	RC	Rectangular	250	X	O	3.6	80~150	Steel	1980	O 3.4	7	1980, 2005	O	X	O		
28	Tlik	2	Steel	1972, 1997	0.2	O 1nos	7.0	80~150	Steel	1972, 1997	O 6.5	1	-	-	-	O	O	0.8	80	Steel	1972	O	3	1972	O	X	O	1nos	X
29	Irind	4	Concrete	1968~2004	36.0	O 2nos	8.5	100~250	Steel, Asbestos cement	1968~2005	O 6.6	1	Steel	Circle	5	X	O	12.6	50~100	Steel,DuctileIron, AsbestosCement	1950 ~1990	O	10	1965, 2005	O	X	O		
							0.7	100, 150	Asbestos cement section	1968								1.4	100	Asbestos Cement section	1955								
30	Leranapar	5	Ground	1890~1975	3.6	O	6.9	50, 100	Steel	1950~1980	O	1	RC	Rectangular	250	O	O	1.5	100	Cast iron	1953	O	8	1953, 1980	O	O	O		
31	Lernarot	3	RC, Concrete	1975, 2000	7.5	O	27.3	80~200	Steel	1975, 2000	O	2	RC	Circle, Rectangular	60, 250	O 1nos 60m3	X	2.8	50, 100	Steel	1975	O	7	2002	O	X	O		
32	Lusagyugh	4	RC	1964, 1982	4.5	O 3nos	5.3	50~100	Steel, Cast iron	1964, 1982	O	2	RC	Rectangular, Circle	200, 250	O 1nos 200m3	X	4.4	50~100	Cast iron, Steel	2006	X	4	2006	X	X	O		
33	Lusakn	1	Steel	2004	0.2	O	3.2	50, 65	Steel	2004	O	2	RC	Rectangular	250	X	O	1.6	150	Steel	1987	O	2	1987	O	X	O		
34	Tsaghkahovit	5	RC, Steel	1953, 2006	51.5	O 2nos	16.5	150, 200	Steel	1953, 2006	O 4.5	2	RC	Rectangular	650	O	O	11.0	50~300	Cast iron, Steel	1955	O	20	1955	O	O	O		
35	Tsaghkashen	1	RC	2002	3.0	X	2.0	100	Steel	2002	X	2	RC	Rectangular	150	O	O	6.9	25~100	Steel	1985	O	25	1985, 1996	O	X	O		
36	Tsilqar	3	RC	1961	0.7	O	1.7	25~65	Steel	1961	O	1	RC	Rectangular	150	O	X	0.5	25	Steel	1961	O	6	1961	O	X	O		
37	Katnaghbyur	4	Masonry	1948~1963	22.5	O 2nos	7.2	50~200	Steel, Asbestos cement	1948~1963	O			X		O	O	1.7	50~150	Steel, Asbestos Cement	1963	O	3	1948, 1963	O	X	O		
							5.2	100, 200	Asbestos cement section	1960, 1963								0.7	100,150	Asbestos Cement section									
38	Karmrashen	2	Concrete	1955, 1989	27.0	O	6.7	150~400	Steel, Asbestos cement	1955~2003	O 0.8			X		O	O	2.8	50~150	Steel	1975	O	3	1986	O	X	O		
							0.8	150	Asbestos cement section																				
39	Kaqavadzor	1	RC	2000	8.0	X	4.5	100~200	Steel, Asbestos cement	1997	O	2	RC	Rectangular	150	O	O	8.0	100~250	Steel, Asbestos Cement	1970	O 7.8	8	1970, 1990	O	X	O		
							0.8	200	Asbestos cement section									2.5	200	Asbestos Cement section									
40	Hartavan	1	Concrete	1953	5.0	O	6.7	100~150	Steel, Asbestos cement	1953	O	1	RC	Rectangular	500	X	O	5.8	50~150	Steel, PE, AsbestosCement	1953	O 5.6	5	1953, 1980	O	X	O		
							6.2	100	Asbestos cement section									1.0	100	Asbestos Cement section									
41	Dzoraglukh	3	RC, Steel	1950~2000	3.8	O 2nos	5.7	65~150	Cast iron, Steel	1950~2000	O 4.7	2	RC	Rectangular	75, 200	X	X	2.9	50~100	Steel	1976	O 2.6	10	1976, 1999	O	X	O		
42	Dzoragyugh	3	Steel	1965	3.0	O					-			X		X	X	0.3	50	PE	2001	O	3	1967, 2001	O	X	O		
43	Meliqgyugh	4	Concrete	1960~1983	10.0	O	8.2	100, 150	Steel, CastIron, AsbestosCement	1960~1983	O	1	RC	Rectangular	250	O	X	2.0	100, 150	Steel, Asbestos Cement	1960	O	3	1985	O	X	O		
							0.9	150	Asbestos Cement section	1960								1.6	100, 150	Asbestos Cement section									

Source: JICA Study Team 2007

Table 4.2.1 Existing Water Supply Facilities (3/8)

ARAGATSOTN MARZ

No.	Community	Intake					Transmission Pipe					Reservoir					Chlorination	Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate l/s	Necessity (nos)	L km	dia mm	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity m^3	Necessity (nos, m3)		L km	dia mm	Material	Year	Necessity (km)	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
44	Miraq	1	Concrete	1986	1.0	O	4.2	100	Steel	1986	O			X		O	X					-	2	1987	O	X	O		
45	Mulqi	4	Masonry, Steel, Concrete	1820~1996	4.5	O 3nos	0.7	25~80	Steel	1970~1996	O	1	Steel	Circle	60	O	O	6.0	50, 100	Steel	1968	O	15	1968, 1996	O	X	-	1nos	O
46	Nigavan	2	Concrete	1975	5.5	O 1nos	7.0	100	Steel	2003	X	1	RC	Rectangular	250	X	O	3.8	100, 150	Steel	1985	O 0.2	4	1985	O	X	O		
47	Norashen	2	RC, Steel	1979, 1991	8.5	O 1nos	6.4	65~150	Steel	1979, 1991	O			X		O	O	4.0	25~65	Steel	1980, 2002	O	3	1991	O	X	O		
48	Norashen (Aragats)	1	Masonry	1964	20.0	O	15.0	100, 150	Steel	1985	X	1	RC	Circle	800	O	O	6.0	32~125	Steel	1955	O	30	1955	O	X	O	1nos	X
49	Shenavan	2	RC	1964, 1978	5.0	O	11.1	150	Steel	1981	O	2	RC	Rectangular	500	O	O	12.4	100~150	Steel	1981	O	12	1981	O	X	O		
50	Shgharshik	3	RC, Masonry	1950~2000	17.0	O	3.5	150, 200	Steel, Asbestos cement	1950, 2000	O			X		O	O	0.5	200	Asbestos cement	1973	O	5	1973, 1994	O	X	O		
							2.0	200	Asbestos cement section	1950								0.5	200	Asbestos cement	1973								
51	Vosketas	1	RC	1989	20.0	O	8.0	100, 125	Steel	1991	O	2	RC	Rectangular	250	X	O	4.6	50, 100	Steel	1989	O	6	1992, 2002	X	X	O		
52	Chqnagh	3	Concrete	1997	2.2	O	3.6	50,80	Steel	1997	O	1	RC	Rectangular	250	O	O	1.8	25~100	Steel	1970	O	0		-	X	O		
53	Jamshlu	1	RC	1957	1.0	O	4.5	150, 250	Asbestos cement	1957	O	1	RC	Rectangular	100	O	X	2.5	50, 100	Steel, Asbestos Cement	1957	O	13	1957, 1996	O	X	O		
							4.5	150, 250	Asbestos cement	1957								0.2	100	Asbestos cement section									
54	Saralanj	5	RC, Masonry, Steel, Concrete	1976, 1996	2.4	O	1.4	32~100	Steel	1976	O	1	RC	Rectangular	200	O	O	1.3	100	Steel	1976	O	3	1996	X	O	-		
55	Sipan	3	RC	1963, 2002	6.0	O	3.1	100	Steel	1991	O			\X		O	O	1.5	50, 100	Steel, PE	1991, 2002	O 0.7	8	1961, 1963	O	X	O		
56	Vardenis	4	RC	1998	6.5	O			X		-			X		O	O	6.0	50, 100	Steel, Cast iron	1997	O	2	1997	O	X	O		
57	Vardenut	2	RC, Concrete	1962, 1996	4.5	O	6.0	100, 150	Cast iron, Steel	1961, 1996	O	1	RC	Rectangular	300	O	O	4.8	80~150	Steel	1961, 1993	O 4.2	3	1993	O	X	O		
58	Verin Sasunik	1	Concrete	2007	0.8	X	1.5	80	Steel	2007	X			X		-	X					-	1	2007	X	X	O		
59	Tegher	2	RC	2002	3.5	X	5.7	50, 150	Steel	1970	O	1	RC	Rectangular	50	O	X	3.6	50, 80	Steel	1970	O	7	2002	X	X	O		
60	Orgov	1	Concrete	1950	4.7	O	3.2	150, 200	Steel	1970	X	1	RC	Rectangular	100	O	O	10.0	80, 150	Cast iron, Steel	1970	O	2	1970	O	X	O		
61	Ortachya	2	RC	1828, 1986	6.5	O	3.5	100, 150	Steel, Cast iron	1959, 1986	O	1	RC	Rectangular	100	O	X	1.2	25	Steel	1986	O	4	1986	O	X	O		

Source: JICA Study Team 2007

Table 4.2.1 Existing Water Supply Facilities (4/8)

SHIRAK MARZ

No.	Community	Intake					Transmission Pipe					Reservoir					Chlorination	Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate l/s	Necessity (nos)	L km	dia mm	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity m^3	Necessity (nos,m3)		L km	dia mm	Material	Year	Necessity (km)	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
1	Alvar	1	Concrete	1989	2.3	O	2.0	100	PE	1989	O	1	Steel	Circle	64	O	O	3.0	100	PE	1989	O	0		-	X	O		
2	Aghvorik	2	Masonry, Concrete	1920	2.0	O	3.0	100	Steel	1960	O	X				O	X	3.5	100	Steel	1950	O	4	1950	O	X	O		
3	Ardenis	2	Concrete	2003	5.0	X	1.5	50, 80	Steel	2003	X	1	Concrete	Rectangular	200	O	O	0.7	80	Steel	2003	O	12	2003	X	X	O		
4	Arpeni	2	Concrete	1950, 1992	5.0	O	6.0	100	Steel, PE	1950, 1992	O	1	Steel	Circle	32	X	O	1.0	80, 100	Steel	1992	O	3	1950, 1992	O	O	O		
5	Bandivan	1	Concrete	1991	5.0	O	2.5	100	PE	1991	O	1	Steel	Circle	48	X	X	1.2	100	PE	1991	X	3	1991	X	X	O		
6	Bashgyugh	1	Concrete	1988	4.0	O	3.0	100	PE	1988	O	1	Steel	Circle	48	O	X	1.7	100	PE	1988	X	7	1988	O	X	O		
7	Garnaritch	1	Concrete	1989	22.0	O	4.0	220	Ductile iron	1989	O	1	Steel	Circle	48	O	O	7.0	100	PE	1989	O	0		-	X	O		
	Yeghnajur						3.0	100	Steel	1989	O	1	Concrete	Rectangular	120	O	X	1.0	100	PE	1989	O	3	1989	X	X	O		
8	Kamkhut	1	Steel	1990	0.3	O					-			X		O	X	0.25	100	PE	1990	X	1	1991	X	X	O		
9	Zari Shat	1	Concrete	1950	1.5	O	0.4	100	Steel	1950	O			X		O	O	1.1	100	Steel	1950	O	8	1950	O	X	O		
10	Darik	1	Steel	1989	8.0	O	1.5	120	Steel	1990	O			X		O	X					-	0		-	X	O		
	Zorakert						3.0	120	Steel	1989	O	1	Steel	Circle	48	O	O	6.7	120	Steel	1989	X	3	1989	O	X	O		
11	Lernakert	2	Concrete, Masonry	1960, 1963	18.0	O	4.0	32, 100	Steel	1970	O	1	Cncrete	Rectangular	700	O	X	3.0	100	Steel	1960	O	12	1960, 1990	X	O	O		
12	Lernut	1	Masonry	1930	1.0	O	1.0	100	Ductile iron	1990	O			X		O	X					-	1	1913	O	X	O		
13	Tsaghkut	2	Concrete	1989	0.5	O	5.0	100	PE	1989	X	1	Steel	Circle	48	X	X	5.0	100	PE	1989	O	0		-	X	O		
14	Kamo	5	Concrete	1965~ 2003	6.8	O 2nos	4.6	100, 150	Steel	1964, 2002	X	1	Concrete	Rectangular	220	O	O	4.5	50, 100	Steel	1964	O 3.0	4	1964	O	O	O		
15	Karmraqar	1	Concrete	1961	0.2	O	0.6	120	Steel	1961	X			X		O	X					-	2	1961	O	X	O		
16	Kaqavasar	2	Masonry, Concrete	1976, 1997	1.0	O	3.1	50, 100	Steel	1976, 1997	O	1	Concrete	Rectangular	200	O	X	3.0	100, 150	PE, Steel	1990	O 2.0	10	1990	O	X	O		
17	Krashen	3	Concrete	1950, 1999	16.0	O	1.0	100~200	Steel	1950~ 1990	O 0.6	2	Concrete	Rectangular	50	O	X	2.85	50~150	Steel	1950	O 0.85	3	1950	O	O	O		
18	Krasar	1	Concrete	2000	2.0	O	4.0	100	PE	1990	O	1	Concrete	Rectangular	70	O	X	4.0	50, 100	Steel, PE	1990, 2000	X	2	1990, 2007	O	O	O		
19	Mayisyan Kayaran	1	Iron	1976	0.2	O	0.1	100	Ductile iron	1970	X			X		O	X	0.25	50	Ductile iron	1976	X	3	1950, 1990	O	X	O		
20	Hovit	1	Concrete	1970	2.0	O	1.5	50	Steel	1970	O	1	Steel	Circle	10	O	O	1.3	20, 50	Steel	1970	O	12	1970, 1990	O	X	O		
21	Dzorashen	1	Concrete	1990	5.0	O	5.0	100	PE	1990	O	1	Steel	Circle	80	O	X	2	100	PE	1990	X	0		-	X	O		
22	Akhuryan Kayaran	1	Steel	1956	0.2	O	1.5	50	Steel	1956	X			X		O	X					-	2	1956	O	O	O		
23	Mets Sariar	5	Masonry, Concrete	1967~ 2003	1.8	O 1nos	11.5	50~100	Steel	1967~ 2003	O 5.0	1	Concrete	Rectangular	100	O	X	4.0	76~100	Steel	1950	O	2	1950	O	O	O		

Source: JICA Study Team 2007

Table 4.2.1 Existing Water Supply Facilities (5/8)

SHIRAK MARZ

No.	Community	Intake					Transmission Pipe					Reservoir					Chlorination	Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate l/s	Necessity (nos)	L km	dia mm	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity m^3	Necessity (nos,m3)		L km	dia mm	Material	Year	Necessity (km)	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
24	Musaelyan	3	Masonry	1952	8.5	O	11.0	100, 150	Asbestos cement, PE	1950, 1985	O	1	Concrete	Rectangular	400	O	O	0.3	100	Steel, Cast iron	1950~1985	O	0		-	X	O		
							10.0	150	Asbestos cement section	1950																			
25	Shaghik	1	Masonry	1990	5.0	O	4.0	100	PE	1990	O	1	Concrete	Circle	48	O	X	2.0	100	PE	1990	O	3	1990	O	X	O		
26	Shirak	1	Masonry	1889	0.5	O	0.1	50	Steel	1990	X	X				O	X					-	1	1888	O	X	O		
27	Pemzashen	1	Masonry	1828	30.0	O	0.5	200	Cast iron, Steel	1960	O	1	Concrete	Rectangular	400	O	X	5.55	100~200	Ductile iron, Asbestos cement	1955	O	21	1955	O	O	O		
																		4.65	100~200	Asbesto cement section									
28	Jajur	3	Concrete, Asbestoscement	1955, 1965	10.0	O	10.5	50~100	PE, Steel, Iron	1961~1997	O	2	Concrete	Rectangular	70	O	X	9.0	50~100	Steel, PE, Iron	1955~1960	O	12	1960	O	O	O		
		1	Asbestos cement	1955																									
29	Jajur Kayaran	2	Steel, Concrete	1962, 1990	6.0	O	1.0	100, 150	Iron, Steel	1965, 1990	O 1.0	X				O	X	0.8	50	Steel	1955	O	3	1955	O	X	O		
30	Jrarat	5	Steel, Masonry	1850, 2003	8.0	O 4 nos	4.6	70~150	Steel	1960~2003	O 4.6	1	Concrete	Rectangular	500	O	X	7.7	75, 100	Steel	1960, 1965	O 7.0	4	1960	O	X	O		
31	Sarnaghbyur	2	Steel	1970	13.5	O					-	X				O	O	8.5	76~100	Steel, Iron	1970	O	20	1970	O	X	O		
32	Sarapat	1	Concrete	1962	2.0	O	4.0	100	PE	1990	O	1	Concrete	Circle	48	O	X	0.2	100	PE	1960	X	8	1960	O	X	O		
33	Sizavet	3	Concrete, Steel	1961, 1975	24.0	O	7.0	160~200	Steel, Asbestos cement	1965, 2001	O 2.0	X				O	O	15.0	75	Steel, PE	1978	O	60	1978	O	X	O	2nos	X
							2.0	160	Asbestos cement section	1965																			
34	Tzoghamarg	2	Concrete	1970	4.2	O	2.2	100	Steel	1990	O	1	Concrete	Rectangular	30	X	X	4.0	100	PE	1991	O	3	1991	X	X	O		
35	Poqr Sariar	3	Concrete	1989	6.5	O	10.0	100	PE, Steel	1989	O	1	Steel	Circle	64	O	O	2.5	50	PE	1989	O	7	1989	X	X	O		

Source: JICA Study Team 2007

Table 4.2.1 Existing Water Supply Facilities (6/8)

GEGHARKUNIK MARZ

No.	Community	Intake					Transmission Pipe					Reservoir					Chlorination	Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate l/s	Necessity (nos)	L km	dia mm	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity m^3	Necessity (nos,m3)		L km	dia mm	Material	Year	Necessity	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
1	Akunq	1	Concrete	1965	15.0	O	0.2	150	Steel	1964	O	1	Concrete	Circle	400	O	O	11.5	100, 150	Steel	1964	O	20	1970	O	X	O		
2	Aghberq	4	Concrete	1952, 1970	1.4	O	4.5	50~100	Steel	1952, 1970	O	4	Concrete	Rectangular	50, 100	O	X	8.0	50	Steel	1952	O	4		O	X	O		
3	Aygut	4	Concrete	1960~ 2004	14.5	O 3nos	8.0	60~100	Cast iron, Steel, PE	1960~ 1998	O	4	Concrete	Rectangular, Circle	100, 200	O	X	22.0	50, 100	Steel	1960, 1970	O	5	1960	O	X	O		
4	Ayrq	1	Concrete	1950	1.5	O	21.0	150	Steel	1950	O	1	Concrete	Rectangular	60	O	X	4.0	50, 100	Steel	1950	O	6		O	X	O		
5	Antaramej	1	Concrete	1960	1.0	O	4.5	50	Steel	1960	O	1	Concrete	Rectangular	50	O	X	1.5	50	Steel	1960	O	2	1960	O	X	O		
6	Astghadzor	5	Concrete	2000~ 2007	100.0	X					-			X		O	X	38.0	25~100	Steel	2000	O	0		-	O	O	5nos	X
7	Artsvanist	2	Concrete	1952, 1970	10.0	O	26.0	100, 150	Steel, Asbestos, Castiron	1952, 1970	O 14.0	2	Concrete	Rectangular, Circle	100, 200	X	X	7.0	80~125	Steel	1955, 1970	O 5.5	8		O	X	O		
							6.0	150	Asbestos cement section	1952																			
8	Geghamabak	1	Concrete	1950	0.5	O	5.0	100	Steel	1950	O	1	Concrete	Rectangular	9	O	X	3.5	50	Steel	1950	O	1		O	X	O		
9	Geghamavan	4	Concrete	1980~ 2004	1.8	O 3nos	5.0	80, 125	Steel	1984	O	1	RC	Circle	500	O	X	6.0	125	Steel	1984	O	1	1984	X	X	O		
10	Gegharkunik	3	Concrete	1953~ 1976	10.5	O	20.0	80, 100	Steel, Asbestos cement	1953~ 1976	O	1	Concrete	Rectangular	500	O	X	6.0	32~80	Steel	1975	O	5	1975	X	X	O		
							3.5	100	Asbestos cement section	1976																			
11	Geghhovit	2	Concrete	1970, 1975	60.0	O 1nos	17.0	150~300	Steel, PE	1970, 1975	O	3	Concrete	Rectangular	300~ 1000	X	X	39.0	32~150	PE, Steel	1970	O 35.0	20	1970	O	O	O	1nos	X
12	Ddmashen	2	Concrete	1998	10.0	O 1nos	12	100~200	Steel	1998	X	2	RC	Rectangular	250	X	X	15.0	100, 150	Steel	1968	O	10	1968	O	X	O		
13	Dprabak	3	Concrete	1950~ 1996	6.5	O	7.5	60~150	Steel, PE	1950~ 1996	O 5.0			X		O	X	8.0	50~100	Steel, PE	1960	O 7.0	3	1960	O	X	O		
14	Drakhtik	1	Concrete	1960	6.0	O	3.5	100, 150	Asbestos cement, Steel	1960	O	1	Concrete	Circle	150	O	X	0.8	100	Steel	1960	O	1	1992	X	X	O		
							1.5	150	Asbestos cement section																				
15	Yerenos	1	Concrete	1970	25.0	X	13	100, 200	Steel	1970, 2004	X	2	Concrete	Rectangular	600~ 700	X	X	24.5	50~200	Steel, Cast iron, uPVC	1970, 2004	O 21.5	15	1,970	O	O	O		
16	Zolaqar	15	Masonry, Concrete	1930~ 2002	318.0	O 1nos					-			X		O	X	16.7	50~150	Steel	1960, 1980	O	15	1960, 1980	X	X	O	14nos	X
17	Zovaber	2	Concrete	1958, 1981	5.0	O 1nos	32.0	50, 100	PE, Steel, Cast iron	1958, 1981	O	1	RC	Rectangular	700	O	X	10.0	50, 100	Steel	1970	O 2.0	6	1970	X	X	O		
18	Tazagyugh	1	Concrete	1960	17.0	X	18.0	70~200	Steel	1960	O 13.5	1	RC	Circle	250	X	O	17.0	75~150	Steel, Asbestos cement	1960	O	15	1960	O	X	O		
																		15.0	100, 150	Asbestos cement section									
19	Lchavan	1	Masonry	1964	45.0	O	0.8	200	Steel	1964	O	1	Concrete	Rectangular	300	O	X	4.0	100	Cast iron, Steel	1964	O	2		O	X	O	1nos	O
20	Lusakunq	2	Masonry, Concrete	1947, 1997	120.0	O					-			X		O	X	4.5	75~150	Steel, Asbestos cement	1947, 1997	O	5		O	X	O		
																		2.5	75, 100	Asbestos cement	1947								
21	Khachaghbyur	1	Concrete	2002	90.0	X					-			X		O	X	5.05	80~200	Steel	2002	O 4.55	6		O	X	O		

Source: JICA Study Team 2007

Table 4.2.1 Existing Water Supply Facilities (7/8)

GEGHARKUNIK MARZ

No.	Community	Intake					Transmission Pipe					Reservoir					Chlorination	Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate l/s	Necessity (nos)	L km	dia mm	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity m^3	Necessity (nos,m3)		L km	dia mm	Material	Year	Necessity	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
22	Tsaghkashen	2	Concrete, steel	1997, 1998	7.0	O 1nos	3.7	80~150	Asbestos cement, Steel	1958, 1998	O 1.0	1	Concrete	Rectangular	150	O	X	3.0	50, 100	Steel	1958, 1998	O	7	1998, 2003	O	X	O	1nos	X
							1.0	150	Asbestos cement section	1958																			
23	Tsaghkunq	2	Concrete	1950	1.0	O	2.1	100	Cast iron, Steel	1950	X	1	Concrete	Rectangular	50	X	X	0.5	100	Steel	1950	O	3	1950	O	X	O		
24	Tsovagyugh	3	Concrete	1970, 1994	10.0	O	24.0	150	PE, Steel	1970, 1994	O	2	RC	Rectangular, Circle	500	O	O	7.0	50, 100	Steel	1970, 1994	O	5	1970	X	X	O		
25	Tsovak	1	Concrete	2006	20.0	X	18.0	150, 200	Steel	1950~ 2006	O	1	Concrete	Rectangular	600	X	X	9.2	50~150	Steel	1994	O	15		O	X	O		
26	Tsovinar	3	Concrete	1967, 1986	45.0	O 2nos	41.0	150, 200	Cast iron, PE	1967, 1986	O 22.0	2	Concrete	Circle	500	O	X	11.0	50~200	Steel	1967	O	40	1960, 1970	O	O	O		
27	Kalavan	1	Concrete	1960	1.0	O	5.0	50	Steel	1960	O			X		O	X					-	1	1960	X	X	O		
28	Barepat	2	Concrete	1960, 1970	1.5	O	3.5	40, 60	Steel, PE	1960~ 1997	O	2	Steel	Circle	20	X	X	2.0	40	Steel	1960	O	0		-	X	O		
29	Karchaghgyur	2	Concrete	1965, 1980	14.0	O	9.0	75, 100	Steel	1965, 1986	O	2	RC	Rectangular	500, 1000	X	O	12.0	50,100	Steel	1968, 1996	O	10		O	X	O		
30	Dzoragyugh	1	Concrete	1997	50.0	X	12.5	500	Steel	1997	X	2	Concrete	Circle	200, 1000	O	X	20.0	75~150	Steel	1960	O	20	1960	O	X	O		
31	Dzoravanq	3	Concrete	1960~ 1987	2.3	O	4.9	50~100	Steel, PE	1960~ 1987	O	2	Concrete	Rectangular	30, 120	O	X	2.5	50, 70	Steel	1960, 1970	O	0		-	X	O		
32	Madina	1	Concrete	1973	6.0	O	1.6	200	Steel	1973	O	1	RC	Rectangular	100	O	O	6.0	50	Steel	1975	O	4		O	X	O		
33	Maqenis	1	Concrete	1960	3.0	O	4.0	80	Steel	1972	O	1	Concrete	Rectangular	70	O	X	1.8	75, 85	Steel	1973	O	12		O	X	O		
34	Mets Marsarik	2	Concrete	1952, 1998	30.0	O	20.6	100, 150	Steel, Asbestos cement	1952, 1963	O	1	Concrete	Rectangular	500	O	X	12.0	50~150	Steel	1952	O	40		O	X	O		
							7.0	100	Asbestos cement section	1952																			
35	Norakert	1	Concrete	1981	6.0	X	24.0	150~400	Steel	1980	O	2	Concrete	Rectangular	300, 500	X	X	6.0	100	Cast iron	1980	O	0		-	X	O	1nos	O
36	Shatjreq	2	Concrete	1988, 2000	12.0	X					-			X		O	O	12.0	80~150	Steel	2000	X	7	1988, 2000	O	X	O		
37	Shatvan	2	Concrete, steel	1970, 2000	15.0	O 1nos	18.7	100, 150	Asbestos cement, PE	1960, 2006	O 17.0	1	Concrete	Rectangular	100	O	X	3.0	150	Steel	1960	O	10	2006	O	X	O		
							17.0	100	Asbestos cement section	1960																			
38	Shorzha	3	Concrete	1960, 1997	14.5	O 1nos	11.0	75, 100	Steel	1960, 1997	O 10.0	3	Concrete, Steel	Rectangular, Elevated	25~700	O 75	X	5.0	50~100	Steel	1960	O	7	1960	X	X	X	1nos	X
39	Jaghatzadzor	1	Concrete	1960	1.0	O	4.5	100	Steel	1950	O	1	Concrete	Rectangular	60	O	X	0.15	50	Steel	1960	O	6		O	X	O		
40	Semyonovka	1	Concrete	1950	5.0	O					-			X		O	X	1.0	80	Steel	1988	O	1	1988	X	X	O		
41	Vaghashen	3	Concrete	1970	22.0	X					-			X		O	X	9.0	25~100	Steel	-	O	0		-	X	O	3nos	X
42	Vardadzor	2	Concrete	1970	32.0	O	5.0	200	Steel	1970	O	2	Concrete	Rectangular, Circle	200, 400	X	O	8.1	50~150	Cast iron, Steel, uPVC	1970, 1972	O	10	1972	O	X	O		
43	Verin Getashen	1	Concrete	1999	15.0	X	25.0	200~530	Steel	1,990	X	1	RC	Circle	500	X	O	20.0	20~150	Steel	1999	O	10	1999	O	X	O		
44	Torfavan	1	Concrete	2005	10.0	O	3.5	150	Steel	2002	O			X		O	X	3.0	40~100	Steel	1980	O	3		O	X	O		
45	Pokr Masrik	1	Concrete	1960	40.0	X	1.2	150	Steel	1960	O	1	Concrete	Rectangular	600	X	X	3.6	100, 150	Cast iron, Steel	1960	O	0		-	X	O	1nos	X

Source: JICA Study Team 2007

Table 4.2.1 Existing Water Supply Facilities (8/8)

TAVUSH MARZ

No.	Community	Intake					Transmission Pipe					Reservoir						Distribution pipe					Public tap			Drainage		Pump	
		Nos.	Material	Year	flow rate	Necessity (nos)	L	dia	Material	Year	Necessity (km)	Nos.	Material	Shape	Capacity	Necessity (nos,m3)	Chlorination	L	dia	Material	Year	Necessity (km)	Nos	Year	Necessity	Existence	Necessity	Existence	Necessity
					l/s		km	mm							m^3			km	mm											
1	Aghavnavanq	6	Concrete, Masonry	1950~2006	4.3	O 3nos	7.0	50~100	Steel	1950~2006	O 4.5	1	Concrete	Rectangular	250	O	X	9.0	50, 100	Steel	1950	O	3	1970	O	X	O		
2	Gandzaqar	3	Concrete	2002	60.0	X	7.0	100, 150	Steel	2001~2003	O	1	Concrete	Rectangular	250	O	X	6.1	50~150	Steel	1970	O	2		X	X	O		
3	Getahovit	2	Concrete	1950, 1976	8.0	O	12.5	100, 200	Steel	1950, 1976	O	1	Concrete	Rectangular	50	O	X	23.5	50~200	Steel	1950	O	3	1950	O	O	O		
4	Gosh	2	Concrete	1981, 2002	11.0	O 1nos	9.0	100	Steel	1981, 2002	O	2	Concrete	Circle	500, 150	O	X	11	50, 100	Steel	1981	O	0		-	X	O		
5	Yenoqavan	2	Concrete	1960, 1965	3.0	O	5.5	100~200	Steel	1960, 1970	O	2	Concrete	Rectangular	150	O	X	1.2	75, 100	Steel	1960	O 1.0	0		-	O	O		
6	Teghut	1	Concrete	1969	4.0	O	7.0	150	Steel	1969	O			X		O	X	4.7	50~150	Steel	1969	O	0		-	O	O		
7	Itsakar	1	Concrete	1965	3.0	O	2.9	75, 80	PE, Steel	1991, 2003	O 0.7	1	Concrete	Rectangular	150	O	X	2.5	40, 50	Steel	1991	O	0		-	X	O		
8	Lusahovit	3	Concrete	1967~1985	7.0	O	6.5	75, 100	Steel	1967~1985	O 5.0			X		O	X	3.0	50	Steel	1967	O	0		-	X	O		
9	Lusadzor	3	Concrete	1950~1978	16.2	O	3.1	50~100	Steel	1950~1978	O			X		O	X	1.4	75~100	Steel	1950	O	2	1950	O	X	O		
10	Khachardzan	1	Concrete	2000	3.0	O	2.0	80	Steel	2000	O	1	Concrete	Rectangular	100	O	X	1.6	40~80	Steel	1990	O	0		-	X	O		
11	Hovq	4	Concrete	1950~1980	8.0	O	7.60	50~100	Steel	1950~1980	O			X		O	X	2.3	50~100	Steel	1950	O	0		-	X	O		
12	Navur	3	Concrete	1950, 2003	3.5	O 1nos	11.8	100	Steel	1956, 2003	O 0.3	3	Concrete	Rectangular	60, 250	O	X	9.0	50, 100	Steel, Cast iron	1956	O	0		-	O	O		

Source: JICA Study Team 2007

CHAPTER 5 WATER SOURCES (WATER AVAILABILITY AND WATER QUALITY)

5.1 General

The field investigations were carried out from July to September 2007. The Study Team summarized the information in tables and evaluated the water quantity and water quality as follows:

(1) Most of the rural communities have enough volume of water from the water sources, however, 50% of the rural communities feel that water volume is insufficient.

(2) Most of the water sources satisfy the chemical water quality as drinking water in accordance with both Armenian and WHO (2004) guidelines. Marginal amount of Mn, Ba, Be, Mo, and Pb are detected from 20 rural communities.

(3) Most of the rural communities contain bacteriological indicators, total bacteria, total coliform bacteria, and thermotolerant. Among them, thermotolerant, which is an indicator of hazardous bacteria, is identified from the 14 rural communities.

5.2 Methodology

The Study Team prepared ‘survey sheets’ for the field investigations in order that information of a necessary level of standard and accuracy should be obtained from the field investigations conducted by a local consultant. The Study Team first carried out a preliminary field investigations using the ‘survey sheets’ to determine if the survey sheets contained sufficient items to be investigated on the sites, followed by modifications and additions of survey items on the survey sheets after the preliminary survey. After the field investigations conducted by the local consultant, evaluation on water sources were conducted as follows:

(1) Assessment of Water Volume Sufficiency

Water volume presently taken from sources to communities was determined by either direct measurement wherever possible or interviews with members of the communities.

Sufficiency or insufficiency was assessed by comparing estimated water demands of a community with water volume presently being supplied to the community.

(2) Users Acceptance of Present Water Quality

During the field investigations, users acceptance for water quality presently used for drinking purposes was broken into two categories; a. acceptable and b. not acceptable. Descriptions on “Category-b not acceptable” were given in the report.

(3) Chemical Water Quality Assessment;

Two guidelines, one the Armenian Guidelines and the other the WHO guidelines (3rd editions), are referred to for water quality assessments. Where the content of a chemical with health significance does not meet one of the guidelines, it is simply so indicated.

Chemicals which are not of health significance are just for reference. Acceptance of such water shall depend on the decisions of the users, as WHO recommends in the 3rd edition.

(4) Bacteriological water quality assessment

Assessment was made based principally on the test records collected from the State Hygiene and Anti-Epidemic inspectorate, Ministry of health. Total coliform bacteria’ and ‘total general bacteria’ are no longer considered as indicators for hazardous contaminations according to WHO 3rd edition, though such bacteriological testing is still being carried out. Only thermotolerant is considered as hazardous bacteria in this report.

5.3 Aragatsotn Marz (61 Target Communities)

5.3.1 Water Sources

(1) Types of water sources

A summary of types of water sources is shown in Table 5.3.1. Majority (48 communities: 78.7%) of water sources are spring water only. Water main also originates from spring water, 60 rural communities use spring water for domestic purpose. Three (3) rural communities use groundwater because they cannot receive water from the water mains. No.46 Nigavan is the only one rural community which does not take spring water.

Table 5.3.1 Types of Water Sources (Aragatsotn Marz)

	Water sources	Nos. of Com.
a.	Spring	48
b.	River + spring	1
c	River + water main	2
d.	Lake + groundwater	1
e.	Groundwater+ water main	3
f.	Water Main	3
g.	Treatment Plant	1
h.	Spring + Water Main	2
	Total	61

Source: JICA Study Team 2007

(2) Sufficiency of Water Volume

A summery of communities with insufficient volume of water is shown in Table 5.3.2. Among six rural communities tabulated in below, four (4) communities, No.11 and 33 are included in Chlkan and No.18 and 28 are included in Irind water supply system. When water supply to those communities properly, their water shortage will be solved. No.23 Eghnik has alternative water source 11km away from the community. The present water source is approximately 1.5km from the community and it is difficult to take water from the alternative water source in view of cost effectiveness.

Table 5.3.2 Communities with Insufficient Volume of Water (Aragatsotn Marz)

No.	Community	Water sources	Alternative water sources
11	Arteni	Groundwater + water main	Water from the water main, Irind water supply system, does not reach Arteni. If the water main operates properly, water volume will be sufficient.
18	Getap	Groundwater + water main	Water from the water main, Chlkan water supply system, does not reach Getap. If the water main operates properly, water volume will be sufficient.
23	Eghnik	Spring	An alternative source is 11 km from the rural community.
28	Tlik	River + water main	Water from the water main, Chlkan water supply system, does not reach Tlik. If the water main operates properly, water volume will be sufficient.
33	Lusakn	Water main	Lusakn is included in Irind water supply system, and 0.2lit/sec water reaches Lusakn although it is planned to be supplied 1.0lit/sec. If the water main operates properly, water volume will be sufficient.
36	Tsilkar	Spring	No other sources are available.
Total six (6) communities (*No. : Community No.)			

Source: JICA Study Team 2007

5.3.2. Water Quality

(1) Results from field investigations

Out of 61 communities surveyed, a total of 15 communities complained that their water quality was ‘Not acceptable’. A summary is as shown in the Table 5.3.3 below.

Three (3) communities (No. 9, 11, 46) complain about their borehole water quality. Though No.18 Getap also uses the groundwater as the water source, it is not operated at present and community does not complain about the water quality. All the rural communities, which use the groundwater, feel that groundwater quality is not suitable as drinking purpose.

Two (2) communities (No.14, 28) using river water complain about the water quality. Rural communities replied that water was turbid in spring season and after rainfall. It assumes that turbidity is a major reason of their complaining.

Another nine (9) communities pointed out that external surface water enters into the main pipe from damaged water supply facilities and water quality worsen. However, Thermotolerant was not identified from six (6) rural communities, No.18, 21, 25, 26, 50, and 61 as shown in Table 5.3.6. It assumes that damaged water supply facilities affects to people's impression about water quality.

Table 5.3.3 Communities Complaining of 'Intolerable' Water Quality (Aragatsotn Marz)

No.	Community	Water Sources	Reasons for deeming 'intolerable'	Notes;
9	Aragatsavan (Talin)	Groundwater	Water from boreholes is not tolerable	hd(970mg/L)
11	Arteni (Aparan)	Groundwater	Water from boreholes is undrinkable	W, hd(210mg/L)
14	Byurakan	River	Undrinkable water	-
16	Geghadir	Spring	Due to asbestos cement pipe	-
18	Getap	No water sources	Irrigation water being used for domestic purposes	W
21	Dian	Spring	Due to damaged intakes and pipes	-
25	Nor Yedesia	Water Main	Due to corroded pipe	-
26	Zovasar	Spring	Due to damaged intakes and pipes	-
28	Tlik	River	Undrinkable water	W
32	Lusagyugh	Spring	Due to damaged intakes and pipes	Col
35	Tsaghkashen	Spring	Due to damaged intakes and pipes	-
45	Mulqi	Spring	Due to damaged intakes and pipes	Col
46	Nigavan	Groundwater	Undrinkable water	hd(825mg/L)
50	Shgharshik	Spring	Due to damaged intakes and pipes	-
61	Ortachya	Spring	Due to damaged intakes and pipes	-
Total 15 communities				

*No. : Community No.;
"W" : Communities with insufficient water volume.
"Col": Communities with water containing thermotolerant
"hd": Communities with water of high hardness (xx mg/L)

Source: JICA Study Team 2007

(2) Results of water quality testing

1) Chemical Analysis

Out of the 61 communities surveyed, a marginal amount of Manganese (Mn), which is more than Armenian Guideline, was identified in water samples from eight (8) communities. However, all are well under the WHO guideline value (Table 5.3.4).

In two (2) communities, No.9 and 46, hardness values exceed the Armenian guideline value (Table 5.3.5) and both communities complain about water quality as mentioned above. Though hardness value of No.11, 210mg/L, is below the guideline value, they also complain about the water quality. It assumes that community people do not prefer to taste of water or they have impression that groundwater quality is not suitable for drinking purpose.

Table 5.3.4 Communities with Water of High "Mn" Content (Aragatsotn Marz)

Community No.	Community	mg/L	Community No.	Community	mg/L
7	Avshen	0.1	25	Nor Yedesia25	0.1
21	Dian	0.1	38	Karmrashen	0.2
23	Eghnik	0.1	57	Vardenut	0.1
24	Yernjatap	0.1	59	Tegher	0.1
Total eight (8) communities					
Guideline values:: Armenia - Mn:0.1; WHO - Mn:0.4					

Source: JICA Study Team 2007

Table 5.3.5 Communities with Water of high "Hardness" Content (Aragatsotn Marz)

Community No.	Community	mg/L	Community No.	Community	mg/L
9	Aragacavan	970	46	Nigavan	825
Guideline values:: Armenia – Hardness: 700 ; WHO – no guideline value					

Source: JICA Study Team 2007

2) Bacteriological Analyses

Out of the 61 communities, Thermotolerant was identified in water from eight (8) communities as shown in Table 5.3.6. This is an indication that water is contaminated by "e-coliform" which will be of a fecal origin and hazardous to human health. It is considered that contaminated water enters into the system through damaged parts of the supply systems.

Table 5.3.6 Communities with Water Containing Thermotolerant (Aragatsotn Marz)

Community No.	Community	Community No.	Community
10	Arayi	40	Hartavan
27	Ttujur	45	Mulki
32	Lusagyugh	49	Shenavan
35	Tsaghkashen	57	Vardenut
Total eight (8) communities; WHO Guideline: shall not be detected			

Source Ministry of Health

5.4 Shirak Marz (35 Target Communities)

5.4.1 Water Sources

(1) Types of water sources

Out of the 35 target communities, 29 communities (83%) use only spring water as the source for drinking water. Other communities also take spring water or water main as shown in the Table 5.4.1.

Table 5.4.1 Types of Water Sources (Shirak Marz)

	Water sources	Nos. of Com.
a.	Spring	29
b.	Spring + Borehole	1
c.	Water Main	3
d.	Spring + Water Main	2
	Total	35

Source: JICA Study Team 2007

(2) Sufficiency of Water Volume

Although sufficient volume of water is available to most of the communities surveyed, two (2) communities claim that the water supply is not sufficient as shown in Table 5.4.2. Field investigations suggest that water yield from the springs are marginal as compared to the estimated demands. It assumes that leakage of the water supply systems may contribute to the insufficiency of the amount of water supplied.

Table 5.4.2 Communities with Insufficient Volume of Water (Shirak Marz)

No.	Community	Water sources	Alternative water sources
8	Kamkhut	water main	none
26	Shirak	spring	none
Total two (2) communities			
*No. : Community No.			

Source: JICA Study Team 2007

5.4.2 Water Quality

(1) Acceptability of water

Out of the 35 communities surveyed, a total of four (4) communities complain that their water is not acceptable, mainly due to contamination through damaged parts of the systems as shown in Table 5.4.3. Two (2) communities, No.15 and 18, explained that public officers recommended not drinking their water based on the laboratory tests. A review of existing bacteriological laboratory tests, however, suggests that thermotolerant is not detected in the water of the said two communities; which suggests there may be no immediate danger to the said two communities.

Table 5.4.3 Communities Complaining of 'Intolerable' Water Quality (Shirak Marz)

No.	Community	Water Sources	Reasons for deeming 'intolerable'	Notes;
1	Alvar	Spring	Unknown	-
13	Tsaghkut	Spring	Biological contaminants in water	W
15	Karmrakar	Spring	Due to water quality analysis	-
18	Krasar	spring	Due to water quality analysis	-
Total four (4) communities				
*No. : Community No.; "W" : Communities with insufficient water volume. "Col": Communities with water containing thermotolerant "hd": Communities with water of high hardness (xx mg/L)				

Source: JICA Study Team 2007

(2) Results of water quality testing

1) Chemical Analysis

Out of the surveyed 35 communities, a marginal amount of chemical components that are of health significance, were detected in water samples from the five (5) communities shown in Table 5.4.4. Molybdenum (Mo) causes debility, headache, loss of appetite, and dizziness. Barium (Ba) causes contraction of blood vessel, convulsion, and paralysis. Lead (Pb) is stored in the body when it takes excessively and it causes lead poisoning. All the test results do not exceed the both water quality guideline values. However, all items affect to human health, re-test shall be highly required. No other chemical components such as hardness exceeded the guideline values.

Table 5.4.4 Communities with Water Containing Chemicals (Shirak Marz)

Test Results			Guideline Value (mg/L)	
Item	Community	(mg/L)	Armenian	WHO
Mo	13 Tsaghut	0.10	0.25	0.07
	24 Musaelyan	0.09		
Ba	17 Krashen	0.11/0.13	0.1	0.7
	28 Jajur,	0.21		
	29 Jajur kayaran	0.11		
Pb	28 Jajur	0.013	0.03	0.01
Total three (3) chemical items, five (5) Communities				

Source: JICA Study Team 2007

2) Bacteriological Analysis

Thermotolerant was identified in water in one (1) community as shown in Table 5.4.5. This is an indication that water was contaminated by e-coliform, which will be of fecal origin and hazardous to human health, through damaged parts of the pipeline.

Table 5.4.5 Communities with Water Containing Thermotolerant (Shirak Marz)

No.	Community
31	Sarnaghbyur (spring)

Total one (1) communities; Guidelines: shall not be detected
Source: Ministry of Health

5.5 Gegharkunik Marz (45 Target Communities)

5.5.1 Water Sources

(1) Type of water sources

Out of the 45 target Communities, 37 (82%) use spring water as the source for drinking water. Others use boreholes or water from existing water mains, as shown in Table 5.5.1.

Table 5.5.1 Types of Water Sources (Gegharkunik Marz)

	Water sources	Nos. of Com.
a.	Spring	37
b.	Borehole	3
c.	Water Main	2
d.	Spring + Borehole	2
e.	Spring + Water Main	1
	Total	45

Source: JICA Study Team 2007

(2) Sufficiency/insufficiency of water volume

Only two (2) communities claim that the volume of water supplied is not sufficient. The field observations suggest that in those two communities the water yields from the springs are poor in addition to leakage from damaged water supply systems. As alternative sources one community proposed river water with a treatment facility and the other to capture other springs near the existing spring area as shown in Table 5.5.2.

Table 5.5.2 Communities with Insufficient Volume of Water (Gegharkunik Marz)

No.	Community	Water sources	Alternative water sources
23	Tsaghkunq	Springs	River water with treatment
24	Tsovagyugh	springs	Nearby available "Aytsemnassar" springs'
Total two (2) communities (*No. : Community No.)			

Source: JICA Study Team 2007

5.5.2 Water Quality

(1) Acceptability of present water

Only one community claims that the water quality is poor as shown in Table 5.5.3. There are no water quality items exceeding the both guideline values according to the test results. Rural community thinks that contaminated substances enter from damaged parts of the transmission line.

Table 5.5.3 Communities Complaining of 'Intolerable' Water Quality (Gegharkunik Marz)

No.	Community	Water Sources	Reasons for deeming 'intolerable'	Note;
17	Zovaber	Spring	Due to damaged transmission line	
Total one (1) community (*No. : Community No.)				

Source: JICA Study Team 2007

(2) Results of water quality testing

1) Chemical Analysis

Marginal amounts of chemical components harmful to health were identified in water samples from five (5) communities as shown in Table 5.5.4. Manganese (Mn) causes water colored black and affects to human health such as sleeplessness, emotional impediment, and shaking of arms and legs. It is shown that beryllium (Be) affects to human health, however, there is no specific research has been conducted concerning as beryllium and human health. Though the water quality test results are marginal level, all items affect to human health matter, re-test shall be highly required. Water with high "hardness" was identified in one community as shown in the Table 5.5.5. No complaining arises from No.23 community about water quality.

Table 5.5.4 Communities with Water Containing Chemicals (Gegharkunik Marz)

Test Results			Guideline Value (mg/L)	
Chemical	Community	(mg/L)	Armenian	WHO
Mn	37 Shatvan	0.1	0.1	0.4
Mo	20 Lusakunq	0.17	0.25	0.07
	44 Torfavan	0.17		
Be	11 Geghhovit	0.00021	0.0002	-
Pb	24 Tsovagyugh	0.012	0.03	0.01

Source: JICA Study Team 2007

Table 5.5.5 Communities with Water of High "Hardness" Content (Gegharkunik Marz)

No.	Community	mg/L	No.	Community	mg/L
23	Tsaghkunk	810	-	-	-
Guideline values:: Armenia – Hardness: 700 ; WHO – no guideline value					

Source: JICA Study Team 2007

2) Bacteriological Analysis

Thermotolerant was identified in water in three (3) communities as shown in Table5.5.6. This is an indication of water contamination by e-coliform which will be of fecal origin and hazardous to human health.

Table 5.5.6 Communities with Water Containing Thermotolerant (Gegharkunik Marz)

No.	Community
6	Astghadzor (deep well)
10	Gegharkunik (spring)
35	Norakert
Total three (3) communities; WHO Guideline: shall not be detected	

Source: Ministry of Health

5.6 Tavush Marz (12 Target Communities)

5.6.1 Water Sources

(1) Type of water sources

Out of the 12 target communities, 9 (75 %) of the communities use spring water as the water sources for drinking purposes, while the other communities use existing water-mains or a river as sources, as shown in Table 5.6.1.

Table 5.6.1 Types of Water Sources (Tavush Marz)

	Water sources	Nos. of Com.
a.	Spring	9
b.	Water Main	1
c.	Spring + Water Main	1
d.	river	1
	Total	12

Source: JICA Study Team 2007

(2) Sufficiency/insufficiency of water volume

None of the communities claim that their water volume is insufficient.

5.6.2 Water Quality

(1) Acceptability of Water Quality

None of the communities claim that the quality of their water is not acceptable.

(2) Results of water quality testing

1) Chemical Analysis

A marginal amount of Manganese, which exceeded Armenian Guidelines, was identified in water samples for one (1) community, though all were well under the WHO guideline value as shown in Table 5.6.2. It affects to human health, re-test shall be highly required. "Hardness" exceeded the Armenian guideline value in one community as shown below, though the community does not complain about this point as shown in Table 5.6.3.

Table 5.6.2 Communities with Water Containing Chemicals (Tavush Marz)

Test Results			Guideline Value (mg/L)	
Chemical	Community	(mg/L)	Armenia	WHO
Mn	5 Yenokavan	0.10	0.1	0.4
Total one (1) chemical item, one (1) community				

Source: JICA Study Team 2007

Table 5.6.3 Communities with Water of High "Hardness" Content (Tavush Marz)

No.	Community	mg/L	No.	Community	mg/L
9	Lusadzor	715	-	-	-
Guideline values:: Armenia – Hardness: 700 ; WHO – no guideline value					

Source: JICA Study Team 2007

2) Bacteriological Analysis

Thermotolerant was identified in the water in two (2) communities as shown in Table 5.6.4. This is an indication that water is contaminated by e-coliform which will be of fecal origin and hazardous to human health.

Table 5.6.4 Communities with Water Containing Thermotolerant (Tavush Marz)

No.	Community
7	Itsakar
12	Navur
Total two communities; WHO Guideline: shall not be detected	

Source: Ministry of Health

5.7 Evaluations on Water Sources

5.7.1 Insufficient Water Supply as Against Demands

The results of the field survey conducted show that most of the rural communities have enough volume of water from the water sources for their water supply, as compared with the estimated demands for the population. However, about 50 % of the surveyed communities complain about insufficiency of the water volume from their water supply system. This insufficiency of water volume occurs mainly due to leakage from damaged water supply systems such as damaged intakes, transmission pipelines, distribution pipelines and taps. In addition, unsuitable practices of water usage such as leaving taps open are causes of water insufficiency. Rehabilitation of the systems is needed as well as rational water use to prevent wasting water.

Three (3) communities (No.36 Tsilkar of Aragatsotn; and No. 23 Tsaghkunq and No.24 Tsovagyugh of Gegharkunik Marz) do not have proper water sources. Introduction of rational water use is recommended after rehabilitation of the present systems.

5.7.2 Water Quality – Chemical Quality

Chemical water quality of most sources is acceptable for drinking purposes in accordance with both Armenian and WHO (2004) guidelines, except for the following marginal cases. Marginal amounts of chemical components of health significance were identified in water samples from the communities are shown in Table 5.7.1.

Table 5.7.1 Summary of Chemical Analysis

Measurement			Guideline Values	
			Armenia	WHO
Mn (mg/L)			0.1	0.4
Aragatson	7. Avshen	0.1	+	-
	21 Dian	0.1	+	-
	23 Eghnik	0.1	+	-
	24 Yernhatap	0.1	+	-
	25 Nor Yedesia	0.1	+	-
	38 Karmrashen	0.2	++	-
	57 Vardenut	0.1	+	-
	59 Tegher	0.1	+	-
Gegharkunik	37 Shatvan	0.1	+	-
Tavush	5 Yenokavan	0.1	+	-
Mo (mg/L)			0.25	0.07
Shirak	13 Tsaghut	0.10	-	++
	24 Musaelyan	0.09	-	++
Gegharkunik	20 Lusakunq	0.17	-	++
	44 Torfavan	0.17	-	++
Ba (mg/L)			0.1	0.7
Shirak	17 Krashen	0.11/0.13	+	-
	28 Jajur	0.21	++	-
	29 Jajur Kayaran	0.11	+	-
Pb (mg/L)			0.03	0.01
Shirak	28 Jajur	0.013	-	+
Gegharkunik	24 Tsovagyugh	0.012	-	+
Be (mg/L)			0.0002	n/a
Gegharkunik	11 Geghhovit	0.00021	+	-
++: Exceeding, +: marginal, -:not exceeding				

Source: Study Team 2007

Certain chemical items (Mn, Ba, Be) are observed to be equal to or more than the Armenian guideline values though well under WHO guideline values; whereas some others (Mo, Pb) exceed WHO guideline values though they are under Armenian guideline values. It is recommended to re-test water in communities concerned to verify/confirm the results of the testing once implementation of rehabilitation works should be decided. Decisions have to be made through discussions at a national level because it is a matter of health concern.

5.7.3 Water Quality – Bacteriological Quality

The Study carried out the bacteriological water quality tests for 53 rural communities. It is observed that most of the water sources in the target communities, 149 out of 153 rural communities, are periodically inspected and tested for bacteriological contaminations by the State Hygiene and Anti-Epidemic inspectorate, Ministry of Health. Thus, bacteriological water quality is evaluated using the test data which Ministry of Health conducts. Most of the water sources contain bacteriological indicators: 'total bacteria', 'total coliform bacteria' and 'thermotolerant'. Although those indicators indicate that the

water sources are contaminated to some extent, only thermotolerant is an indicator for hazardous bacteria. Thermotolerant was detected for the following 14 communities as shown in Table 5.7.2. On the other hand, the Study conducted bacteriological tests for five (5) samples out of 14 communities and no community was detected by thermotolerant. The 14 rural communities shall identify the causes of the contamination and shall immediately apply chlorination to their water in view of human health.

Table 5.7.2 Summary of Communities with Water Containing Thermotolerant

Aragatson	Shirak	Gegharkunik	Tavush
10 Arayi	31 Sarnaghbyur	06 Astghadzor	07 Itsakar
27 Ttujur	-	10 Gegharknik	12 Navur
32 Lusagyugh	-	35 Noraket	-
35 Tsaghkashen	-	-	-
40 Hartavan	-	-	-
45 Mulki	-	-	-
49 Shenavan	--	-	-
57 Vardenut	-	-	-

Source: Ministry of Health

Even though thermotolerant has not been detected yet in other communities, they are recommended to preferably apply chlorination to the water or to be prepared for immediate chlorination in the event that thermotolerant should be identified in their water by one of the periodic inspections in the future.

5.7.4 Preference of Water Quality - Hardness

Some communities complain about ‘hardness’. Though water indicating high value of hardness tastes and communities do not prefer such taste, hardness itself does not affect to human health. It is possible to use as domestic water. Communities with water containing hardness more than 700 mg/L (Armenia Guideline value) are listed in Table 5.7.3 below.

Table 5.7.3 Summary of Communities with Water Containing High Hardness

Marz	Community	Measurements (mg/L)
Aragatson	9 Aragacavan	970
	46 Nigavan	825
Gegharkunik	23 Tsaghkunk	810
Tavush	9 Lusadzor	715

Source: JICA Study Team 2007

CHAPTER 6 SOCIO-ECONOMIC CONDITIONS AND WATER USE OF THE 153 RURAL COMMUNITIES

6.1 General

General features of socio-economic conditions and water use of the communities as follows.

(1) Agriculture is main industry and limited employment opportunity,
(2) Insufficient community budget and limited allocation for water supply maintenance,
(3) Ownership of existing water supply system belongs to community,
(4) Water fee is collected by flat rate without water meter,
(5) They do not have the appropriate skills or experiences for management of rural water supply.

The target of the Study is 153 rural communities, each of them has its own characteristics. In order to formulate the water supply operation and maintenance plan for each rural community the Study has collected information regarding the socio-economic conditions and water use of each rural community. Therefore, the current socio-economic conditions and present water use in 153 communities were surveyed.

6.2 Methodology

The socio-economic survey was conducted in 153 communities in Aragatsotn, Shirak, Gegharkunik and Tavush marzes. The work was carried out by a local consultant during the period June-August 2007.

The socio-economic survey method represented an interview survey using a questionnaire sheet. The key informants were the rural community leaders and/or deputy leaders. Standardized methods were used for recording the responses to the question items.

The survey questionnaire consisted of the following sections: administrative data, baseline data, socio-economic data, water use and water demand data, as well as operation and maintenance data.

Administrative and baseline data sections included questions on rural community administration, population, number of households, tendencies of changes in population number, average income of households, and annual budget of the rural community,

including centrally established taxes and duties, subsidies from the state budget, local duties and fees, land and property rent and revenue from the sale of rural community property.

The socio-economic section of the questionnaire included questions on the items of major production of the rural community, including agricultural and factory products. Special attention was paid to the role of women carrying out specific rural community activities.

The water use and water demand section was intended to study the present condition of the water supply volume, number of house connections, number of water meter installation, schedule of water supply, satisfaction with the service, monthly water fee per household (if any), as well as water fee collection ratio. In additional to these, questions were included on the volume of irrigation water, availability of water use permits and others. The questionnaire sheet of each rural community is shown in DATA BOOK.

6.3 Rural Community Interview Summary

6.3.1 Population and Demography

Table 6.3.1 summarizes population numbers in 2007 in all the 153 rural communities surveyed. To make the information more characteristic, categories of the population composition are as follows: (a) <250 residents, (b) 251-500 residents, (c) 501-1,000 residents, (d) 1,001-3,000 residents, (f) 3,001-5,000 residents and >5,000 residents.

Table 6.3.1 Composition of Population in the JICA Study Area in 2007

Population distribution in the surveyed communities	Aragatsotn		Shirak		Gegharkunik		Tavush		Total	
	Number of communities	Population number	Number of communities	Population number	Number of communities	Population number	Number of communities	Population number	Number of communities	Population number
(a) <250	10	1,653	12	1,487	5	970	-	-	27	4,110
(b) 251-500	13	4,655	11	3,677	4	1,209	4	1,755	32	11,296
(c) 501-1,000	23	16,846	4	2,244	10	6,903	3	1,734	40	27,727
(d)1,001-3,000	11	17,075	6	8,270	14	26,828	4	6,520	35	58,693
(e)3,001-5,000	3	12,090	2	7.533	8	33,810	1	3,840	14	57,273
(f)>5,000	1	5,600	-	-	4	24,818	-	-	5	30,418
Total	61	57,919	35	23,211	45	94,538	12	13,849	153	189,517

Source: JICA Study Team, 2007

According to the JICA Study in 2007, the total population in all 153 surveyed rural communities is almost 190 thousand. The total growth of the population was approximately 4.2% in the six year period since the 2001 census results, when the population number was 181,887. However, this is not the tendency everywhere. For

example, in the communities surveyed in Aragatsotn Marz, a population decline was observed compared to 2001 (approximately 3.3%), whereas in the communities surveyed in Gegharkunik Marz the population increased by 10.3% compared to 2001. And finally, 2.3% and 2.1% population increase has been observed compared to 2001 in Shirak and Tavush marzes respectively.

Table 6.3.2 provides information on the number of households, as well as average population number per household in the 153 surveyed rural communities. The grand average population per household is 3.6. However, there are several variations from the average. For example, No.13 Dprabak (Gegharkunik), No.3 Antarut (Aragatsotn) and No.28 Jajur (Shirak) the average per household population numbers are 1.4, 1.1 and 1.5 respectively, whereas is No.6 Avtona (Aragatsotn), No.5 Bandivan (Shirak), No.19 Lchavan (Gehgarkunik) the average per household population numbers are 9.3, 9.2 and 7 respectively.

Table 6.3.2 Composition of Households in the JICA Study Area

Marz	Number of Communities	Number of Households	Number of Population	Average People per Household
Aragatsotn	61	15,176	57,919	3.8
Shirak	35	6,126	23,211	3.8
Gegharkunik	45	26,846	94,538	3.5
Tavush	12	4,276	13,849	3.2
Total	153	52,424	189,517	3.6

Source: JICA Study Team, 2007

6.3.2 Community Budgets

Insufficient budget is a major defect to proper management of water supply systems in most of the rural communities surveyed. Table 6.3.3 summarized community budgets for 2006 for all the 153 rural communities surveyed. To make the information more characteristic, we have categorized the annual community budgets as follows: (a) < AMD 500 thousands, (b) AMD 500-1,000 thousands, (c) AMD 1,000- 5,000 thousands, (d) AMD 5,000-10,000 thousands and (e) > AMD 10,000 thousands. The most remarkable budget size is (c) AMD 1,000- 5,000 thousands.

Table 6.3.3 Community Budgets in JICA Study Area

Annual budget of the community (x AMD 1,000)	Aragatsotn	Shirak	Gegharkunik	Tavush	Total	% of total
(a) <500	8	2	2	1	13	8.5
(b) 500-1,000	8	6	5	2	21	13.7
(c) 1,000- 5,000	36	19	19	5	79	51.6
(d) 5,000-10,000	4	6	14	3	27	17.7
(e) >10,000	5	2	5	1	13	8.5
Total by marz	61	35	45	12	153	100

Source: JICA Study Team, 2007

44% of rural communities regularly allocate the budget to drinking water supply sector. It is considered that allocation from the community budget to the drinking water sector in the period 2004-2007 is insufficient as shown in Table 6.3.4.

Table 6.3.4 Community Budget Allocation to Drinking Water Sector

Allocation from community budget to drinking water sector	Aragatsotn	Shirak	Gegharkunik	Tavush	Total	% of total
Some regular allocation	32	11	18	6	67	43.8
No allocation at all	14	14	14	3	45	29.4
Irregular allocation	15	10	13	3	41	26.8
Total by marz	61	35	45	12	153	100

Source: JICA Study Team, 2007

Many small rural communities are simply too small to be viable entities, and can barely pay salaries, let alone make the required recurrent allocations to ensure adequate maintenance for key community assets, including drinking water supply systems.

6.3.3 Social Security Indicators

As seen from Table 6.3.5, the highest rate of pensioners, unemployed people and those receiving benefits is in the surveyed 12 communities of Tavush.

Table 6.3.5 Main Social Security Indicators in 153 Rural Communities in Four Marzes

Social Security Group	Aragatsotn		Shirak		Gegharkunik		Tavush		Total	
	Number	% of total	Number	% of total	Number	% of total	Number	% of total	Number	% of total
Pensioners	8,561	14.8	2,982	12.9	13,300	14.1	2,408	17.4	27,251	14.4
Unemployed	1,903	3.3	124	0.5	6,186	6.5	1,611	11.6	9,824	5.2
Receiving benefits	1,912	3.3	1,163	5.0	4,752	5.0	1,926	13.9	9,753	5.1
Total	12,376	21.4	4,269	18.4	24,238	25.6	5,945	42.9	46,828	24.7

Source: JICA Study Team, 2007

The situation with employment varies significantly. For example, in the 32 out of 61 rural communities surveyed in Aragatsotn, 17 out of 35 rural communities of Shirak and 16 out of 45 rural communities of Gegharkunik there is virtually no-unemployment, whereas in other communities the unemployment ratio is between 20-50%. As of the no-unemployment, some people are self-employed. Another reason for low unemployment is that a lot of people who don't have employment in their rural community have left to Russia or other countries for employment.

The unemployment problems are particularly severe for socially vulnerable groups described in the mentioned Table 6.3.5. One of the mechanisms employed by the

government to meet the basic needs of vulnerable groups is provision of family benefits. There is family benefit system in Armenia for the families, whose income is below certain level. Ministry of social security has developed a scale of salaries, and the families whose total salary is below the scale, receive family benefit. Before, such people would get 50% discount on utilities (telephone, gas, electricity) and public transport, but since now there are private operators for the utilities, government decided to provided family benefit for the poor families, and has eliminated the discount system.

As for the health sector, the analysis conducted allows stating unequivocally that the most alarming and key issue of healthcare is the lack of access to healthcare services: medical care and medicine. Only three rural communities, No.8 Aragats, No.34 Tsaghkahovit, and No.11 Arteni in Aragatsotn Marz have medical ambulance stations, and there is a policlinic in No.27 Pemzashen (Shirak Marz). In most of the other rural communities there are only first-aid health posts.

In 2006 several water-related health problems occurred in 16 of the 153 rural communities surveyed. Cases of diarrhea, kidney disease, dysentery, skin disease, stomach disease, intra-hepatic calculus, colitis, gall-bladder disease, typhus, rabbit-fever and other allegedly water-related diseases occurred in the rural communities of No.2 Gandzaqar, and No.6 Teghut (Tavush Marz), No.8 Aragats, No.14 Byurakan, No.37 Katnaghbyur, and No.43 Meliqgyugh (Aragatsotn Marz), No.1 Akunq, No.3 Aygut, No.6 Astghadzor, No.9 Geghamavan, No.11 Geghhovit, No.14 Drakhtik, No.15 Yeranos, No.20 Lusakunq, No.24 Tsovagyugh and No.34 Mets Masrik (Gegharkunik Marz).

6.4 Sources of Income

Table 6.4.1 summarized the average monthly income per household in AMD in all the 153 rural communities surveyed. It should be noted that information provided in Table 6.4.1 is based on the information from rural community heads, and in some cases is approximate. To make the information more characteristic, the categories of the average monthly income per household are as follows: (a) < AMD 10,000, (b) AMD 10,001-30,000, (c) AMD 30,001 – 50,000, (d) AMD 50,001-100,000 and (e) > AMD 100,001.

Table 6.4.1 Average Monthly Income per Household

Average monthly income per household (AMD)	Aragatsotn	Shirak	Gegharkunik	Tavush	Total	% of total
(a) <10,000	7	5	3	1	16	10.5
(b) 10,001-30,000	41	18	25	8	92	60.1
(c)30,001 – 50,000	10	7	13	3	33	21.6
(d) 50,001-100,000	2	2	4	-	8	5.2
(e) >100,001	1	3	-	-	4	2.6
Total by marz	61	35	45	12	153	100

Source: JICA Study Team, 2007

In total, in 108 out of the 153 rural communities surveyed (or more than 70%) the average monthly income per household is less than AMD 30,000. There is rather lower average when compared to the average salary per family in Armenia which is now between AMD 80,000 and 90,000. And in only 4 out of the 153 surveyed rural communities (or less than 3%) was the average monthly income per household more than AMD 100,000. This is a serious issue for consideration while proposing tariffs for drinking water supply and discharge services in the above-mentioned rural communities.

In most of the rural communities there are no major industries currently operating. Agriculture is the main source of income for the population. Particularly, income is generated from the following sources:

- Agricultural and livestock products (dairy products, eggs, and meat)
- Vegetables and fruit (potatoes, cabbage, cauliflower, and fruit)
- Cereal crops (wheat and barley)
- Wool

6.5 Gender

6.5.1 General Profile of Gender in Armenia

International Fund for Agricultural Development (IFAD) reports that Armenia grants women equal rights under the law, including equal entitlement to education, health care, employment and certain anti-discrimination measures, but that such legislation is not widely applied since Armenia does not have a public Agency designed to deal with gender issues. The National Action Plan 2004-2010 on Improving the Status of Women and Enhancing Their Role in Society emphasizes the need for effective institutions to address women's issues. The Plan also highlights the unequal participation of women in the country's political and social spheres and calls for women's increased involvement in democratization and the development of civil society.

6.5.2 Present and Future Situation of Gender in Connection with Water Supply

(1) Burden of carrying water

According to some verbal interviews to the local residents, it is not only women but also men are in charge of the burden of carrying domestic/drinking water on daily basis from public tap. After the implementation of the project, households will have a house connection in principle and will not have to go far to get water anymore. Unless there is a particular external impact on the society, there won't be a remarkable change of work sharing related to the burden of carrying water even after the water supply facilities are rehabilitated.

(2) Water Users' Organization

When the water supply facilities are rehabilitated, Water Users' Organization, which is composed of water users, will be necessary for daily operation and maintenance. As domestic water is firstly used by women, who are in charge of cooking and other housework, it is important to involve more women in the campaign of the rational water use by Water User's Organization.

6.5.3 Evaluation

In rural society in Armenia, domestic/drinking water is generally carried by both of men and women when they need to do so. Thus, there is no distinctive differentiation between the both sexes, and the distribution of gender functions, which can be interchanged based on the circumstances, is rather likely to be conditional. Even if the mode of water supply changes, the burden of carrying water will be equally shared between men and women just as it is, because the rehabilitation of water facilities would give quite little impact on traditional or cultural structures in local societies. In other words, there is and will be quite little anxiety about gender issues as long as water supply is concerned.

It is important, however, to enhance the women's participation in rural society, introducing more activities, including drinking water users' organization, with a view to empowering the women and overcoming the poverty problem.

6.6 Operation and Maintenance of Water Supply System

6.6.1 Monthly Water Fees

Table 6.6.1 provides summary information on the payments associated with drinking water supply in the communities surveyed. Among the 153 surveyed communities, 117

(approximately 75%) communities do not employ water fees, and 36 (approximately 25%) communities collect water fees.

Water fees are collected in various forms: i.e. – combinations of monthly or annually and per capita or per household. Among the 36 communities, 29 communities collect monthly fees, one collects a yearly fee regularly; whereas others collect fees irregularly when needed and/or only from villagers that can afford to pay; or gave no clear replies. All 36 communities adopt flat rates, though no penalty is given to those who do not pay. "Donations" from certain villagers or even national and/or international organizations are often essential funds for O&M.

In order to review an outline of the present situation regarding water fee payment, various water fee collection methods and schedules as described above paragraph were converted into the form of a "monthly fee per household" and based on the assumption that collection ratios are 100%. The results are given below in Table 6.6.1.

Table 6.6.1 Monthly Water Fees

Drinking water monthly fee per household, in AMD	Aragatsotn		Shirak		Gegharkunik		Tavush		Total		
	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	Number of communities	% of surveyed communities	
0 (no fee)	46	75.4	27	77.0	35	77.8	9	75.0	117	76.5	
< AMD 200	2	3.3	1	2.9	3	6.7	-	-	6	3.9	
AMD 201-500	7	11.5	1	2.9	1	2.2	2	16.7	11	7.2	
AMD 501-800	3	4.9	-	-	1	2.2	1	8.3	5	3.3	23.5
AMD 801-1000	3	4.9	3	8.6	2	4.4	-	-	8	5.2	
AMD 1001-1500	-	-	3	8.6	3	6.7	-	-	6	3.9	
Total	61	100	35	100	45	100	12	100	153	100	

Source: JICA Study Team, 2007

6.6.2 O&M Costs Incurred in the Year 2006

Information on O&M costs incurred in the year of 2006 were only given on a verbal basis and from a limited number of communities; no information or records were made available on the O&M costs in the previous years. O&M costs mainly consist of direct costs such as (1) electricity, (2) labor cost and (3) material cost, as shown in Figure 6.6.1 below. Only the cost for electricity is on a regular basis; others costs are on an irregular basis and only arise when repairs are needed. Thus the costs needed in a single year vary considerably from year to year, "fundraising" is then needed when major repairs are needed. No systematic and/or regular O&M activities have so far been made except for fee collection for electricity costs where needed for pumping.

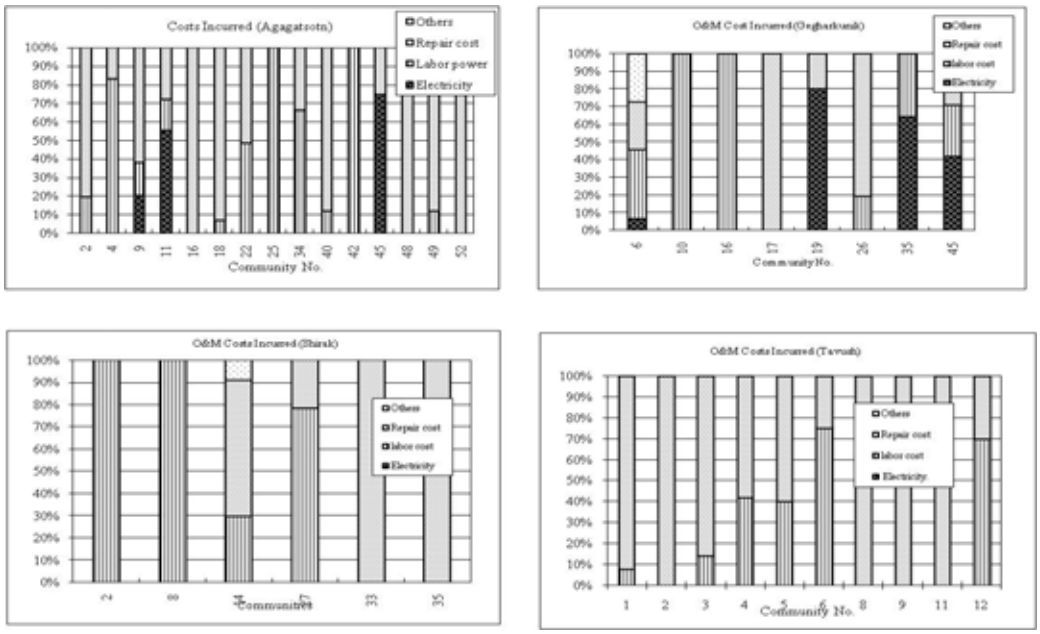


Figure 6.6.1 Types of O&M Costs

Source: JICA Study Team 2007

A Summery of O&M costs in the communities where water fees are collected by any mode is given in Table 6.6.2 below. Total O&M cost in 2006 vary from community to community because some communities undertook major repair works and the others did not. Estimated average monthly water fees, with an assumption that O&M costs needed in a community should be borne by all the households in the community, range from 200 to AMD 260 /month/household. It may be concluded that this range of monthly water fee per household is needed to maintain the present water supply systems at the present levels where communities suffer from water shortage in winter and/or bacteriological contamination into water and so on.

Table 6.6.2 Summary of O&M Costs

Marz		Costs in 2006 (AMD/year)	Household (nos)	Average (AMD/month/HH)
Aragatsotn	Max	12,000,000	1600	625
	Min	53,000	798	6
	Average	89,000	-	250
Shirak	Max	1,000,000	400	208
	Min	50,000	62	67
	Average	170,000	-	258
Gegharknik	Max	3,000,000	420	595
	Min	240,000	369	54
	Average	1,240,000	-	242
Tavush	Max	5,250,000	870	503
	Min	172,000	399	36
	Average	1,910,000	-	207
AMD/Month/HH was calculated given that all household in the community pay water fee.				

Source: JICA Study Team 2007

6.6.3 Coverage of Collected Fees against the O&M Costs Incurred – Balance Sheet

Out of the 36 Communities where water fees are collected in various forms, only eight communities replied that the water fees collected actually covered the O&M costs. A summary is shown in Table 6.6.3 below.

Table 6.6.3 A Summary of Water Fees Collected, O&M Cost and Collection Ratios

Marz	No	Community	Interviewed information				Calculation			Note
			HH	Monthly Fee-AMD	Coverage over O&M Cost	Annual Cost -AMD	Money Annually Collected-AMD	Calculated HH who Pays Fee	Collection Rate	
			(a)	(b)	(c)	(d)	(e)=(d)*(c)	(f)=[(e)/(12month)]/(b)	(g)=(f)/(a)	
Aragatsotn	18	Getap	75	1000	40%	675,000	270,000	23	30%	Gravity
Aragatsotn	22	Yeghipatrush	187	1000	70%	490,000	343,000	29	15%	Gravity
Aragatsotn	40	Hartavan	246	300	50%	160,000	80,000	22	9%	Gravity
Aragatsotn	45	Mulqi	178	1000	90%	400,000	360,000	30	17%	Electcicity
Aragatsotn	52	Chqnagh	65	220	60%	100,000	60,000	23	35%	Gravity
Gehgharkunik	10	Gegharkunik	369	338	50%	240,000	120,000	30	8%	Gravity
Gehgharkunik	19	Lchavan	104	1000	80%	750,000	600,000	50	48%	Electcicity
Gehgharkunik	26	Tsovinar	1728	1000	40%	2,480,000	992,000	83	5%	Gravity
Average	Communities using pumps (electricity)		-	-	85%	-	-	-	32%	-
	Communities using gravity systems		-	-	52%	-	-	-	17%	-
	All		-	-	60%	-	-	-	21%	-

HH: Household, AMD:Armenian Dram

Source: JICA Study Team 2007

A range from 40 % to 90 % (60% in average) of actual O&M costs are covered by revenue collected in the eight communities; communities using electricity for pumping collect an average of 70% of the actual O&M costs whereas communities using gravity systems collect an average of 52% of actual O&M costs.

Calculation of collection ratios based on the information obtained through interview surveys shows that collection ratios range from 5 % to 50% (21% in average) in eight communities.

All information and interpretation above show that:

- Most of the communities (117 communities) do not collect water fees but rather allocate community budgets for the O&M costs of their water supply systems.
- Only 36 among 153 communities collect water fees in various collecting modes.
- Only 60 % of the O&M costs actually incurred are covered by the money collected, which just maintain the present levels of water supply services. The remaining 40 % are covered either by community budgets or other funds available.
- Present collection ratio of household-wise is considered to be below 50%, possibly down to 20 %.

6.6.4 System Maintenance

Responsibility for water supply in the locations, where water supply facilities are owned by the communities lies with the rural community heads. In 137 rural communities the rural community heads and local residents are mainly involved in repair works of the water supply facilities. In the remaining rural communities, repair works are being conducted by irrigation Water User Associations, local and international NGOs, and the Armenian Social Investment Fund. Six community heads claim that nobody is engaged in repair works of the water supply facilities in their communities. In a few cases (mostly related to renovation of pumps), specialists are hired from outside for repair works.

In almost all the rural communities surveyed there is no specialized organization in charge of the operation and maintenance of drinking water supply facilities. As for the preferred method of organization of operation and maintenance, 41% of community heads suggested that all costs should be covered by drinking water fees, whereas the 49% were in favor of residents participating in O&M works as much as possible and thus reducing the cost of O&M, taking into consideration the existence of socially vulnerably groups in those communities.

Table 6.6.4 Preferred O&M Method According to Rural Community Heads

The preferable O&M method	Aragatsotn		Shirak		Gegharkunik		Tavush		Total	
	Number of communities	%	Number of communities	%	Number of communities	%	Number of communities	%	Number of communities	% of total
Residents participate in O&M works as much as possible to reduce the cost	26	43	21	60	22	49	6	50	75	49
All costs are covered by water fees	29	48	13	37	14	31	6	50	62	41
O&M is completely subsidized by the State	0	0	1	3	1	2	0	0	2	1
Difficult to answer	6	9	0	0	8	18	0	0	14	9
Total	61	100	35	100	45	100	12	100	153	100

Source: JICA Study Team, 2007

In addition, 9% find it difficult to answer. This is good figure given the existence of socially vulnerable groups in the communities. Additional explanatory work and increasing awareness will further increase the ratio of communities agreeing that O&M should be covered by water fees.