Institute for Applied Environmental Economics

NATIONAL POLICY DIALOGUE ON RURAL WATER SUPPLY AND SANITATION IN ARMENIA

Policy packages for rural settlements

A project for the State Committee for Water Systems in Armenia, managed by the EAP task force, and with financial support of European Union under the EU Water Initiative

Disclaimer: Opinions presented in this document are those of the Consultant and do not necessarily represent the opinion of the Steering Committee of the project or of the Armenian Government
This report is on interim results achieved by mid September 2007, final results (December 2007) may deviate, due to remodelling and additional data

Author: Jochem Jantzen

05 November 2007

Institute for Applied Environmental Economics (TME)
Hogeveenseweg 24
NL 2631 PH Nootdorp
The Netherlands
tel.: (+31)-15-310 67 38
fax: (+31)-15-380 12 18
e-mail: tme@tme.nu
url: www.tme.nu

TABLE OF CONTENTS

SUMMARY

This interim report presents the results of the initial assessment of two policy packages for rural Water Supply and Sanitation in Armenia. To start with, examples are given of the expenditures linked with different levels of rural water supply, for 3 "model" villages. Also, the results of a survey amongst rural settlements without service of Water Companies are discussed.

The example calculations clearly show that the higher the level of service (in terms of quantity and distance), the higher the expenditures per household. However, the step from no piped water to Minimal Water Supply Standards is the most expensive one. So expressed in costs per cubic meter, the basic MWSS approach leads to the highest costs of water supply per cubic meter, higher levels of water supply lead to higher total annual costs for households, but as a result of the increased quantities of water supplied, to lower costs per cubic meter.

A survey, that has been conducted amongst rural settlements without WSCs[1], leads to some remarkable conclusions. Water production in rural settlements is in general quite high: on average 300 lcd is available. It also appears that water supply in these settlements is mainly financed from local budget contributions, but still it is estimated that about 17% of expenditures is financed by user charges. There is a wide variation in costs of water supply in these rural settlements: from almost 0 ADM/m3 to above 100 AMD/m3. In the majority of cases, costs are less than AMD 20/m3.

As a first step towards building consensus on a policy scenario for water supply in rural settlements, two scenarios have been simulated, in comparison with the baseline scenario:

- the Minimal Water Supply Standards (MWSS)scenario, aiming at providing each rural inhabitant in Armenia with at least 50 litre per capita per day, with at least 4 hours of regularity and with a maximal distance of 100 meters from the dwelling to a standpost;
- the combined MWSS and Poverty Reduction Strategy Paper (PRSP) scenario, aiming at both MWSS and also increasing on plot water supply to about 70% of rural population.

Table A gives an overview of the expenditures in the 3 scenarios.

Table A Estimated expenditures and investments for rural water supply in Armenia, 2008 – 2015, in billion AMD[2]

Scenario	expenditures 2008	expenditures 2016	investments/ renovations 2008 - 2015
Baseline	2.6 (1.6*)	1.6	1.7
MWSS	5.1	3.0	24
MWSS & PRSP targets	6.4	3.5	36

* Operation and maintenance and re-investment expenditures

Compared to the baseline, the 2 policy scenarios lead to a steep increase in expenditures. In 2008, twice the amount projected in the baseline would have to be spent to pick up with the policy scenarios. In total, the implementation of MWSS would require some AMD 25 billion, if also targets of the PRSP should be achieved, some AMD 35 billion should be invested in the period 2008 – 2015.

[1] WSCs = Water and Sewage Companies
[2] AMD = Armenian Dram, in this report we have applied a exchange rate of 470 AMD per €.

Once MWSS would be implemented, annual operational and maintenance costs and re-investments, would almost double from AMD 1.6 billion to AMD 3 billion. Achieving the more ambitious targets of the “combined scenario” of MWSS and PRSP would require some 20% higher annual expenditures.

Some 75% to 80% of investments needed in the two scenarios, will be focussed on the rural settlements not served by WSCs. In these

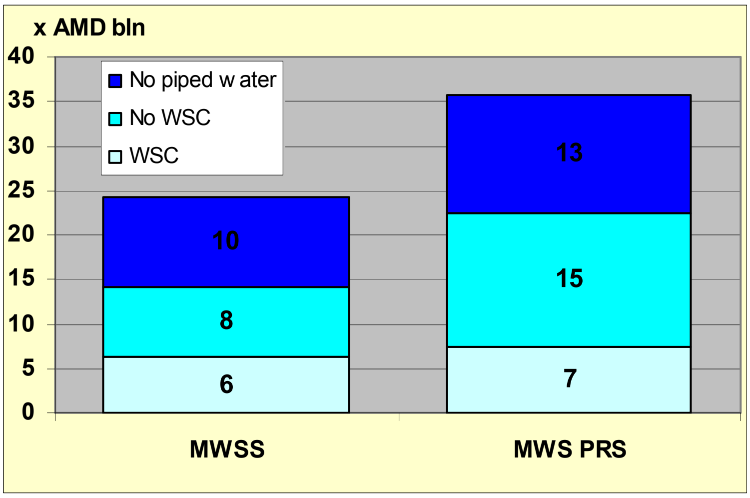


Figure A
Division of investments expenditures over Water and Sewage Companies, settlements with own supply and settlements with no supply, for the MWSS and the combined MWSS & PRSP scenario

In settlements where currently no water supply system exists (about 5% of rural population), some 40% of investments must be focussed. In settlements with no WSC services, but with own water supply services (about 50% of rural population), about 30 - 45 % of investments and in settlements currently served by WSCs (45% of rural population) about 20 – 25%.

1 INTRODUCTION

This interim report on the National Policy Dialogue (NPD) on a Financing Strategy (FS) for rural Water Supply and Sanitation (WSS) in Armenia, gives an overview of the results of initial scenario simulations for improving the water supply in rural Armenia.

Starting from the baseline, which was presented and discussed in March 2007 at the first Steering Committee (SC) meeting, and considerations on how a policy package could be developed, discussed at the 2nd SC meeting in July 2007, two policy scenarios have been simulated:

- the Minimal Water Supply Standards (MWSS) scenario, aiming at providing each rural inhabitant in Armenia with at least 50 litre per capita per day (lcd), with at least 4 hours of regularity and with a maximal distance of 100 meters from the dwelling to a standpost;
- the combined MWSS and Poverty Reduction Strategy Paper (PRSP) scenario, aiming at both MWSS and also increasing on plot water supply to about 70% of rural population.

Before the results of these simulations will be discussed attention will be paid to:

- some example calculations to show cost differences of various service levels for water supply in rural Armenia;
- the results of a survey to rural settlements on rural water supply, sanitation, the expenditures and financing (by user charges and municipal budgets).

A comparison between the Feasible simulations and the estimates based on empirical information from the survey is discussed in annex 1.

Due to limited time, data on rural WSS still to be collected and analysed and technical problems with the Feasible model, the results are preliminary and may be subject to changes, as soon as all additional data can be included in the analysis.

2 EXAMPLE SIMULATIONS

2.1 Introduction

Members of the SC (Steering Committee) have asked during the meeting of 11 July 2007, to simulate with Feasible various options of levels of water supply in rural settlements. The results than can guide the members of the SC in their decision making.

For that purpose for 3 different types of settlements, simulations have been carried out:

- a settlement of 1200 inhabitants, of which 65% are connected to a central water supply system (50% in house tap, 50% standpipe), 35% have no access to piped water;
- a settlement of 250 inhabitants, with no piped water available;
- a settlement of 850 inhabitants, with no piped water available.

The first example simulation refers to the "average rural settlement" in Armenia, and will show the consequences of different policy choices for such villages. The second and third example serve to illustrate the possible consequences of policy options in settlements that currently have no access to piped drinking water. There are about 100 of such villages in Armenia.

The following policy options have been simulated:

- **BL**: baseline situation (as described above);
- **MWS SP20**: scenario based on Minimal Water Supply Standards (MWSS), The population not served by piped water (in BL) will be served by standposts,), assuming 20 lcd water available at (new) standposts (and 100 for yard taps and 150 lcd for in house tap). Standpost is maximally 100 meters from the dwelling;
- **MWS SP50**: is the same as the MWS SP20 scenario, but now in stead of 20 lcd, 50 lcd is available at standposts;
- **MWS SP50+** (only in example 1), is the same as MWS SP50, but now the distance from standpost to dwelling is maximally 50 meters;
- **PRS**: scenario based on the targets for rural water supply in the Poverty Reduction Strategy Paper. The assumption is that 50% of the population not served (in the BL) by in house (or yard tap) will be connected to piped water by in house tap;
- **PRS MWS**: scenario based on combining targets of the MWSS and the PRSP. The assumption is that 50% of the population not served (in the BL) by in house or yard tap will be connected to piped water by in house tap (as in PRS), the other part of population not served by in house or yard tap or standpost, will be served by standpost (50 lcd);
- **PRS MWS+** (only in example 1), same as PRS MWS, but with standpipes at maximal 50 meters;
- **MAX**: 95% of population is connected to piped water by in house tap (100 lcd);
- **MAX+** (only in example 1): same as MAX, but now 200 lcd available at in house taps.

For all simulations it has been assumed that 5% of the population of the settlements lives outside the core area of the settlement (in the fringe area) and will not be served by piped water, but by protected water sources.

Per example, the results are presented in three graphs:

- the first graph illustrates number of inhabitants connected to different types of water supply (in house and standpost) and the amount of water supplied in the settlement, under the different scenario assumptions
- the second graph focuses on presenting the annual expenditures (operation and maintenance expenditures and re-investment expenditures) and the average costs of supplying water (in AMD per cubic meter);

- the third graph shows the annual costs per household connection (on average 4 members per household assumed), for households connected with in house taps, for household using standposts and the average for all households.

2.2 Settlement with 1200 inhabitants

In this example settlement of 1200 inhabitants, 65% of population is connected to a central water supply system (50% in house tap, 50% standpipe), 35% have no access to piped water. Implementation of the MWSS would imply that 95% of the population will have access to piped water. In the MWS-options by means of standpost, in the combined PRS MWS option by means of in house tap and standpost. In the PRS option, there is mainly a shift from standpost to in house connections, and no increase in the number of inhabitants served by piped water.

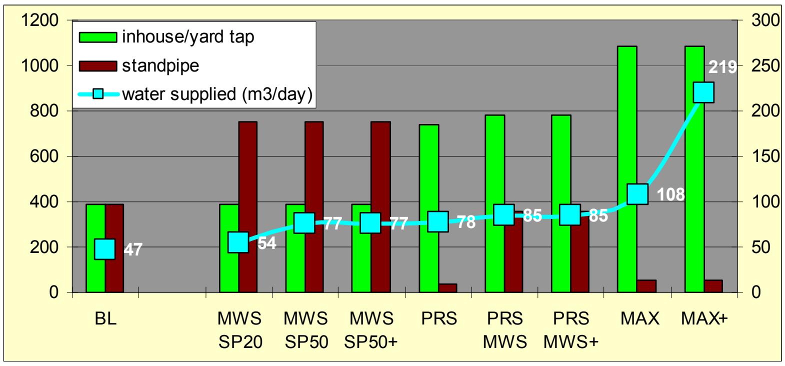


Figure 2.1
Connection to piped water and water supply, 1200 inhabitants

The graph shows that compared to the baseline, the higher the level of service, the more in house taps and the more water supplied to the village. In the MAX+ case, water supply amount is fourfold the amount of the Baseline.

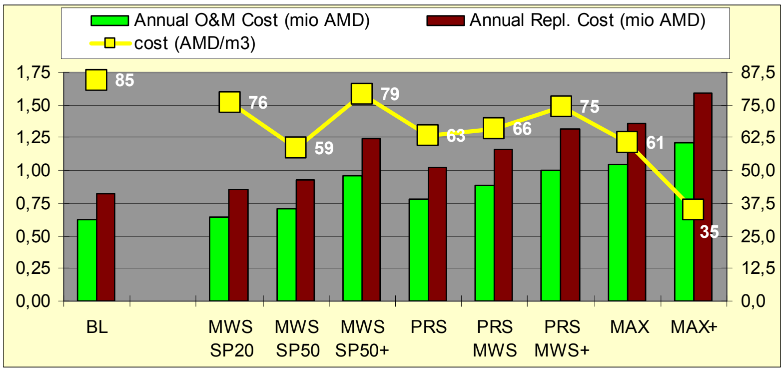


Figure 2.2
Total annual expenditures on operation and maintenance and re-investments, and costs per cubic meter water supplied

Although higher levels of water supply involve higher annual expenditures, unit costs of water supply will decrease at the same time. In the Baseline unit costs are highest at AMD 85 per m3, the unit costs of MWSS and the combined scenarios PRS MWS result in lower unit costs of between AMD 59 – 79 per m3. With “maximal” supply, costs would decrease to AMD 35 per m3.

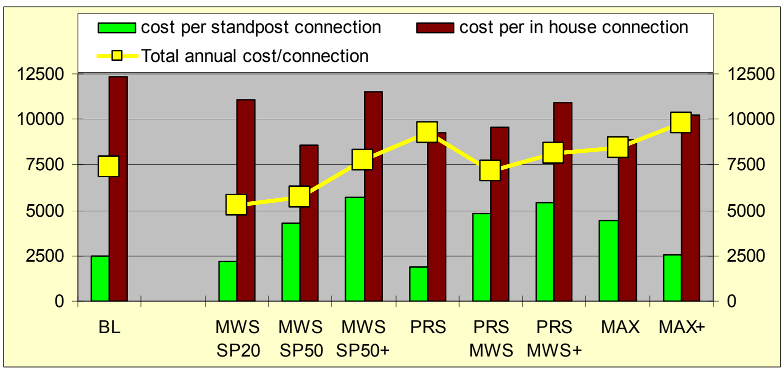


Figure 2.3
Annual costs per household connection, total average, and for households served by in house tap and by standpost

This figure shows that the costs per connection do not necessarily increase that much with higher level of services.

Due to a larger scale of the water supply network, actually, the costs per connection will be lower in the MWS SP50 option, than in the baseline (in this particular example). Combined targets (PRS MWS) would lead to about the same costs per connection as in the baseline.
The higher total costs in the settlement (as shown in figure 2) are compensated by a larger number of inhabitants of the settlement that receive service (and thus would be more willing to pay).

2.3 Settlement with 250 inhabitants, no piped water available in base year

In the base year this settlement has no central water supply. Water can be taken in at 4 km distance. The MWSS option in this case implies provision of water through standposts (about 4 in a village of this size) to 95% of the population. The PRSP option would assume in house connections for about 50% of population, the option with combined target (MWSS and PRSP) also assumed standposts for the remainder of the inhabitants.

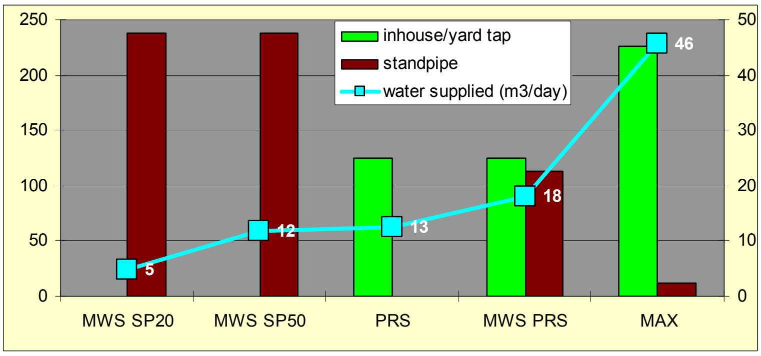


Figure 2.4
Connection to piped water and water supply, 250 inhabitants

The graph shows that, the higher the level of service, the more in house taps and the more water supplied to the village. Whereas in the MWS option at minimum only 5 m3 is available each day, in the combined option (MWS PRS) 18 m3, and in a “maximal” approach 46m3.

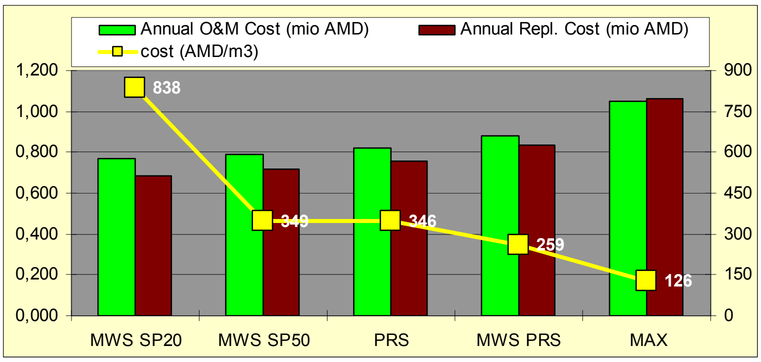


Figure 2.5
Total annual expenditures on operation and maintenance and re-investments, and costs per cubic meter water supplied

MWSS costs AMD 1.5 mln per year, a combined approach would cost AMD 1.7 million. To achieve “maximal” supply AMD 2.1 mln per year is needed. Unit costs decrease from AMD 838 per m3 in the MWS SP20 option, to AMD 126 per m3 in case of the MAX option.

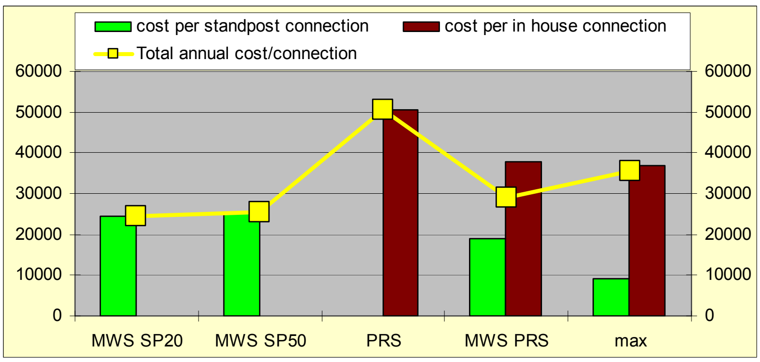


Figure 2.6
Annual costs per household connection, total average, and for households served by in house tap and by standpost

This figure shows that the costs per connection would be about AMD 25.000 per connection per year and 20% higher in the combined PRS MWS case.

Compared to the costs of supply in average rural settlements with 1200, costs are considerably higher in a small village of 250 inhabitants. Whereas MWSS and combined PRS MWS would costs between AMD 5.000 and 7.500 in an average sized village, in the small village costs per connection (in this example) are 5 times higher!

2.4 Settlement with 850 inhabitants, no piped water available in base year

In this example, it is assumed that at a distance of 500 from the village, water can be taken in. The same assumptions concerning the different development options as in the village of 250 inhabitants apply.

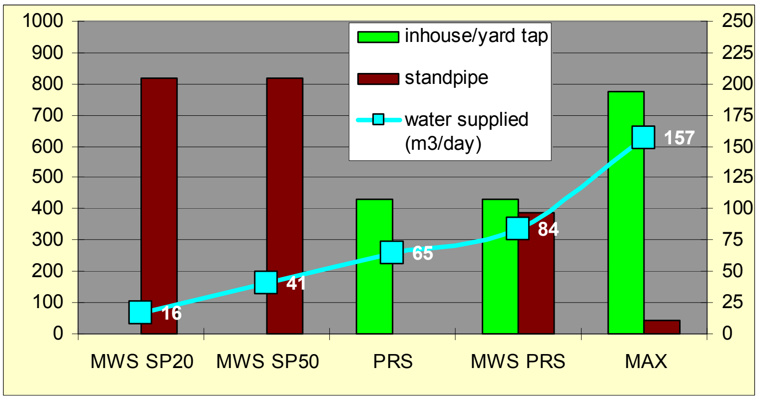


Figure 2.7
Connection to piped water and water supply, 850 inhabitants

As in the other examples, also here the water supply situation improves. In the maximal option, supply is almost 10x higher than in the very basic supply option (MWS SP20).

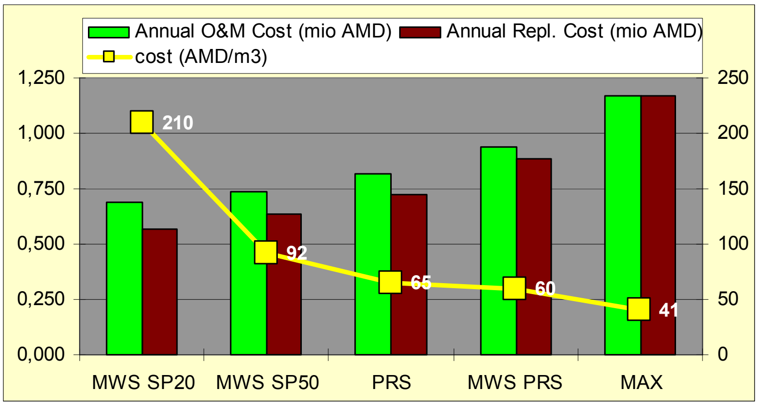


Figure 2.8
Total annual expenditures on operation and maintenance and re-investments, and costs per cubic meter water supplied

In this example, basic water supply costs AMD 1.2 – 1.4 mln per year for the settlement. Achieving combined targets (PRS MWS) would increase costs to AMD 1.8 mln.
Unit costs for water supply drop from AMD 210 per m3 for very basic supply to AMD 41 per m3 for maximal supply.

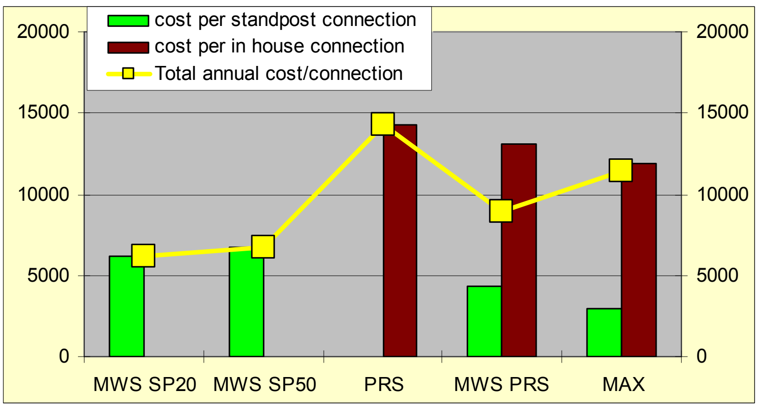


Figure 2.9
Annual costs per household connection, total average, and for households served by in house tap and by standpost

MWSS in this example costs AMD 6000 – 7000 per year per household, achieving combined targets AMD 9000.
This is slightly higher than in the case of the example for 1200 inhabitants, but considerably lower than for the village with 250

in habitants.

2.5 Discussion of the results

In general costs will increase with service level, but the same service level in different situation may lead to quite different cost outcomes.

The simulations of the different policy options for the example clearly show large cost differences between options. Most remarkable is that the total annual costs of minimal water supply are lower in the larger village (850 inhabitants) than in the small village (250 inhabitants). This due to the distance between village and water intake in the small village, which is assumed to be 4 km (in example 3 it is 500 meter). The costs of transmission pipes (which are relatively high) heavily influence this outcome.

The results indicate that achieving MWSS in villages with already existing water supply (example 1) costs of water supply would hardly need to increase, and even could lead to lower – per household – costs (compared to the baseline). Even the combined targets of MWSS and PRSP can be obtained at about the same costs per household as in the baseline.

For villages without water supply (examples 2 and 3) the step from no supply to MWSS is larger than next steps to achieve combined targets of MWSS and PRSP. This may be an argument to target the combined approach, than just MWSS (as it also leads to lower per cubic meter costs).

A last observation is that in small villages currently not having any kind of central water supply, supplying the population with piped water (standpost, standpost + in house taps or in house taps) can be quite expensive (costs of supplying water may be in the range of AMD 150 – 350 per cubic meter!).

3 SURVEY IN 150 RURAL SETTLEMENTS WITHOUT SERVICES OF WATERCOMPANIES

3.1 Introduction

With the aim of obtaining more quantitative information on the financial and infrastructural situation in the (about) 550 rural settlements not served by a water (and sewerage) company (WSC), a questionnaire was developed and submitted to about 150 settlements (15 per Marz) in Armenia. The questionnaires are disseminated are collected by the SCWS (through Marzes offices) and the results of the questionnaires are analysed by TME.

3.2 Statistical population, sample and response

The aim is to get a sample that is representative for the population living in the about 550 rural settlements without water supply from a water company. The following table gives an overview of some of the population characteristics, compared to the response of the sample.

Table 3.1
Population and settlements in Marzes not served by Water and Sewage Companies, all settlements and responding settlements in the sample

Marz	population	# of settlements / Marz	average # of inhabitants per settlement	# of settlements / Marz	average # of inhabitants per settlement
Aragatsotn	71 212	79	901	13	1464
Ararat	28 138	21	1340	10	941
Armavir	74 105	39	1900	15	2492
Gegharkunik	95 879	70	1370		
Kotayq	51 728	26	1990	10	1876
Lori	59 513	77	773	15	1364
Shirak	45 202	55	822		
Syunik	33 544	99	339	14	1122
Tavushi	60 996	46	1326	15	1842
Vayotz Dzori	32 424	40	811	15	1265
Total	**552 741**	**552**	**1001**	**109**	**1564**

(source: Estimated by team, 2007)

Of the 150 questionnaires, 109 were completed and returned, although in many cases not all questions are answered. From 2 Marzes – Gegharkunik and Shirak –no questionnaires are returned.
So the conclusion can be that the response rate is very satisfactory, if the two non responding Marzes are not taken into account, the overall response rate is 91%!

As there is a wide variation between rural settlements (size, altitude, etc.), one also needs to look how the sample (the results of the 109 questionnaires) compares to the total population, living in the about 550 settlements.

If all settlements without WSC-services are compared to the sample, by size class (small, medium and large settlements), the following analysis of the response in the sample can be made:

Table 3.2
Statistical coverage of the response on sample, by size of rural settlement

Type of settlement	All settlements	Response in sample	Coverage
Small settlements: from 0 to 530 inhabitants	264	32	12%
Medium rural settlements: from 530 to 1360 inhabitant	161	32	20%
Larger rural settlements: over 1360 inhabitants	128	45	35%
Total	**553**	**109**	

12% of the smaller rural settlements is covered by the sample, 20% of the medium sized settlements, and 35% of the larger settlements. This means that without statistical correction, the results of the larger settlements weight about 3x heavier than of the smaller, and almost 2x heavier than of the medium settlements.

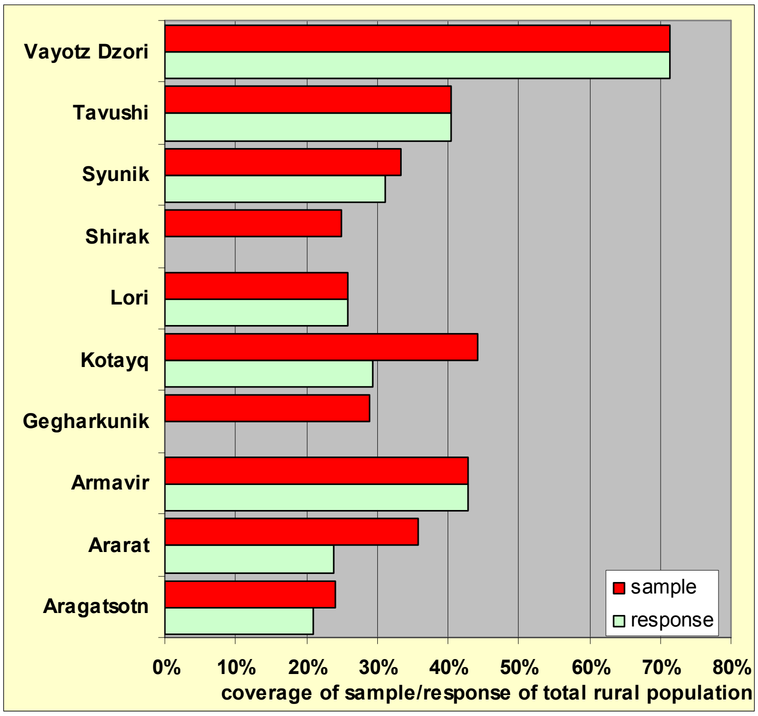


Figure 3.1
Coverage of sample and response of total rural settlements without service of a Water company

Figure 1 shows the coverage of the sample and response in comparison with all rural settlement without service of a WSC. In all Marzes, the response rate is at least 20%, in Vayotz Dzori even70%.

The next step to check how representative the sample is compared to the all rural settlements. For this the average number of inhabitants of the sample and of all settlements is compared. This is shown in Figure 2

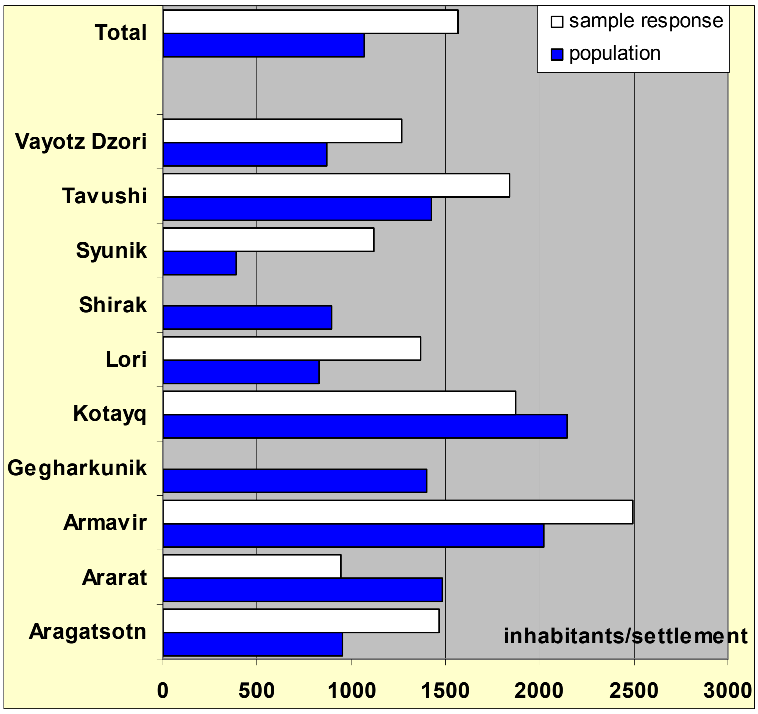


Figure 3.2
Average population in settlements of the sample response and of all settlements

Figure 2 clearly shows that on average, the size of rural settlements in the sample is about 500 inhabitants larger than the average size of all settlements. Only in Kotayk and Ararat the responding rural settlements are on average smaller.

This means that when further results of the inquiry are to be analysed, this should be considered, and if possible, a (statistical) correction should be carried out.

3.3 Financial information

Question 1 of the questionnaire concerns the expenditures on WSS:

Table 3.3
Expenditures on water supply

1: How large are the annual expenditures on water supply? (Operation & Maintenance and CAPEX if any)	Number of answers	Response rate
1. Total (AMD per year)	64	59%
2. Operation and Maintenance (AMD per year)	61	56%
3. Capital expenditures (AMD per year)	33	30%

More than half of responding settlement is able to quantify expenditures. From the answers it can concluded that roughly half of the responding settlements also has done some investments during the last year.

The (uncorrected) results are shown in the following table (in AMD per year):

Table 4
Estimated total, operational and capital expenditures per year

1: How large are the annual expenditures on water supply? (Operation & Maintenance and CAPEX if any)	Total expenditures	Average per settlement
1. Total (AMD per year)*	80.224.200	1.253.503
2. Operation and Maintenance (AMD per year)	49.515.600	811.731
3. Capital expenditures (AMD per year)	29.908.600	906.321

* the total is slightly higher than the sum of O&M and CAPEX as for some settlements these were not specified seperately

The 64 settlements reported in total AMD 80 million expenditures, or on average AMD 1.253 million per year per settlement. Considering that the population in the responding settlements is on average 500 inhabitant larger than the average population in all relevant rural settlements, this figure cannot simple be extrapolated to all settlements.

By relating inhabitants per settlement with total costs, the average costs of WS per capita can be estimated. This is shown in Figure 3, also showing the number of inhabitants per settlement (64 in total).

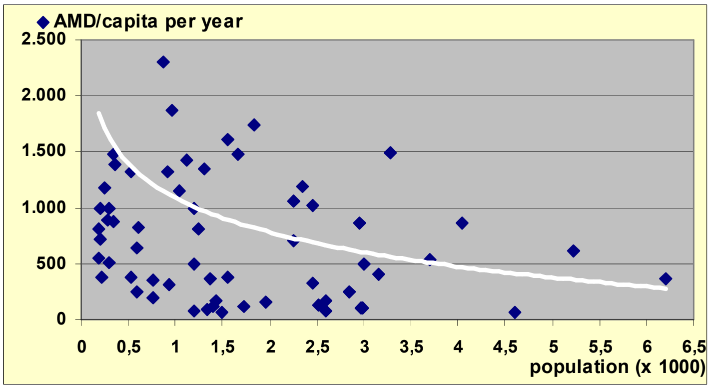


Figure 3.3
Average costs of water supply in rural settlements, AMD per year

In 61 of the 64 settlements, average costs are estimated at between AMD 67 per capita and 2500 AMD. In 3 settlements, not shown in the graph, costs are higher. For two small settlements, costs are estimated at between 7500-8500 AMD per capita per year.

From figure 3 it appears that a correlation between size of the settlement and average costs/capita exists. If the sample is subdivided in 3 groups, the average costs per inhabitant can be estimated at:

- small settlements: from 0 to 530: AMD 1783 per capita per year;
- medium rural settlements: from 530 to 1360 AMD 853 per capita per year;
- larger rural settlements AMD 769 per capita per year.

It is also (partially) possible to make a comparison per region. In figure 4 this is shown, by comparing average costs per inhabitant per year per Marz, with the average number of inhabitants per Marz.

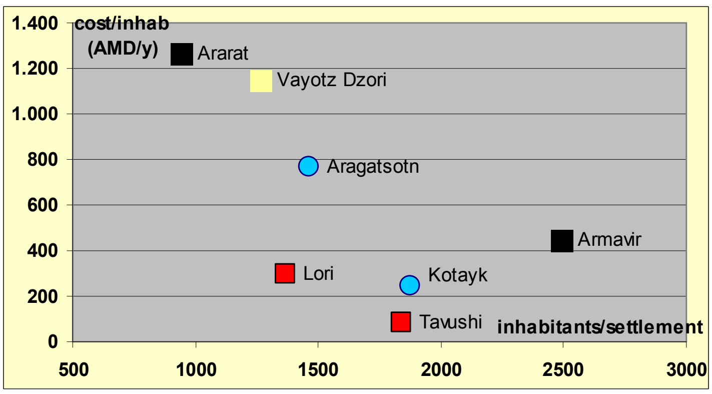


Figure 3.4
Average costs of water supply in Marzes, in AMD per capita per year

It can be seen that the average costs of WSS per inhabitant vary largely. In Ararat and Vayotz Dzori, costs are relatively high (about AMD 1200/cap), in Lori, Tavushi and Kotayk, costs are relatively low (under AMD 400/cap).

Question 2 deals with the rural population, actually paying directly for their water supply.

Table 3.5
Payment for water by households

2: Do people pay for water supply?	Settlements		Population of sample	
1. Yes	21	19%	45.336	27%
2. No	88	81%	122.035	73%

It can be seen that about 25% of rural population actually pays for water supply.
The average size of settlement that report revenues of user charges is 2159 in habitants, about 600 inhabitants more than the average of the sample, and about
Question 3 is about the way payments are effected. If people pay for WSS, they mostly pay a monthly fee (15x), an annual fee (5x) or partial by providing “in kind” services (2x) or other, unspecified payment methods (1x).

Payment of user charges is more common in larger settlements. The average number of inhabitants in such settlements is 2160, whereas the average of the all settlements is 1000 inhabitants (see table 1).

Question 4 deals with the basis for charging water services. In most cases this is based on a fixed fee (17x), metering is applied 3 times, other unspecified ways of payment are applied n 2 settlements.

Question 5, asking for the annual revenues of water charges, is only replied by 6 of the 21 settlements (where people pay for WSS). In these 6 settlements, total reported revenues of water charges are AMD 3.869.384/year, or AMD 644.897 per settlement.

Further analysis of the provided answers (on monthly fees for example, public budget subsidies, total costs and water supplied throughout the year), for another 13 settlements (minimum) estimates could be made for the annual revenues of water charges. In the resulting 19 settlements, total annual revenues are estimated at AMD 21.237.500, or AMD 1.117.763 per settlement (or AMD 488 per capita per year). This would cover some 25% of total reported expenditures.

The next figure shows the per capita revenues of user charges in the 19 settlements-

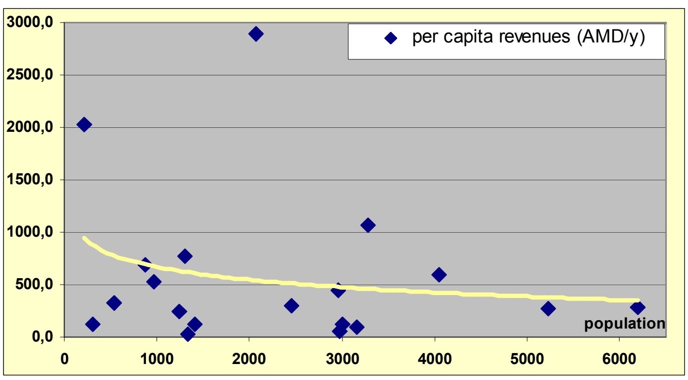


Figure 3.5
Per capita revenues of user charges in 19 rural settlements in Armenia, in AMD/capita per year

It appears that user charges (if applied) are – on average – higher in smaller than in larger settlements.

Comparing the (estimated) revenues with the reported expenditures in settlement where the population pays for water, the median level of cost recovery is about 31%, the unweighted average about 45% (minimum 13%, maximum 100%).

Question 7 deals with revenues from other sources, mainly public budget. In total, 37 settlements reported contributions from the municipal budget, with a total of AMD 42.2 mln. Figure 6 gives the subdivision of the amounts per types municipal contributions.

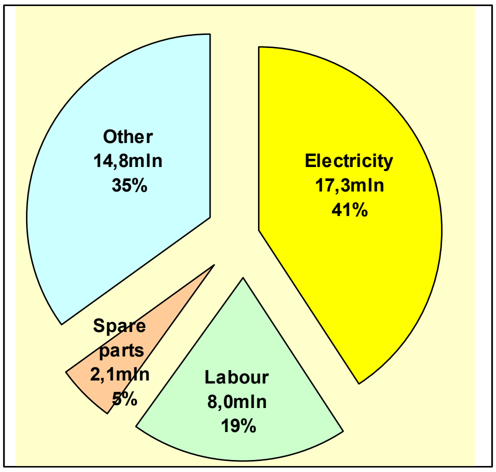


Figure 3.6
Subdivision of contribution from municipal budgets, in AMD mln per year

9 settlements report contributions from the municipal budget for electricity, representing 41% of total contributions. "Other" expenditures are reported by 14 settlements and cover 35% of contributions. These probably refer to cash transfers. Smaller contributions refer to labour and spare parts.

When comparing total expenditures with total budget contributions and revenues from user charges, it can be estimated that of total expenditures of AMD 80.2 mln, AMD 21.2 mln is covered by user charges (26%), and AMD 42.2 mln by the municipal budgets (53%). For some 20% of expenditures, no financial resources are reported[3].

3.4 Water supply

The second set of questions is about water supply in rural settlements without services of WSCs.

Question 1 asks if piped water is available. In 88 settlements the answer is positive, in 20 settlements no piped water is available (of which 10 in Ararat).

Question 2 deals with the type of connections: in-house tap, yard tap or standpost.

In figure 7, the subdivision for all responding villages is shown. The villages are sorted on basis of the number of inhabitants (left = smaller, right is larger).

[3] this may direct towards financing problems, but also is a result of non response (as 34% of settlements that report expenditures do not indicate any source of revenues)

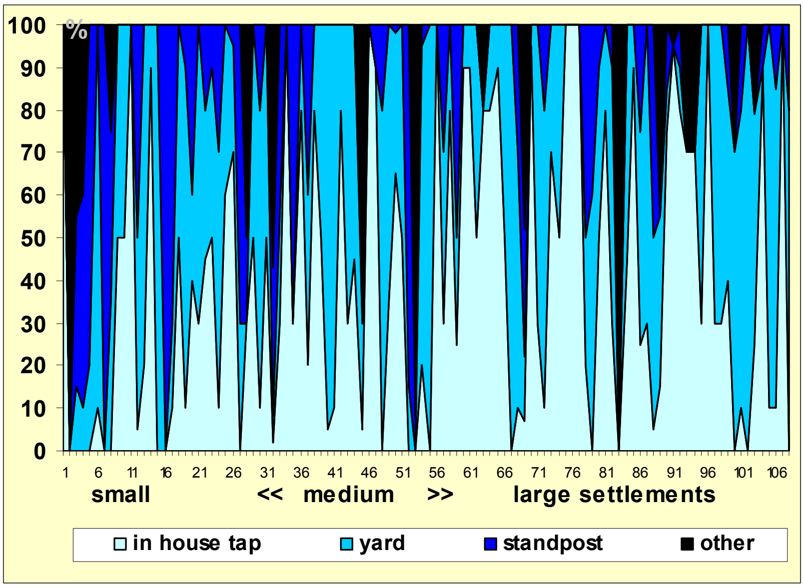


Figure 3.7
Type of water supply (in house tap, yard tap, standpost, other) per rural settlement, sorted from small to larger settlements, in percents

It is obvious that there is a wide variation in the type of supply. There are small villages with a large share of in house taps, but there are also larger settlements with a small share of in house taps. There is, on first sight, no clear correlation between size of the settlement and the quality of the water supply (in terms of distance). Only a very generally, it can be said that it looks like larger villages have relatively more in house and yard taps (lighter in the figure), smaller settlements more yard taps and standposts (darker blue in the figure).

This is confirmed if all settlements are grouped in 3 classes, as shown in figure 8.

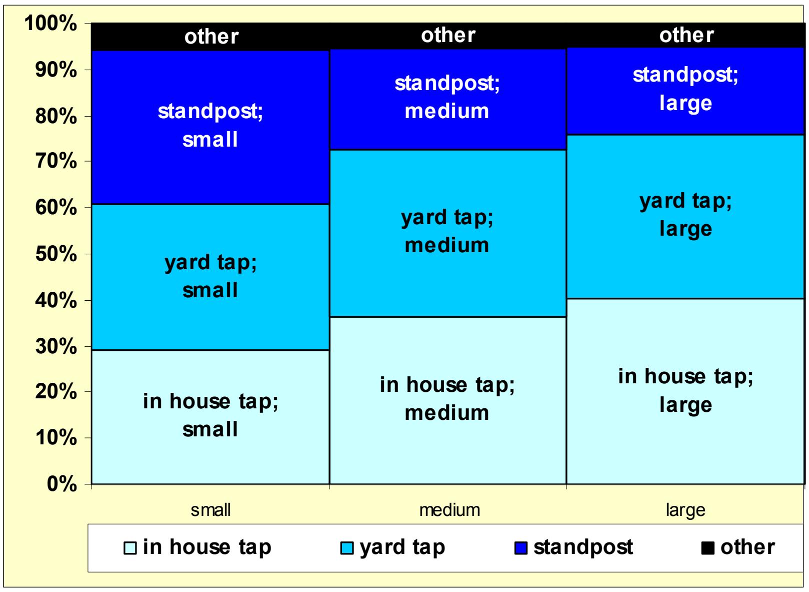


Figure 3.8
Type of water supply (in house tap, yard tap, standpost, other) for small (< 530 inhabitants), medium (between 530 and 1360 inhabitants) and large rural settlement (> 1360 inhabitants)

From this figure, it is clear that there is a correlation between size of settlement and type of water supply. The larger the settlement, the higher the share of in house and yard taps, the smaller the share of standposts.

A further analysis of the results shows that there are large differences between Marzes, see figure 9.

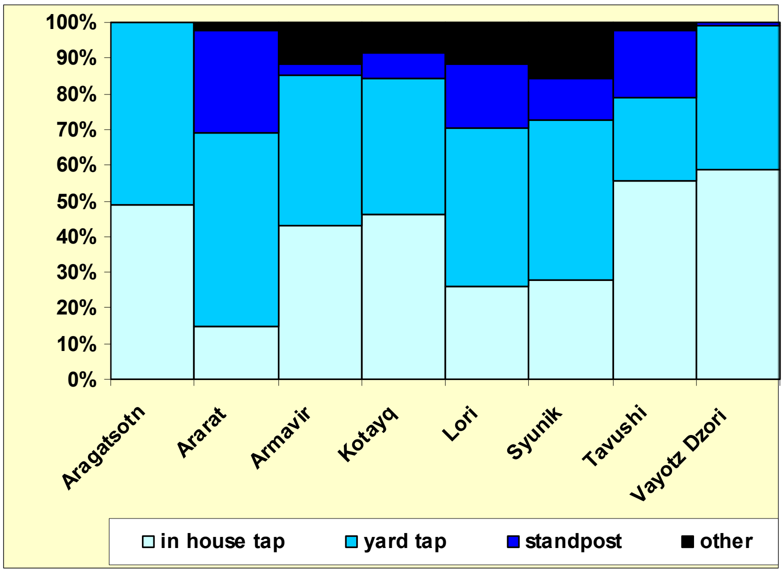


Figure 3.9
Type of water supply (share of in house tap, yard tap, standpost, other) for 8 Marzes in Armenia

Figure 8 shows that in some Marzes (for example Aragatsotn, Tavushi and Vayotz Dzori), in house supply is significantly higher than in other Marzes (Ararat, Lori and Syunik).

In general, it can be concluded that the responding settlements have on average at least 70% on plot supply (in house tap or yard tap). It may however, well be that yard taps in reality sometimes are more like standposts (the distance from houses to yard tap and/or standpost is unknown).

Question 3 deals with the regularity of supply.

Table 3.6
Regularity of water supply in rural settlements. per Marz

Marz	hours per day	days per week
All responding settlements	15	6,4
Aragatsotn	22	7
Ararat	13	7
Armavir	8	6,5
Kotayq	17	7
Lori	18	7
Syunik	17	6,9
Tavushi	10	5,3
Vayotz Dzori	17	5,4

On average, the responding rural settlements have 15 hours water per day, for 6.4 days per week. The regularity is best in Aragatsotn, with almost around the clock supply, 7 days per week. In Armavir the situation is worst, with only on average 8 hours supply, for 6.5 days a week. Also in Tavushi, regularity is a problem.

Question 4 addresses the daily quantity of water available. 96 of the 109 responding settlements have specified this. Total daily water supply is estimated at about 46,000 m3 per day (in summertime 49,000 m3, in wintertime, 41,000 m3).
More interesting is to estimate the per capita availability of water, this is throughout the year on average 300 lcd (representing a population of 154,000 (92% of sample population), in summer 320 lcd, in winter 265 lcd.

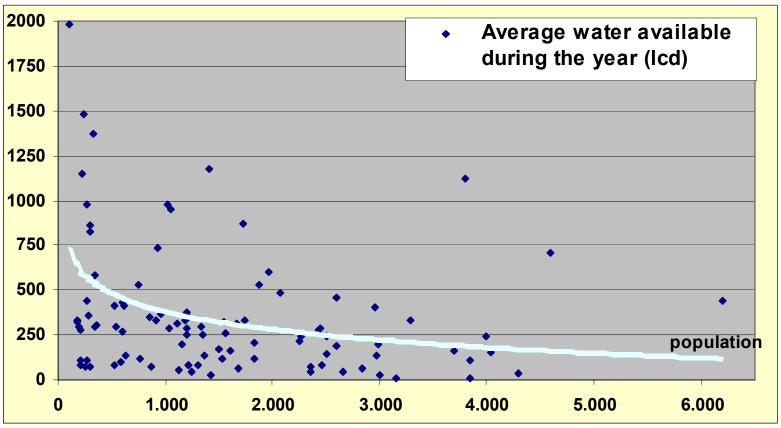


Figure 3.10
Water available per capita (lcd), in relation of the size of rural settlements (99 settlements)

This figure shows that there is a wide variation in water availability in rural settlements. It looks as if in small settlements on average more water is available than in larger ones. This is confirmed if the average water availability is estimated for small, medium and larger rural settlements:

- in small sized rural settlements (< 530 inhab.) the availability is on average 644 lcd;
- in medium sized rural settlements (between 530 – 1360 inhab.) the availability is on average 312 lcd;
- in larger sized rural settlements (> 1360 inhab.) the availability is on average 273 lcd.

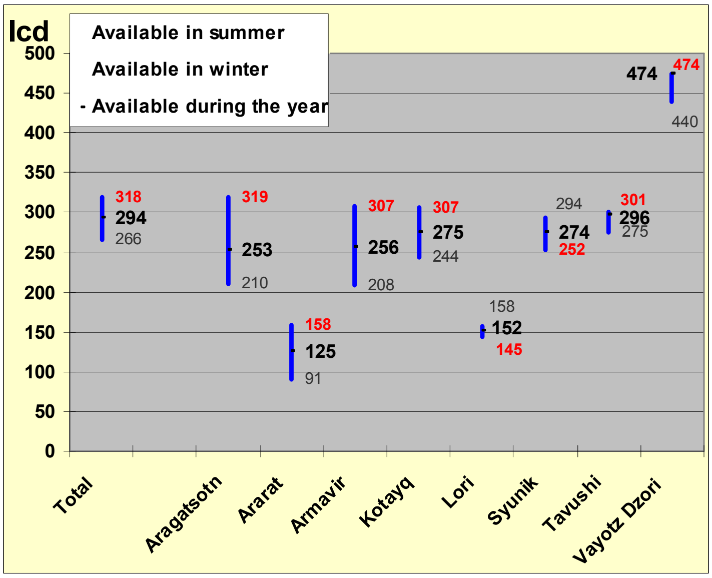


Figure 3.11
Average availability of water in 8 Marzes (in lcd), during the year, summer and winter

In figure 11 the average water availability per capita is presented per Marz. In most Marzes, the average availability is between 250 and 300 lcd. In Ararat, availability is quite low: 125 lcd, also in Lori: 179 lcd. In Vayotz Dzori availability is high, with 474 lcd.
In some Marzes (Aragatsotn, Ararat and Armavir), the difference between water availability during summer and winter can be as big as 40-55%. In the other Marzes differences are less significant. In most Marzes supply in summer is higher than in winter, only in Lori and Syunik the opposite is true[4].

3.5 Financial information and Water supply combined

The analysis can be pushed further by combining financial and water supply information. This is done in the next figure, relating costs per cubic meter water available with population size of rural settlements. The costs per cubic meter available are estimated by dividing the (partly estimated) annual expenditures per settlement, by the (partly estimated) water availability per year (in cubic meters).

[4] Although water available in summer may be higher than in winter, this does not necessarily mean that water availability "at the tap" in summer is also higher, due to use for irrigation.

For 63 of the 109 settlements these unit costs could be estimated.

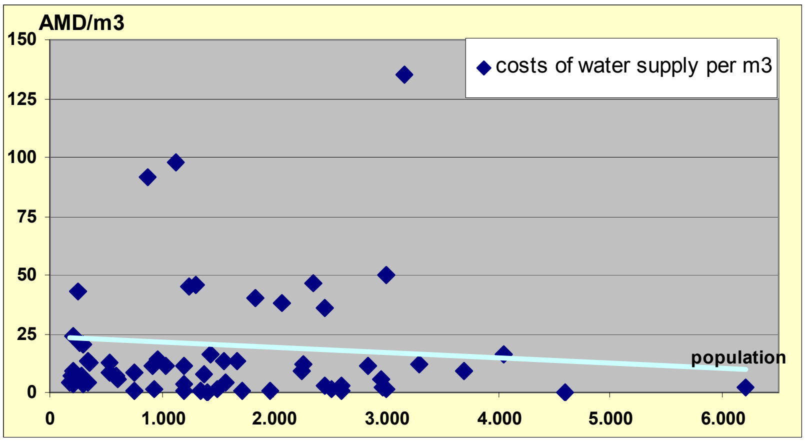


Figure 3.11
Costs of water supply, in 63 settlements in Armenia, in AMD per cubic meter

The costs of water supply in rural settlement are relatively low, on average (unweighted) AMD 20 per cubic meter (weighted: AMD 7.8 per cubic meter).
There is also some correlation between size of the settlement and the (non-weighted) costs of water supply:

- in small sized rural settlements (< 530 inhab.) the average costs are AMD 26 per cubic meter;
- in medium sized rural settlements (between 530 – 1360 inhab.) .) the average costs are AMD 21 per cubic meter;
- in larger sized rural settlements (> 1360 inhab.), the average costs are AMD 16 per cubic meter.

The estimated costs of water supply cannot be taken as estimate for drinking water supply for households without correction.
As the results on water quantities available per capita show, the average level of water supply is well above the need for household use (excluding irrigation). Due to the lack of metering, there is no incentive to save water.
Moreover, it can happen that supply of water is unevenly divided over the rural population, due to lack of possibilities to manage water quantities in the network.
Annual costs are also relatively low, as a result of a lack of re-investments and renovations of the water supply system. As the results of the baseline indicate, sufficient funds for re-investments are needed (about roughly the same as for operation and maintenance).

Future costs will be higher, in case steps are taken towards a more advanced water management system in rural settlement (with on average possibly a lower supply, and more advanced infrastructure (incl. metering)).

3.6 Sanitation

The third, and last part of the questionnaire addresses the situation concerning sanitation in rural settlements (not supplied by WSCs). So far, little quantitative information is available.

Question 1 (the only question on sanitation) is on the types of sanitation available in the settlement (% of population covered by the different options):

- individual pit latrines;
- individual septic tanks;
- open ditches;
- sewerage;
- other.

The question is answer by 104 settlements (95% of the sample).

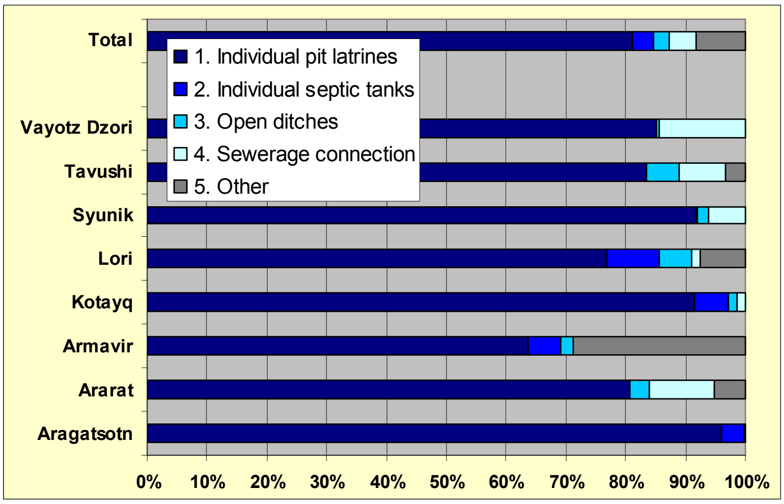


Figure 3.12
Share of 5 sanitation options in rural settlements in Armenia, % of population served by different options

By far the most used option for sanitation is pit latrine. Over 80% of rural population in settlements without WSCs use this option. Septic tanks, open ditches and sewerage each are used by on average 3% of the sample. Other, unspecified options are used by 8%.

3.7 Extrapolation of the sample results

Based on the sample and with the help of statistical techniques, a best estimate can be made for various parameters. For the Financing Strategy the focus is on water supply (availability) and the annual expenditures and the financing by user charges and budget.

The extrapolation is based on a subdivision of the rural settlements without WSC-services in 8 Marzes (for 2 Marzes no information is available). For each Marz, the results were subdivided in small, medium and large settlements. For all settlements in the 8 Marzes, the same has been done for the number of inhabitants. By comparing, per subgroup (for example, “Lori, small”) the number of inhabitants in the sample with the total number of inhabitants in all relevant settlement, a factor with which the sample results can be multiplied can be determined (assuming that the sample represents all settlements in the subgroup, which in reality may deviate substantially). In this way one can arrive at a “best estimate” of water availability, expenditures, charge revenues and municipal budget contributions.

Table 3.7
Estimated available water, total expenditures and way of financing per Marz, reported by rural settlements in the sample

	available Water (mln m3/y)	Total Expenditures (AMD mln/y)	User charges (AMD mln/y)	Municipal budget (AMD mln/y)	Deficit (-) or Surplus (AMD mln/y)
Aragatsotn	1,8	14,6	2,4	11,8	-0,4
Ararat	0,4	11,9	1,5	7,8	-2,5
Armavir	3,5	18,2	8,2	16,8	+6,8
Kotayq	1,9	4,6	1,6	1,6	-1,4
Lori	1,1	6,6	0,3	3,2	-3,0
Syunik	1,6	0,0	0,0	0,0	-0,0
Tavushi	3,0	2,6	0,0	0,3	-2,3
Vayotz Dzori	3,3	21,8	7,2	0,8	-13,9
Armenia	**16,5**	**80,2**	**21,2**	**42,3**	**-16,7**

For the sample, the water availability is estimated at 45.3 mln m3 per year, at annual costs of AMD 80.2 mln. About 80% of costs is covered, 26% by user charges, the rest by municipal budget contributions. In one case a surplus is reported (Armavir).
If the results of the sample are extrapolated using information on the population characteristics of small, medium and larger rural settlement, the following results can be achieved.

Table 3.8
Estimated available water, total expenditures and way of financing per Marz, extrapolated for all relevant settlements

	available Water (mln m3/y)	Total Expenditures (AMD mln/y)	User charges (AMD mln/y)	Municipal budget (AMD mln/y)	Deficit or Surplus (AMD mln/y)
Aragatsotn	7,9	60,5	6,5	47,8	-6,1
Ararat	1,1	44,7	6,7	24,8	-13,2
Armavir	9,5	40,1	17,1	44,3	+21,3
Kotayq	6,5	15,9	4,6	3,4	-7,8
Lori	3,9	28,8	0,8	14,1	-13,9
Syunik	8,0	25,9	0,0	0,0	-25,9
Tavushi	8,4	10,2	0,0	0,6	-9,6
Vayotz Dzori	6,8	50,1	12,3	1,3	-36,5
Armenia	**52,1**	**276,2**	**48,0**	**136,5**	**-91,7**

The extrapolation results in an estimated availability of water of 142.8 mln m3 per year in the settlements not served by WSCs (8 Marzes. Excl. Gegharkunik and Shirak). Total expenditures are estimated at AMD 276 million, of which 17% is covered by user charges, 49% by the municipal budget, and 33% there is no coverage (mentioned).

Inclusion of Gegharkunik and Shirak increases the mentioned estimates by about 20-25% (estimate based on population).

4 POLICY SCENARIOS

4.1 Introduction

In this chapter the results of the first simulations with Feasible on policy development scenarios will be discussed and compared to the results of the baseline scenario.

Two scenarios will be discussed:
- the Minimal Water Supply Standards (MWSS);
- a scenario combining the targets of MWSS and the Poverty Reduction Strategy Paper (PRSP).

The target of MWSS is to provide 100% of rural population with at least 50 litre per capita per day, within 100 meters of the house by at least a standpost. Population already served at a higher level (yard tap, in house tap) will remain with that level of service.

The target of the combined scenario is to provide at least all rural inhabitants with MWS, but also increase the level of on plot supply (yard tap or in house tap) by on average 25% of rural population (from 45% to 70%).

The simulations have been carried out with the rural WSS module of the Feasible model (COWI, 2005).

The results of the analysis are preliminary due to:
- limited available time (between mid July and mid September of 2007);
- incomplete information (from some WSCs still some important data to receive);
- modelling problems with the Feasible model, which needed to be corrected.

4.2 Modelling rural WSS

Rural water supply in Armenia is roughly divided in settlements that are served by Water and Sewage Companies (WSCs), about 45% of inhabitants, and settlements without such services 55% (of which about 5% has no supply system at municipal level[5]). This is presented in Figure 4.1.

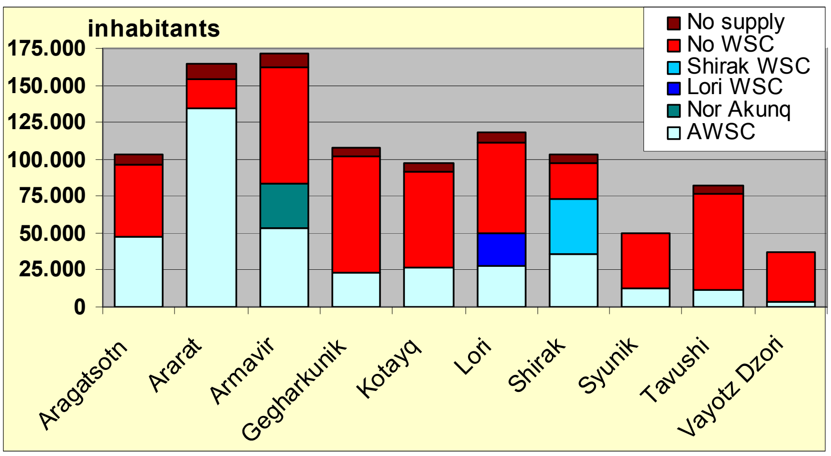


Figure 4.1
Rural water supply in Armenia, sub-division of inhabitants between supply by Water companies, municipal supply and no supply

It can be seen that rural water supply in Armenia is differentiated. In Ararat about 80% of population is served by a WSC, whereas

[5] The subdivision and especially the share of rural population living in settlements without any supply (no WSC and no municipal service) is an estimate, based on the results of the census, and questionnaires by JICA (2006) and TME (2007).

in Vayotz Dzori almost all rural inhabitants are served by municipal services.

When modelling rural settlement in Feasible, several "off model" issues have been encountered:
- in Armenia, about 40-45% of population is served, through a central supply system, connecting rural settlements to distant water sources. This option is not present, thus cannot be modelled exactly) in Feasible. It is assumed that the costs of such central supply is comparable with the costs of individual water intakes for rural settlements;
- the average water supplied to rural inhabitants is in the range of 250 lcd, which is considerably higher than default values in Feasible (and these defaults refer to satisfactory supply in European Countries). This indicates oversized networks in (rural) Armenia (or use for other than household purposes like irrigation) but also that if the currently supplied amount of water would be modelled in Feasible, the costs of operation and capital replacement (or re investment) would be overestimated;
- regularity: in Feasible it is assumed that less hours per day supply is available, the higher the costs to supply of a certain, fixed amount (say 50 lcd). So increasing regularity in combination with a fixed amount of water (lcd) leads to lower total expenditures[6]. For modelling reasons we have applied modest water uses per capita in the scenario simulations (50 lcd for standpost, 100 lcd for on plot supply).

The two policy package scenarios that are simulated can be described as follows:
- MWSS scenario: 100% of rural population is supplied with at least 50 litre per capita per day, within 100 meters of the house by at least a standpost. Population already served at a higher level (yard tap, in house tap) will remain with that level of service;
- MWSS and PRSP scenario: as with the MWSS scenario, but also increase the level of on plot supply (yard tap or in house tap) by on average 25% of rural population (from 45% to 70%).

4.3 Expenditures

The totals expenditures for the 3 scenarios are presented in the next figure.

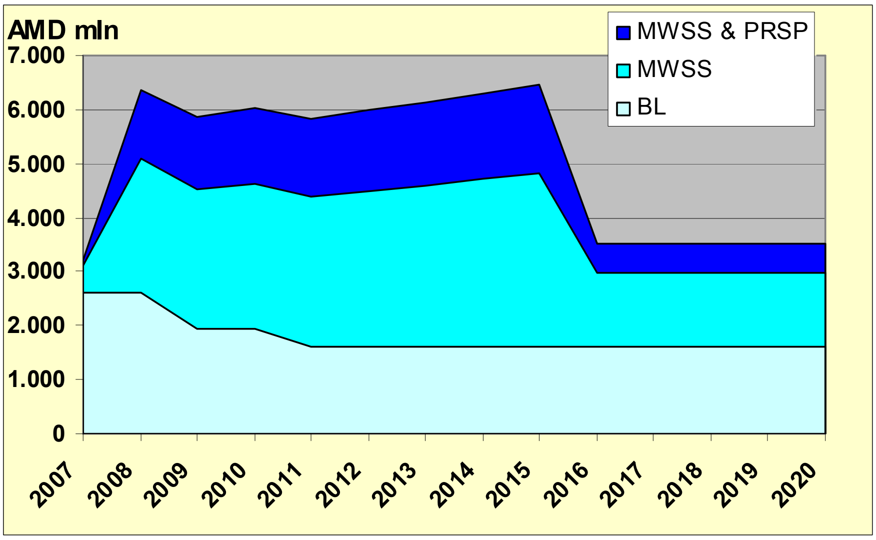


Figure 4.2 Annual total expenditures for rural water supply in 3 scenarios, Baseline, Minimal Water Supply and MWS combined with Poverty Reduction Strategy Paper targets

Baseline expenditures decrease from about AMD 2.7 billion in 2007 to about AMD 1.6 after 2011 (current loans are implemented). In the

[6] To supply a certain quantity of water in less hours per day, means that the capacity needs to be larger (larger diameters of pipes)

MWSS scenario, annual expenditures will increase to about AMD 4.5 billion until 2015 (when the implementation is assumed to be completed). Implementing combined targets of MWSS and PRSP leads to an estimated annual expenditure of about AMD 6 billion until 2015.

After implementing the MWSS and the PRSP (after 2015), annual expenditures are estimated at AMD 3 billion for the MWSS scenario and AMD 3.5 billion for the combined MWSS and PRSP scenario.

The structure of expenditures in the 3 scenarios is shown in the following figure.

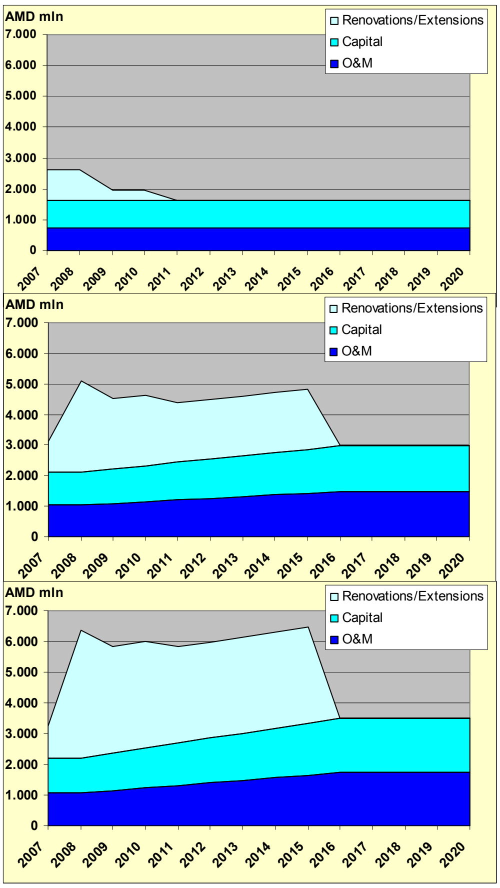


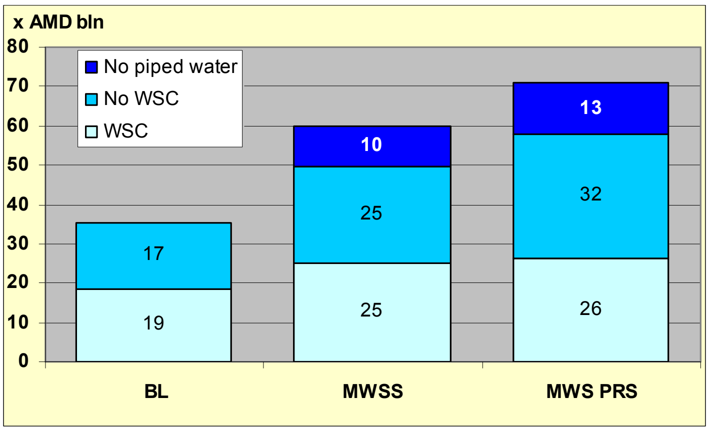
Figure 4.3
Cost structure of the Baseline scenario, the Minimal Water Supply Scenario and the combined Minimal water Supply and Poverty Reduction Strategy scenario

In the baseline scenarios, the expenditures apart form normal operation and maintenance and re/investment expenditures, mainly relate to renovations, not to increase supply. Operation & maintenance and re/investment expenditures remain stable over the period of analysis.

In the two policy scenarios, due to the increased service level (more connections, higher level of supply), the operation and maintenance and re/investment expenditures will gradually increase to AMD 3 – 3.5 billion.

In the next step in the analysis, a specific look is taken at the capital stock in the three scenarios.
In the baseline, it is estimated that the total value of the capital stock (if it were in good condition, the replacement value), is about AMD 35 billion. A little more than half of the capital stock for rural WSS is operated by WSCs. There is a large need for renovation indicated, about 50%, but in the Baseline nor the policy scenarios, specific expenditures have (not yet) been scheduled for this.

Figure 4.4
Total estimated capital stock needed to achieve Minimal Water Supply Standards (MWSS) and combined MWSS and Poverty Reduction Strategy (MWS PRS) targets, in billion AMD



To achieve the targets of both policy scenarios, large amounts of money will need to be invested. For the MWSS scenarios, at least AMD 25 needs to be invested, for the combined scenarios AMD 35 billion.

Investments in extensions are mainly concentrated in rural settlements not having service by a WSC. To achieve MWSS in settlements with already existing piped water systems (but no WSC) about AMD 8 billion needs to be invested, in the about 100 settlements that currently lack any centralised supply system, an estimated ADM 10 billion need to be invested. Existing WSCs would only need to invest about AMD 6 billion.
Increasing the level of supply to achieve also the PRSP targets, would require AMD 11 billion additional investments (compared to MWSS): AMD 1 billion for WSCs and AMD 10 billion in settlements not served by WSCs. Of these AMD 3 billion in villages currently not having central supply.

Apart from the investments in extensions, it can be estimated that between AMD 15 – 20 billion will be needed (over a longer period) to renovate the existing water supply systems in rural settlements.

4.4 Financing

The amount of finance available in the baseline scenario has been estimated at about AMD 3 billion in 2006, dropping to AMD 1.5 billion in 2015. These numbers need some small corrections, as some more information is available:

- for the Shirak WSC charge revenues for 2006 are estimated at 15.5% (rural share of clients) of AMD 430 million. As the collection rate is expected to increase form 64% to 92% in 2009, revenues then will be AMD 96 million:
- For rural settlements without service of WSCs, revenues of user charges are estimated at AMD 60 million in 2006 (derived from result of the survey);
- For rural settlements without service of WSCs, revenues from municipal budgets are estimated at AMD 170 million (derived from result of the survey).

If this is taken in to account, in 2006 AMD 3.2 billion was available for financing expenditures on rural WSS in the baseline, in 2015 an estimated AMD 1.8 billion.

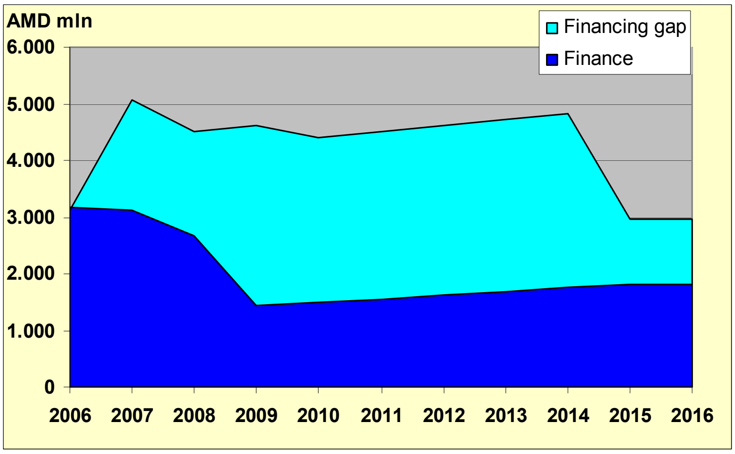


Figure 4.5
Available Finance and Financing gap in the MWSS scenario

In the MWSS scenario, the financing gap increases rapidly from 2007 onwards. From 2009 to 2015, the gap is about AMD 3 billion annually.

After 2015, the gap decreases to slightly larger than AMD 1 billion, as it is assumed that no further extensions are needed after 2015.

In the next graph, the same analysis is made for the combined MWSS and PRSP targets.

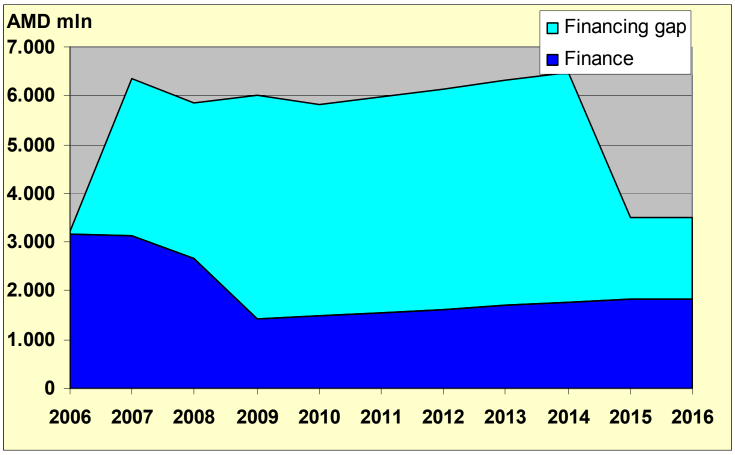


Figure 4.6
Available Finance and Financing gap in the combined MWSS & PRSP scenario

In the “combined scenario”, the financing gap reaches AMD 4.5 billion in 2009, and this stays roughly the same until 2015. After 2015, the gap decreases to annually about AMD 1.7 billion (about 50% of total operation & maintenance and re/investment expenditures).

It is clear, that in the two policy scenarios, even more than in the baseline scenario, additional financial resources will be needed. If by 2015, in the MWSS scenario, at least the operation & maintenance and re/investment expenditures should be covered by user charges, the revenues of user charges should at least increase 80% compared to the baseline projection.
In the “combined scenario”, the needed increase would be about 115%.

This does not necessarily mean that water tariffs have to be increased by the same %. Compared to the baseline, in the policy scenarios more inhabitants receive water. As shown in the chapter where several examples have been discussed, water supply to a settlement may double when shifting from the baseline supply to the “combined scenario”.
The possible increase in user charges, is not necessarily evenly spread amongst settlements. Currently, in settlements served by WSCs, on average annual payment per capita is AMD 2100[7], in settlements without WSCs on average AMD 106[8].

Even if the revenues of user charges can be increased as needed, still in the period 2008 – 2015, AMD 25 – 35 billion additionally will be needed to finance the extensions, AMD 3.5 – 5 billion annually. If this is to be financed by loans, this will eventually lead to interest payments: at 5% between AMD 1.25 billion and 1.75 billion annually.

[7] actual payments will be higher, as revenues have been divided by all population rather than by paying population in settlements served by WSCs
[8] only 1 in 5 inhabitants actually pay, so “paying inhabitants” will on average pay about AMD 500 per year.

ANNEX 1: QUESTIONNAIRE

Name of Community:

Information on financial issues

Question 1: How large are the annual expenditures on water supply? (Operation & Maintenace and CAPEX if any)
1. Total (AMD per year)
2. Operation and Maintenance (AMD per year)
3. Capital expenditures (AMD per year)

Question 2: Do people pay for water supply?
1. Yes
2. No

Question 3: If YES, How do people pay for water supply?
1. Monthly money fee
2. Annual money fee
3. Other way of money payment method
4. Non money payment (in kind)

Question 4: How is the fee calculated?
1. Water use, measured by meter
2. Fixed fee
3. Other

Question 5: How large are the annual revenues of water tariffs?
1. Annual revenues in the community are: (AMD per year)

Question 6: Who collects the money?
1. Employee
2. Other

Question 7: What are OTHER resources of revenues for the water supply system? (AMD per year)
1. Municipal budget, payment for electricity
2. Municipal budget, labor
3. Municipal budget, spare parts
4. Municipal budget, other
5. Subsidies from Marz
6. Subsidies from State

Current water supply situation

Question 1: Is piped water supply available?
1. Yes
2. No

Question 2: Which percentage of the population has access to water supply?
1. Tap in the house, %
2. Yard tap, %
3. Tap available within 100 meters from house, %

Question 3: Water supply availability in the community
1. How many hours per day? (hours per day)
2. How many days per week? (days per week)

Question 4: Please estimate the daily amount of water available in your community (m3/day)
1. Average available during the year
2. Available in the summertime
3. Available in the wintertime

Current water sanitation

Question 1: Please indicate if the water sanitation is arranged in your community

1. Individual pit latrines
2. Individual septic tanks
3. Open ditches
4. Sewerage connection
5. Other

ANNEX 2: COMPARING SURVEY RESULTS WITH FEASIBLE

Introduction

Based on the survey, discussed in chapter 3, estimates of water availability and expenditures are made for rural settlements in Armenia without WSC services. At the same time, with the Feasible model, for these settlements also simulations are available.

In this annex, the model outcome will be compared with the outcome based on analysis of empirical data.

Water production

Model simulations are based on
- EU cost functions and default values (on for example water use per capita) incorporated into the FEASIBLE mode;
- Adapted to Armenia, for labour cost and productivity (factor 3 cheaper).

The survey gives a large enough sample, to assess water production per Marz in settlements not served by WSC. The can be compared with the outcomes of Feasible. A rough comparison is shown in the next table.

Table 1
Water availability/production according to estimate based on sample and according to Feasible model estimate, in m3 per year (2006)

Marz	Water production estimated from sample	Water production estimated from model	Factor between sample and model
Aragatsotn	7.888.990	1.425.089	5,5
Ararat	1.057.326	750.826	1,4
Armavir	9.522.361	2.551.644	3,7
Kotayq	6.541.920	2.334.680	2,8
Lori	3.876.704	1.869.355	2,1
Syunik	8.030.708	1.756.811	4,6
Tavushi	8.363.647	1.564.423	5,3
Vayotz Dzori	6.822.426	2.247.813	3,0
Armenia (8 Marzes)	**52.104.083**	**14.500.642**	**3,6**

Source: water production of sample estimated from questionnaire results (TME, 2007d), assessment of water production in Feasible based on baseline scenario analysis with Feasible and assumptions made in the model

On average a there is a difference of a factor 3.60, empirically estimated water availability is 52 million m3 per year, while in the Baseline scenario Feasible assessed water consumption at 14.5 mln m3, based on default water use values.

Possible explanations for this large difference can be:
- Large difference between of the default values incorporated in Feasible (40 lcd for standpost, 100 lcd for yard-taps, 150 lcd for in-house connection) used in the (initial)

baseline assessment and the water availability estimated from the results of the survey (about 300 lcd[9]);
- The currently oversized water networks;
- Leakage in the network (thus higher production than consumption);
- Other than household use of water (e.g. also for irrigation).

Whatever the reason of the differences, it is clear that the Feasible default values, that are used to assess water production (in Feasible production = consumption) are not very representative for rural Armenia. Feasible assumes a “tailor made” water supply system, whereas in Armenia, other standards have been applied when developing the water supply systems. In the final assessment to be made, this needs to be corrected for at least the baseline scenario (higher water demand).

This implies that in the final assessment of the baseline scenario, the default values will be substituted by higher values to reflect present higher water demand.

Expenditures

Also, the estimated expenditures on water supply with Feasible can be compared with the empirically estimated expenditures. This is done in table 2.

Table 2
Estimated expenditure on water supply, according to estimate based on sample and according to Feasible model estimate, in AMD mln per year

Marz	Expenditures water production estimated from sample	Expenditures water production estimated with Feasible (baseline)	Factor between sample and model
Aragatsotn	60,5	82,8	1,4
Ararat	44,7	93,5	2,1
Armavir	40,1	64,8	1,6
Kotayq	15,9	106,1	6,7
Lori	28,8	123,1	4,3
Syunik	25,9	65,4	2,5
Tavushi	10,2	92,5	9,0
Vayotz Dzori	50,1	27,4	0,5
Armenia (8 Marzes)	**276,2**	**655,6**	**2,4**

On average, the modelled expenditure needs are a factor of 2.4 higher than the present expenditures estimated from the survey.

The cost estimates based on the sample can be lower than the modelled ones, due to:
- lack of capital replacement in reality (lack of repairs, etc.);
- overestimation in the model of costs of labour and materials and thus overestimating costs of operation and maintenance and/or re-investments.

Overall, as soon as:

[9] In Feasible water production is assumed to be equal to water consumption (no leakage); in the survey the question was on “How much water was available in your community?”. The answer to this question does not necessarily refer to water available at the tap for households, but can refer also to water production.

(A) default values on water supply (production/availability) used in the Baseline resulted in estimated total water production 3.6 times lower than the present water production (which might be excessive for the domestic usage, taking into account leaks and (mis)use of drinking water for irrigation); and
(b) the expenditure needs estimated with FEASIBLE are 2.4 times higher than present expenditure (highly insufficient for proper operation and maintenance, not to speak about assets replacement) assessed by the survey,

the expenditure per 1 cubic meter of water produced estimated by the FEASIBLE model are factors higher than present expenditure.

The present (average) expenditure on water supply in rural areas amounts to some 600 (from 150 to 1500 AMD (€ 0.3 – 3)) per person per annum, while FEASIBLE suggests that (if water supply systems are properly operated and maintained and if worn-out assets are replaced in line with depreciation rates) the average expenditure would be rather AMD 1500 (€ 3.3) per person per annum.

LITRATURE

EAP TF/COWI, 2004, “The FEASIBLE Model, Version 2, User Manual and Documentation”, January 2004.

EAP TF/COWI, 2005a, “The FEASIBLE Model, Rural cost functions, User Manual”, prepared by COWI or OECD, June 2005.

EAP TF/COWI, 2005b, “Rural cost functions for water supply and sanitation, (EXD/PCM/EN/NMC/04/125), Technology Overview and Cost Functions”, November 2005.

TME, 2007a, “Financing strategies on rural Water Supply and Sanitation in Armenia, Baseline simulation”, Nootdorp, March 2007.

TME, 2007b, “Financing Strategies on Rural Water Supply and Sanitation In Armenia Millennium Development Goals and Minimal Water Supply Standards”, Draft Note, Nootdorp, 16 May 2007.

TME, 2007c, “Methodological Guidelines for Financing Strategies on Rural Water Supply And Sanitation, Version 1”, Yerevan/Paris/Nootdorp, June 2007