Public Perception of Water Price and Service Quality: An Empirical Analysis of Household Water Delivery in Armenia*

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Abstract – Within the last decade, Armenia witnessed a process of rapid and massive privatization of municipal water provision services. A number of top-down assessments consider it successful. However, there is a lack of micro level empirical evidence supporting it. In this empirical research a bottom-up approach with employment of a survey instrument is used to validate and provide another perspective for furnishing a more balanced view on the present state of affairs with municipal water services. A nationally representative household survey was conducted in both in urban and rural areas and covered operation areas of all five operating water utilities. Results show that an average water consumption of 75 liters per person per day meets the requirement of medium-term maintenance. In urban areas households consume and pay more for water services. Over 60% of all households rate water price as high. Overall, households are satisfied with water services, with residents in rural areas showing higher satisfaction. According to the utility ranking based on service quality satisfaction, Shirak records the highest and Nor Akunq has the lowest rank. Despite high satisfaction, 50% to 70% of households experience water services problems and there is a wide-spread problem of water service related debts in some cases may reaching up to 20 times the minimum salary.
Key words: water access, water consumption, water service quality, water payment, debts, price perception, service quality perception, water service problems, water utility ranking, Armenia

1. Introduction

After a decade of neglect and under investment, in the late 1990s the Armenian government launched large-scale water sector reform program to prevent further deterioration of the water infrastructure and improve the management of the water industry. The reform process was conducted in the context of the broader agenda of structural changes taking place in Armenia since 1994 backed by traditional conservative economic policy

*The views expressed are those of the author and do not necessarily reflect the views of any institution she is affiliated with.

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standpoints. It was featured by legal, regulatory and institutional reforms along with decentralization and commercialization with introduction of private sector participation in provision of water services. Even in view of the earlier success and accumulated experience with public-private partnerships in other sectors (energy, telecommunication, etc.), privatization in the water sector has been implemented using step-by-step approach that supposed starting with a short-term management contract with the possibility of extension if the experience was successful. This was dictated by a critical importance of clean and reliable water supply for human existence and health and the dramatic impacts that failures may have. The first management contract made in 2003 offered a transitional period during which the private operator achieved performance improvements and enhanced the confidence for deeper and wider involvement of the private sector. Since then, and within a decade, provision of water services with private sector participation increased from zero to 63% of the population, which records the third highest level in Europe (Harutyunyan 2014a) after UK (88%) and France (75%). The rest of the population in 580 villages relies on their own independent systems (Harutyunyan 2014a).

While there is a great deal of studies and reports stating the Armenian water privatization case as successful based on top-down macro assessments on utility level (Marin 2009, Harutyunyan 2015), little attention is paid to the level of satisfaction with water services based on households perceptions. Exception is the study (Mkhitaryan 2009), which, however, is not comprehensive and inconsistent for making utility comparisons and presents a limited survey results. At the same time, the bottom-up approach confronts the failures of top-down approach by throwing light on the actual situation at the side of end-users. Hence, the present research uses bottom-up, participatory approach that positions people – water service customers (or households as a unit of analysis) – at the center of the research. Moreover, household survey is a method that permits to reduce the impacts of informal connections on official counts of registered performances (Clarke et al 2009) and allows reducing the bias and attaining more pragmatic results.

The aim of the present empirical research is to provide a bottom-up perspective on the actual state of affairs with municipal water services. The survey instrument is used to answer the following questions: (1) What are the consumption and billing practices of Armenian households? (2) How Armenian households perceive quality and price of delivered municipal water services? And, (3) What are the problems related with water services? The paper analyzes public perception and consumption in urban and rural areas delivered by all five water utilities currently operating in Armenia. Utility ranking assessment based on household satisfaction with water services is also presented.

2. Methodology

A household survey instrument was employed to determine public perceptions, satisfaction, practices and issues in relation to municipal water services. The survey followed the standardized survey interviewing process, which according to Fowler and Mangione (1990) is a proper tool for explanatory research with use of statistical techniques. The survey questions were predesigned and structured. The standardized design as supplemented with open-ended questions for obtaining explanations or more meaningful answers to some of the issues based on the respondents' knowledge, feelings and experience.

The survey was conducted through face-to-face interviews that enabled generating high response rates. This is an extremely important factor, taking into account that the survey research is based on probability sampling procedure with data analysis techniques designed to get results that can be generalized with confidence to the entire population. The survey research reached a 91% response rate with only 19 cases for refusals, the main reason of which was lack of time or, in fewer cases, lack of interest in the topic.

The survey was conducted with due consideration of ethical aspects. The following ethical norms (De Vaus 2002) in relation to respondents were observed: 1) Voluntary participation of the respondent was held by openly informing respondents that they were not obliged to participate and could cease the interview any time; 2) For getting informed

consent from the respondents, brief information was provided about the selection procedure, the aim and subject of the survey with approximate time required from the respondents; 3) The respondents were assured about the confidentiality of their responses, implying that only the researcher is able to trace the respondent with responses and the access of any other persons would be prevented. Protective measures were followed on all the stages of data collection, process and presentation. The respondents were also informed that the data in any research piece of work would be presented in an aggregate (summarized) way after statistical analysis and that the completed paper questionnaires at the end of the research would be processed in a way that no information, especially on personal data of the respondents, could be retrieved.

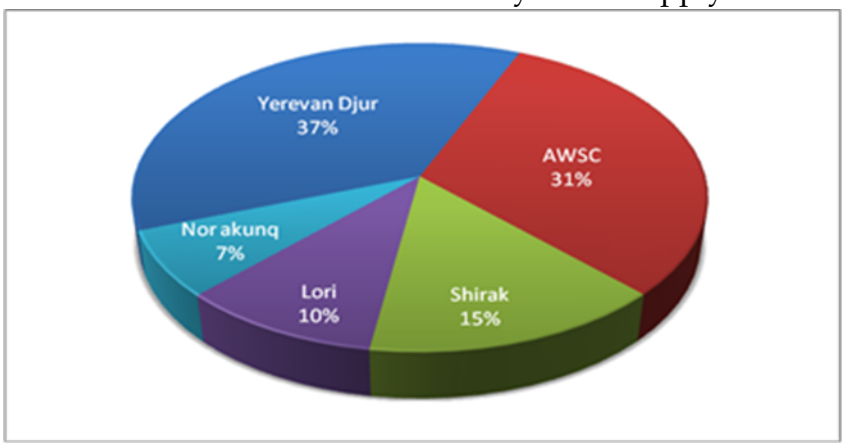
One of the probability sampling methods – the multistage cluster sampling techniques was employed with a representative sample size of 205 households from all over Armenia. The survey research data was collected in 2014 from all eleven marzes (regions) of Armenia making it a national survey: pan-Armenian survey. Both urban and rural areas were covered in the survey. The service areas of all water utilities currently operating in Armenia were considered to make comparisons and ranking for utilities as well. Multistage cluster sampling was performed with preliminary stratification by geographical (water utility service area, administrative regions and urban/rural areas) and demographic characteristics. The sampling in the research was done by using the regional administrative records and maps. This is a preferred approach, which according to Gunatilake et al (2007) is more practical for the analyst rather than seeking for a completing listing of households. Hence, maps, the census database and the list of administrative territorial units of the RA Law on Administrative-Territorial Division of the Republic of Armenia comprised the sampling frame.

Data was analyzed using various statistical tools, including generation of frequencies, means, regressions, correlations of various factors, including including utility and urban/rural factors. The tests for significance used Pearson, Spearman, eta and Kendall's tau correlation coefficients depending on the level of measurement of analyzed data.

TABLE 1. Sample area by settlement type

	Frequency	Percent	Cumulative percent
Yerevan	58	28.3%	28.3%
Other urban	70	34.1%	62.4%
Rural	77	37.6%	100.0%
Total	205	100%	

FIGURE 1. Distribution of households by water supply utilities (%)



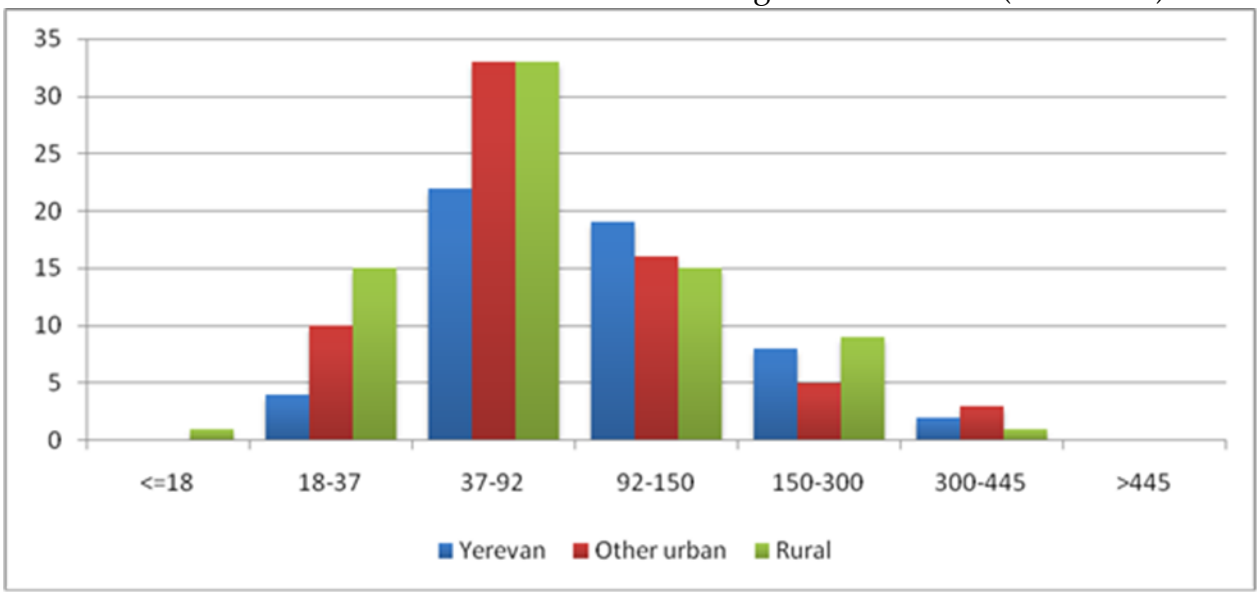
Comparison of means was based on chi-square for categorical data, t-test, one way analysis of variance (ANOVA), etc.

3. RESULTS AND DISCUSSION

The demographics of survey respondents reflects the actual demographics of the country by urban and rural residents. Survey respondents distribution is 62% urban and 38% rural areas (Table 1) covering all 11 marzes (regions) of Armenia.

Figure 1 presents the distribution of households by water utilities that supply water services. According to the sampling strategy, the share of households included for each utility company reflects the share of population served by the utilities. More details on sample framework are presented in the sampling strategy section above.

FIGURE 2. Distribution of households according to income level ('000 AMD)



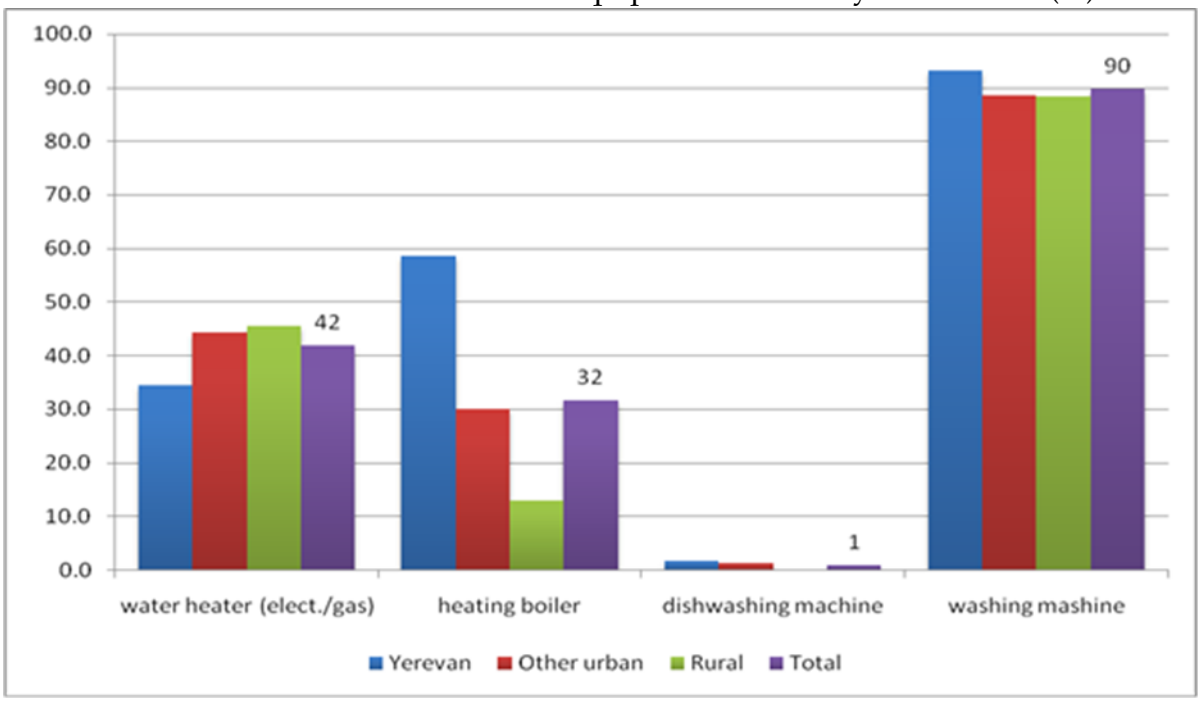
3.1. **Characteristics of households.**

The monthly income level of households is presented in Figure 2. Overall, 86% of households have an income of less than 150 000 AMD (360 USD). The average household income for the capital city, other urban and rural areas fall within the same range of 37 000 - 92 000 AMD (90-220 USD).

For getting a better sense of these figure, they can be compared to the official minimum 45 000 AMD (112 USD) and average monthly salary of 140 000 AMD (350 USD) in 2014. It is typical in household surveys that respondents are inclined to report higher expenses and less income. In the case of a survey in Armenia, even though the question given to the respondents clearly stated "monthly income from all sources", many perceive income as salary received from an official job or governmental support, but not the income received as a part of self-employment jobs or remittances from migrant family members.

The level of availability of washing machines in households both in rural and urban areas of Armenia is high. In total it amounts to 90% of all households (Figure 3). As for dishwashing machines, only 1% of the population in urban areas have one. Among households surveyed, 42% and 32% respectively have an electricity/gas based water heater or a boiler facility which also provides home heating.

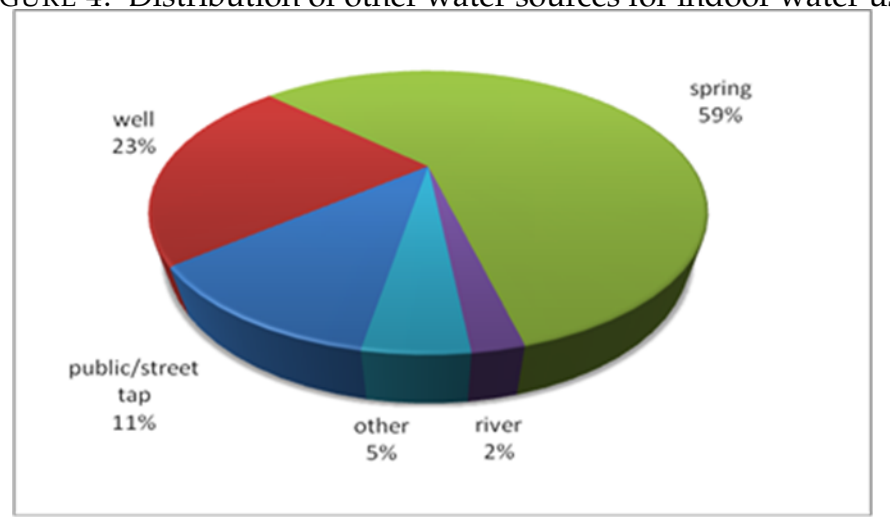
FIGURE 3. Distribution of water equipment owned by households (%)



The data analysis shows that 99% of households have municipal water connection as a primary source for indoor water use. The remaining 1% of households represents rural residents that have their own well as a primary water source. None of the respondents indicated to have shared water sources either for municipal connection or a yard tap. At the same time 21 % of residents mentioned that besides the primary source they use other water sources for household uses. More precisely, the distribution of secondary sources is presented in Figure 4. For instance, 59% of other sources for indoor water use are springs. If there is a good source of drinking water nearby, people have it as an option for better (tastier) water but not for use on a regular basis. The average distance of this source is more than 100 meters far from the dwelling. On average, households spend 40 minutes for collecting that water.

Of those who have private wells only 25% use electric pumps for getting well water, while others get it manually. On average, the depth of wells is 18-40 meters. Households spend on average 30-60 minutes per day for getting well water. A number of respondents

FIGURE 4. Distribution of other water sources for indoor water use

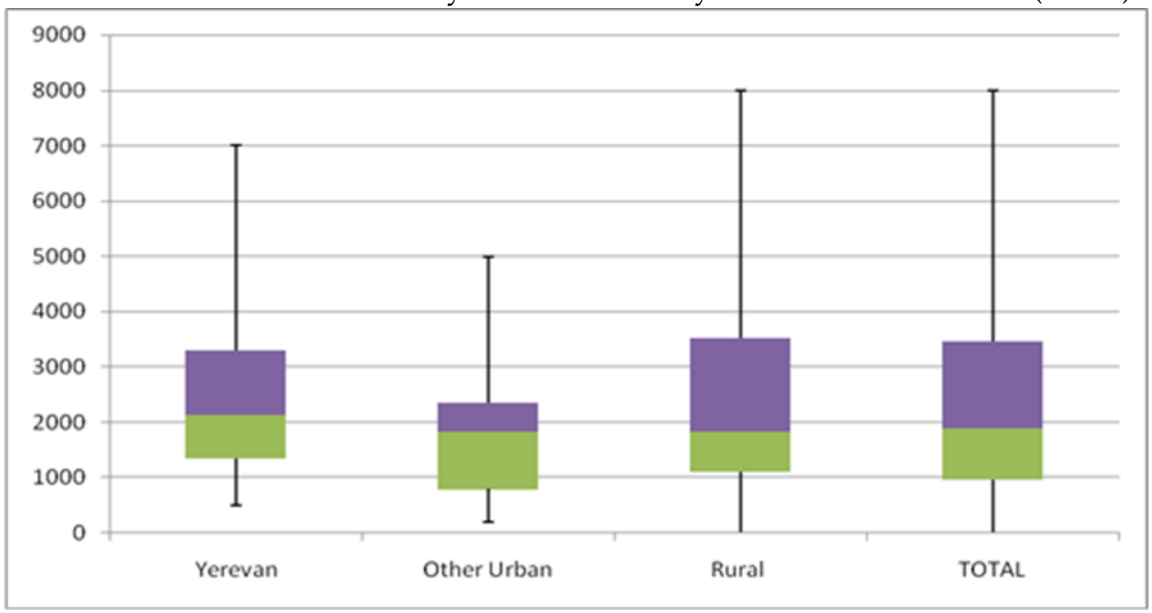


who have wells indicated that they do not use well water for drinking purposes. In general, there are several reasons why people use well water. Some do not have municipal connection because there is no municipal connection in the area at all or because the new pipe is under construction. There are also cases that households are not interested in having the municipal connection because of the location of the house that is not technically suitable for municipal connection and/or of high cost of connection. There was also a case that the high price for connection (80 000 AMD, 200 USD) was the main reason for the household not to connect to the municipal connection. Finally, even when having municipal connection people still use their wells for various purposes such as garden irrigation, the sidewalk cleaning, or clothes washing since they do not need to pay for it. Some respondents worried that the wells could be metered and priced.

3.2. **Household water payment.**

On average, households pay about 2 000 AMD (4 USD) per month for water supply with the maximum being 8 000 AMD (20 USD) (Figure 5). The data for the fourth (higher bills) quartiles are more varied than the data for first (lower bills) quartiles. In rural areas water bills are more heterogeneous. In other urban areas water payments are the most homogeneous. On average, in capital city Yerevan households pay more (median 2 127 AMD, 5.3 USD) for water services per month than households in other urban areas (median 1826

FIGURE 5. Household monthly bills for water by urban and rural areas (AMD)



Note: The boxed section indicates the bill range of the middle 50% of the distribution of urban and rural areas. The line in the middle of boxes (marked by colors) indicates the median.

AMD, 4.5 USD) and in rural areas (median 1 822 AMD) (Annex 1). The narrower shape of the box for households in other urban areas indicates a relative similarity of payments within this group.

A one way analysis of variance (ANOVA) was used to test for the differences in the means of the dependent variable (water payment) broken down by the levels of the independent variable. The "ANOVA" table shows that the mean of water payment differs between the three levels of urbanization at the significance level of 0.06 (F-test=2.856, $p < 0.1$).

Since there are three groups in the independent variable, it is not obvious which particular companies have significantly different means. This requires a further step in the analysis with a post hoc comparison, which will enable to identify which pairs of groups have sufficiently large differences that are unlikely to be due to a sampling error. The Scheffe test is used for this purpose (Annex 1). The mean differences marked with an asterisk indicate the pairs of companies that have real differences with their satisfaction

level. The obvious thing in these post hoc comparisons is that the mean of capital city Yerevan stands out as being different from other urban areas.

The water payment variable is an important one, since due to the lack of information on the exact water consumption by households, water payment can be referred to as a proxy for households' water consumption.

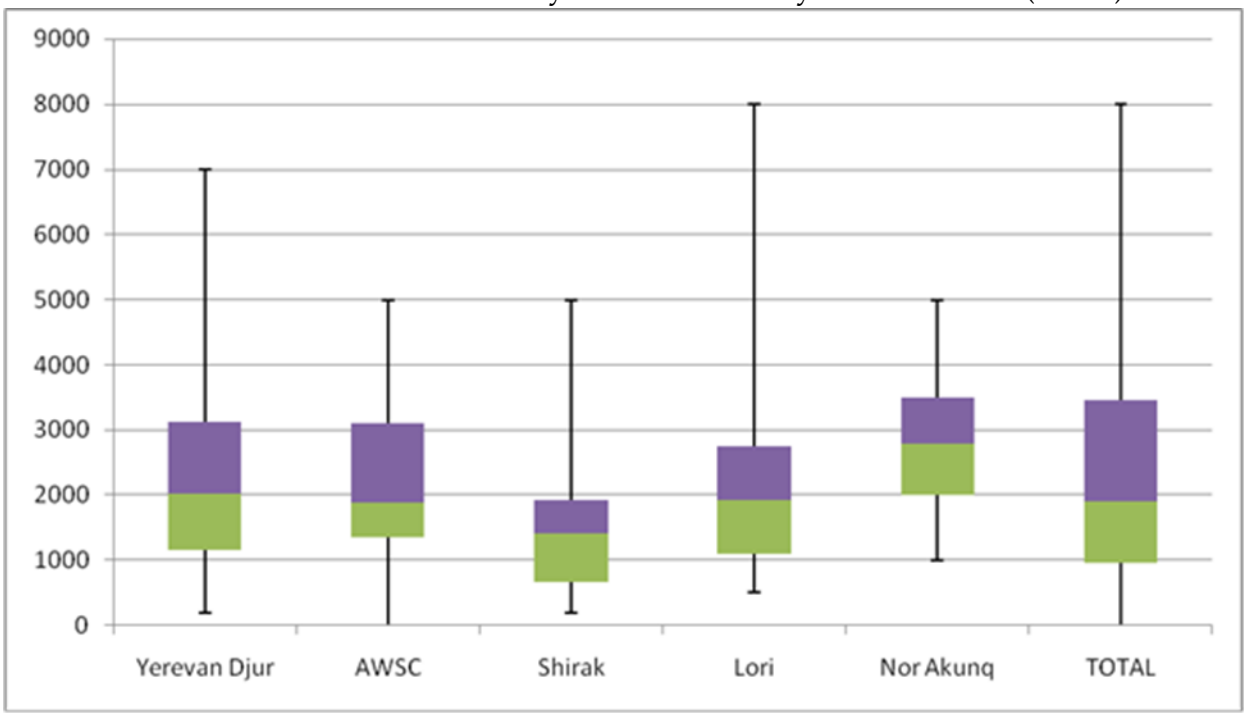
Estimation of the correlations coefficients for identifying the extent to which the household water payment is related to the degree of urbanization (Yerevan, other urban and rural) results in a very weak negative correlation (Kendall's tau = -0.115) (Annex 1). In this case, taking into account the direction of the coding the interpretation of this correlation coefficient is as follows: the more urban the area the higher the water payment is. Moreover, the two-tailed test of significance at $p < 0.05$ shows that this correlation is significant at the level of 0.042, giving reason for rejecting the H0 hypothesis of no relationship. Hence, there is a weak association between the level of urbanization and water payment that is likely to hold in the population.

The split of water bills by water utilities service areas is presented in Figure 6. The highest variance of water bills is recorded with Lori utility, while the most homogenous payments are in Shirak utility. On average, households pay more in Nor Akunq service area (median 2800 AMD, 7 USD), while Shirak households pay less with a median of 1414 AMD (3.5 USD) (Annex 1).

Again, ANOVA was used to test for the differences in the means of the dependent variable (water payment) between the water supply utilities. The "ANOVA" table below shows that the mean of water payment differs between the levels of water utilities at the significance level of 0.01 (F-test=4.705, $p < 0.05$).

The further step with Scheffe post hoc comparison shows mixed results on the pairs of groups have sufficiently large differences that are unlikely to be due to sampling error (Annex 1). The mean differences marked with an asterisk indicate the pairs of companies that have real differences with their satisfaction level.

FIGURE 6. Household monthly bills for water by water utilities (AMD)



Note: The boxed section indicates the bill range of the middle 50% of the distribution of utilities. The line in the middle of boxes (marked by colors) indicates the median.

Similarly, the estimation of correlation of the household water payment with the size of water utilities shows that there is insubstantial negative correlation (Kendall's tau = -0.05) (Annex 2). The test of significance shows that this correlation is too likely to be due to sampling error. Therefore, we continue to assume that, despite this correlation of -0.053, the real correlation is 0. The size of the companies is not related to water payments.

Estimation of correlation of the household monthly income with the size of household water payment shows that that there is a moderate positive correlation (Kendall's tau = 0.233) (Annex 2). Taking into account the direction of the coding, the interpretation of this correlation coefficient is as follows: the high household monthly income the higher the household water payment. The further two-tailed test of significance reveals that this relation is significant at 0.000 ($p < 0.001$). Hence, this moderate correlation of 0.233 is very likely to hold in the population.

Taking into account the importance of the water payment factor, the correlation analysis was extended with a number of other variables at interval and binomial level (Table 2).

Those interval variables were taken that passed the test for normality based on a rule of thumb of skewness (-2:2) and kurtosis (-4:4). The results indicate that there is a statistically significant relationship between the water payment variable and the following variables:

- Number of people: moderately strong positive correlation (Pearson's R = 0.254) that is significant at the level of 0.000 ($p < 0.001$). The higher the number of people in the household the higher the water payment.
- Heating boiler: moderate positive correlation (Pearson's R = 0.225) that is significant at the level of 0.001 ($p < 0.01$).
- Washing machine usage: moderate positive correlation (Pearson's R = 0.238) that is significant at the level of 0.003 ($p < 0.01$).
- Shower usage: moderately strong positive correlation (Pearson's R = 0.261) that is significant at the level of 0.000 ($p < 0.001$).
- Buckets for bathing usage: moderate negative correlation (Pearson's R = -0.238) that is significant at the level of 0.000 ($p < 0.001$).
- Frequency of use/shower: moderate positive correlation (Pearson's R = 0.227) that is significant at the level of 0.004 ($p < 0.01$).
- Frequency of use/buckets: very strong positive correlation (Pearson's R = 0.357) that is significant at the level of 0.020 ($p < 0.05$).
- Flush toilet: weak positive correlation (Pearson's R = 0.177) that is significant at the level of 0.012 ($p < 0.05$). The correlation is small but still is minimally acceptable.
- Pump: moderate negative correlation (Pearson's R = -0.235) that is significant at the level of 0.024 ($p < 0.05$).

3.3. **Household water consumption.**

Table 3 resents the split of water consumption by water utilities. Interesting thing to highlight is that, contrary to the expectation, in the Nor Akunq service areas where water price is the highest (203 AMD, 0.5 USD), water consumption is the highest (13 m^3) too, while

TABLE 2. Relationship between water payment and other variables

Variables	Correlation coefficient	Significance
Number of people	0.254****	0.000
Electric/gas water heater	0.013	0.851
Heating boiler	0.225***	0.001
Dishwashing machine	-0.006	0.929
Washing machine usage	0.238***	0.001
Bathtub	0.071	0.317
Shower usage	0.261****	0.000
Buckets for bathing usage	-0.244***	0.000
Frequency of washing	0.072	0.317
Frequency of use/shower	0.227***	0.004
Frequency of use/buckets	0.357**	0.020
Event time/shower	0.000	0.999
Volume used /buckets	0.029	0.841
Flush toilet	0.177**	0.012
Pump	-0.235**	0.024
Action to minimize water use	-0.042	0.557

*Correlation coefficient significant at the 0.1 level; ** at 0.05 level; *** at 0.01 level; ****at 0.001 level. Interval measurement level.

TABLE 3. Household water price and consumption

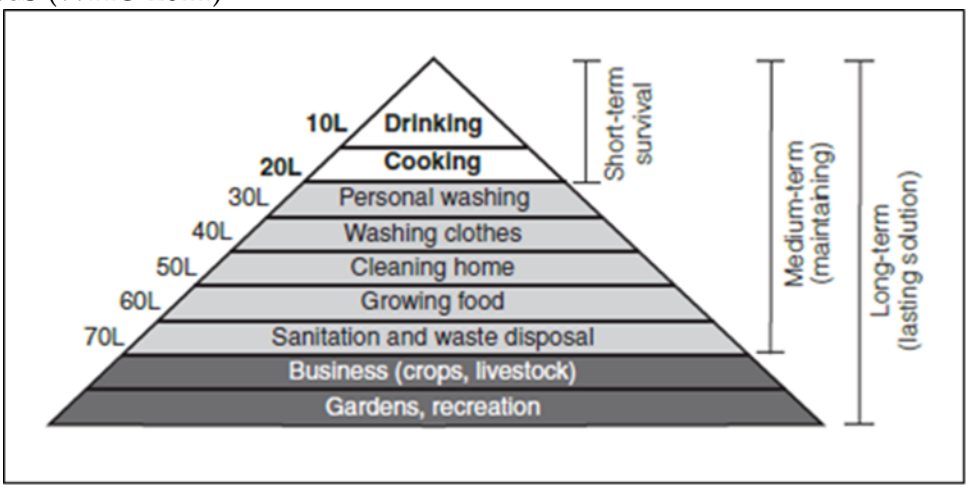
Water sources	Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq
Median water bill, AMD	2031	1880	1414	1920	2800
Water price, AMD	181	180	172	181	203
Water consumption, m^3	11	10	8	11	14

in Shirak area where water price is the lowest (172 AMD, 0.43 USD), water consumption is also the lowest (8 m^3).

On average, a household consumes about 10 m^3 of water. Taking into account that the average household size is 4 persons, the average per capita water consumption amounts to about 2.25 m^3 per month. This makes 75 litres per capita per day. In order to understand whether this amount is enough for meeting human needs, some comparisons need to be made based on WHO standards.

According to the WHO report "people should have safe and equitable access to sufficient quantity of water for drinking, cooking and personal and domestic hygiene". It also sets some standards for minimal water use. The minimum amount of safe water (survival

FIGURE 7. Hierarchy of water requirements after Maslow's hierarchy of needs (WHO 2011)



level) that is necessary for drinking and implementing basic hygiene and cooking for an individual is 20 litres per day (Figure 7). The demand for water depends on a variety of factors such as individual physiology, gender, climate, social and cultural norms, etc. Water is needed for a variety of activities, which are of different importance. Figure 7 shows the hierarchy of water requirements following Maslow's hierarchy of needs. The most important water need is at the top of the pyramid. In the short term perspective water for drinking and cooking is more important than water, for example, for washing clothes. However, in the longer time perspectives more water is needed for better meeting the health and other benefits.

In this context, average water consumption in Armenia is higher than the sufficient short-term basic survival level of 20 litres. It meets the requirement of medium-term maintaining. Hence, any policy decisions on price should be made very carefully taking into account the subsequent impacts on water demand, which could be expected to be reduced at the expense of health.

3.4. **Water metering.**

Regarding the level of water metering, over 97% of households have water meters and pay according to meter records. Those who do not have meters either pay normative of

250 litres per person per day or a fixed amount of 1 000 AMD (2.5 USD) per month. None of responds received any technical or financial support with installation of water meters.

Here, it is important to highlight the unique case of water metering process in Armenia. Within a rather short period of time, the country succeeded in introducing large-scale metering for municipal water supply. Being almost non-existent in the early 2000s, water metering by 2010 averaged 86%, for some utilities reaching up to 99% (near-universal metering), which is among the highest levels world-wide and unique in that it is individual apartment level metering with conservation effects in contrast to building block level metering (Harutyunyan 2014b). It became a key measure in introducing a volumetric-based tariff system and enforced water payments.

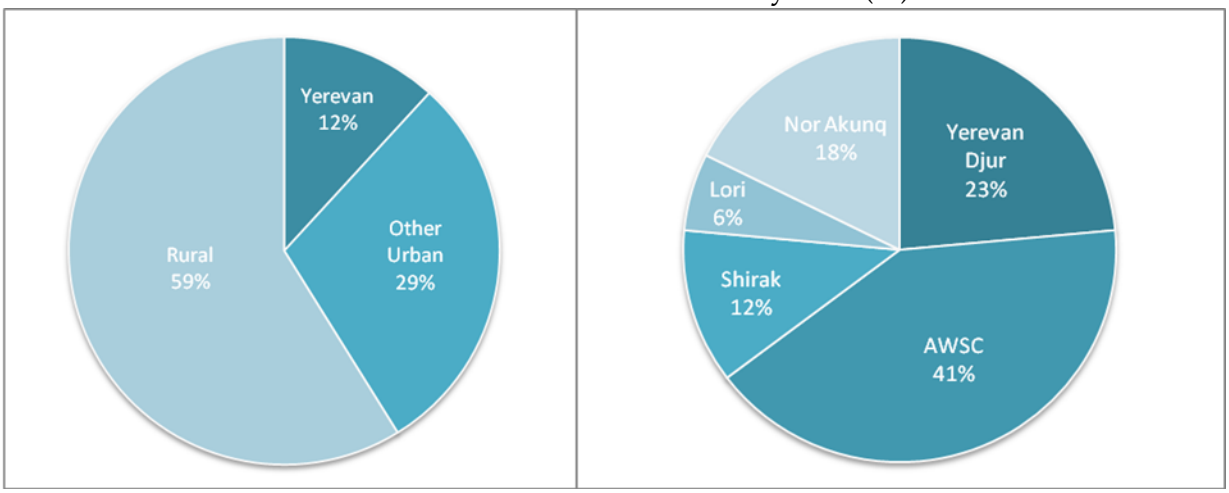
3.5. **Water payment debts.**

Over 8% of all surveyed households (17) declared that they have debt issues related to the water bill payment. It is important to note that initially the water bill payment debt issue was not designed into the survey question and during the fieldwork nothing was asked about debts with water payment. The debt issue was indicated by those who raised it themselves. Hence, this number could be very much underestimated. Despite this, the quite high percentage of indebted households and in some cases tremendously high amount of the debts raised the necessity to make more investigation to better understand the issue.

Figure 8 shows that almost 60% of those who have problems paying water bill reside in rural areas. Debt issue is the smallest in capital city Yerevan (12%), though it is a major issue for its surrounding rural areas reflected in second highest level of indebtedness (23%) of Yerevan Djur. The highest indebtedness (41%) is registered within AWSC service area.

The study revealed a considerable range of debts that amount from 2 400 to 700 000 AMD (6-1750 USD) with the mean of 146 000 AMD (365 USD). The median household debt amounts to 45000 AMD (112.5 USD). Comparing this amount with the minimum

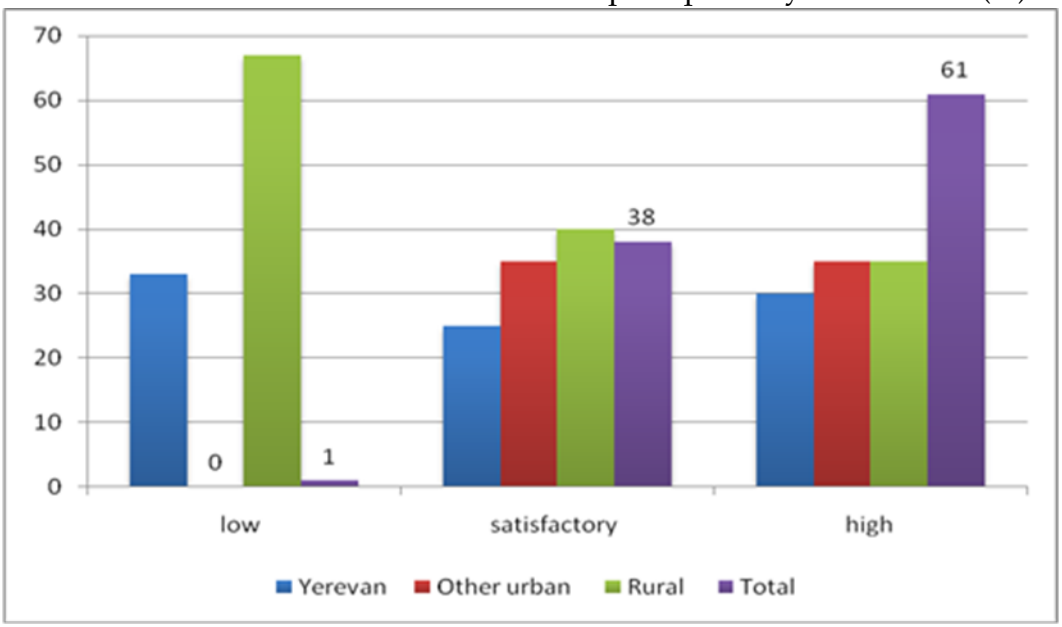
FIGURE 8. Debts for water utility bills (%)



wage of 35 000 AMD (84 USD), one can see that in some cases the water payment debts may reach up to 20 times the minimum salary.

In general the debts were created immediately after the meter installation. Those households that were not paying the water bill before the installation received bills for the periods of their non-payment. The debts were calculated based on the normative of 200-250 litres per person per day. At the same time the households were complaining that at that period they were hardly receiving 1 hour of water service per day and could hardly use that amount of water. There are also cases that after the installation of metering the utility workers have not been accepting the monthly water payments based on meters with the demands of full debts repayment. Hence, the before metering debts were increasing. According to another debts example, water utilities presented a big debts statement. Only after the household could show that all the water bills had been paid, the water utilities canceled it. The respondent said: "We were lucky not to lose the bills certifying the payment." There were other households that were not that lucky to keep the bills for water payment that received the debt statements. Currently, a number of households have passed or are in court process with water utilities for debts issues. Cases were also found when poor families were disconnected from water supply due to the inability to repay water debts.

FIGURE 9. Distribution of water fee rate perception by households (%)



3.6. **Water price perception and billing.**

Households were asked to rate their perception with the fee rate for the water service delivery. Only 1% with majority in rural areas finds that water price is low. About 38% finds it satisfactory and over 60% of all households consider that is high (Figure 9). There is a widespread perception that a number of households made a comment that unlike oil or gas the water is their own resource, coming from mountains and it should not be sold to local people. At the same time, 99% of households that they pay for the water supply services.

Regarding water payment methods, households usually pay at the bank (44%) or at the post (38%) (Figure 10). With new technological innovations, there is a new tendency to make payment through ATMs, which is yet practiced mostly in the capital city Yerevan. Paying to the water worker was the only choice before privatization and for some time after it. Currently, it is on its way out.

3.7. **Perception of water service quality.**

The analysis of the perception of households about the quality of water services show that more than 85% of all surveyed households are satisfied, of which 31% are completely

FIGURE 10. Distribution of water fee payment methods (%)

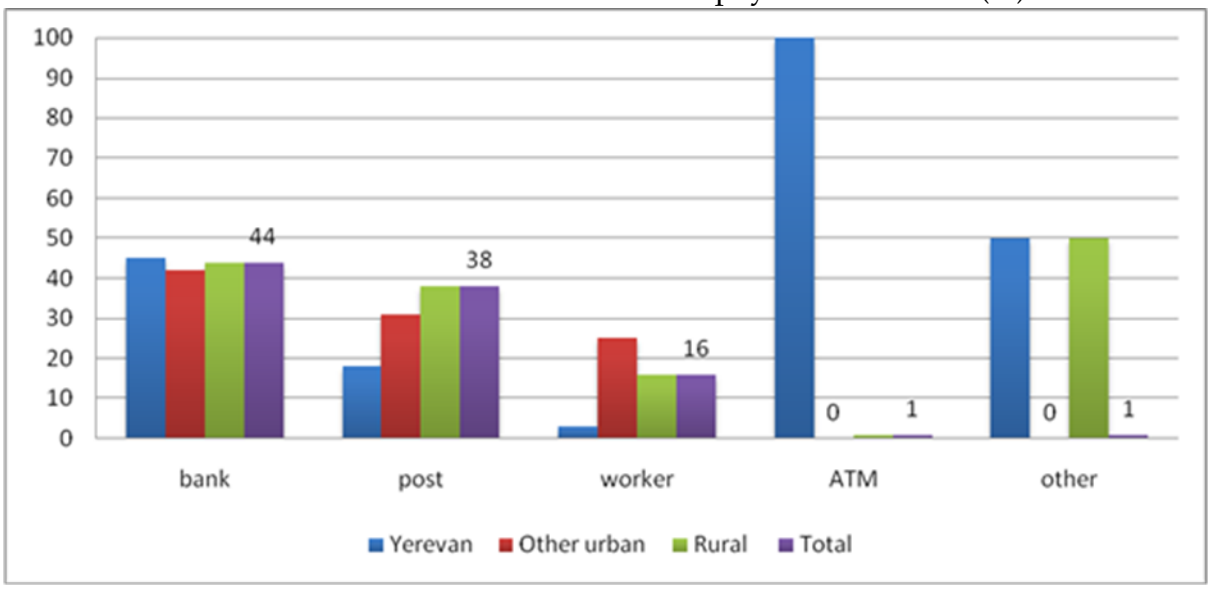
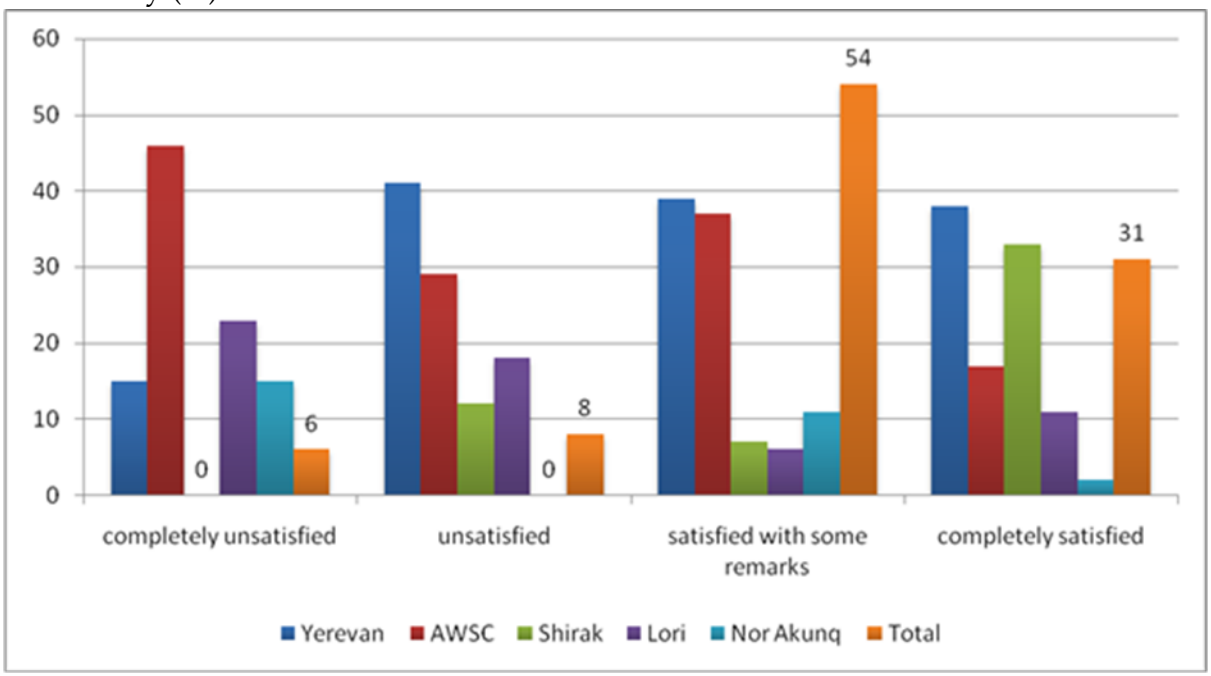


FIGURE 11. Households perception of the quality of water services for each utility (%)



satisfied and 54% are satisfied with some remarks (Figure 11). The highest percentage of service satisfaction (including both complete and with some remarks) is registered with Yerevan Djur utility (33%). The highest percentage (5%) of households that are not satisfied or completely unsatisfied with water quality is recorded for AWSC.

TABLE 4. Utility ranking based on household satisfaction with water service quality

Rank	Water company	Grouped median	Mean
1	Shirak	3.66	3.61
2	Yerevan Djur	3.22	3.17
3	Lori	3.07	2.90
4	AWSC	2.98	2.89
5	Nor Akunq	2.86	2.80
	Total	3.19	3.10

On average, people are satisfied with water quality but with some remarks with grouped median of 3.19 (Annex 3). The highest average satisfaction (3.66 grouped median) is registered with Shirak services with the lowest variance. The lowest with Nor Akunq (2.86 grouped median). Based on these results the ranking of water companies can be done according to household satisfaction with water service quality (Table 4).

Are the differences between the means of companies likely to be due to sampling error or reflect a real difference in the population? The F- test output shows a F-test figure of 5.692 with a significance level of 0.000 indicating that there is almost no chance that the differences between the mean satisfaction of five water companies is due to sampling error (Annex 3). Hence, we safely reject the null hypothesis of no difference between the water company group means.

Since there are five groups (companies) it is not obvious which particular companies have significantly different means. This requires a further step in the analysis with a post hoc comparison, which will enable to identify which pairs of groups have sufficiently large differences that are unlikely to be due to sampling error. The Scheffe test is used for this purpose (Annex 3). The mean differences marked with an asterisk indicate the pairs of companies that have real differences with their satisfaction level. The obvious thing in these post hoc comparisons is that Shirak company stand out as being different from the other companies.

For identifying the correlation of the household perception of water service quality with the scale of water utilities shows that there is a strong correlation (eta = 0.320) (Annex

TABLE 5. Level of satisfaction with water service quality by urban/rural areas

	completely unsatisfied	unsatisfied	total unsatisfied	% of total unsatisfied.	% of total HH
Yerevan	1	3	4	13%	2%
Other urban	7	8	15	50%	7%
Rural	5	6	11	37%	5%
Total	13	17	30	100%	15%
	satisfied with remarks	completely satisfied	total satisfied	% of total satisfied	% of total Households
Yerevan	33	20	53	31%	26%
Other urban	41	14	55	31%	27%
Rural	36	30	66	38%	32%
Total	110	64	174	100%	85%

3). The F-test for this pair of variables was significant at the 0.000 level, hence, we can be confident that an eta of at least this high is found in the population. Furthermore, the eta-squared figure of 0.102 indicates that 10.2 percent of the variance in households' perception of water quality is explained by difference in water company size. According to Cohen rule of thumb, this is a medium measure of size.

The analysis of water quality satisfaction according to urban and rural variance (Table 5) shows that of those households that are satisfied (both completely and with remarks) with water service quality 38% reside in rural areas, which amounts to 32% of all the surveyed households. About 63% in rural and urban areas are satisfied with some remarks, while 37% expressed higher level of satisfaction. The highest number (30) of households with complete satisfaction is recorded in rural areas. At the same time, the lowest number (4) of households dissatisfied with water service quality resides in Yerevan. However, in total urban households are more dissatisfied with water quality (63%), which makes 9% of total surveyed households.

Paradoxically, in rural areas where water services are usually worse and people bear more costs for better water services, households are expressing more satisfaction. At the same time, in Yerevan, there water services is general are higher, overall satisfaction is

lower, reflecting their higher expectation from water services and higher level of complaints in areas with lower duration and opportunity to observe other districts in the city with 24 hours of water supply. The estimation of the correlations coefficients for identifying the extent to which the household perception of water quality is related to the degree of urbanization (Yerevan, other urban and rural) results in almost no correlation (Spearman rho = 0.006) (Annex 3), which does not raise the necessity to go further with significance testing.

3.8. **Perception of problems related to water services.**

The households were asked about the frequency of four main problems that they were faced within the last year (Figure 12). One thing that is obvious in Figure 12 is that from 30% up to 50% of households reported of having never faced the problems with disruption of delivery schedule, cutting off water for a few days, low quality or low pressure issues. Subsequent sections detail the analysis for each of these water supply problems.

3.8.1. *Quality.*

Regarding water quality, about 21% of households often or almost always have water quality issues (above Figure 12). About half of households have never had water quality issues. Overall, Armenian households sometimes face problems with water quality (3.36 grouped median, Annex 4). Completely unsatisfied are only households in the Nor Akunq area with 1.33 grouped median. Households in Shirak and Lori almost never have quality problems with 3.72 and 3.63 grouped medians. Based on these results the ranking of water companies is done according to household perception of water quality. The results are presented in Table 6. The higher the rank the better since there is less occurrence of water quality issues.

Are the differences between the means of companies likely to be due to sampling error or reflect a real difference in the population? The F- test output shows a F-test figure of 17.070 with a significance level of 0.000 indicating that there is almost no chance that the differences between the mean satisfaction of five water companies is due to sampling

FIGURE 12. Households perception of water service related problems (%)

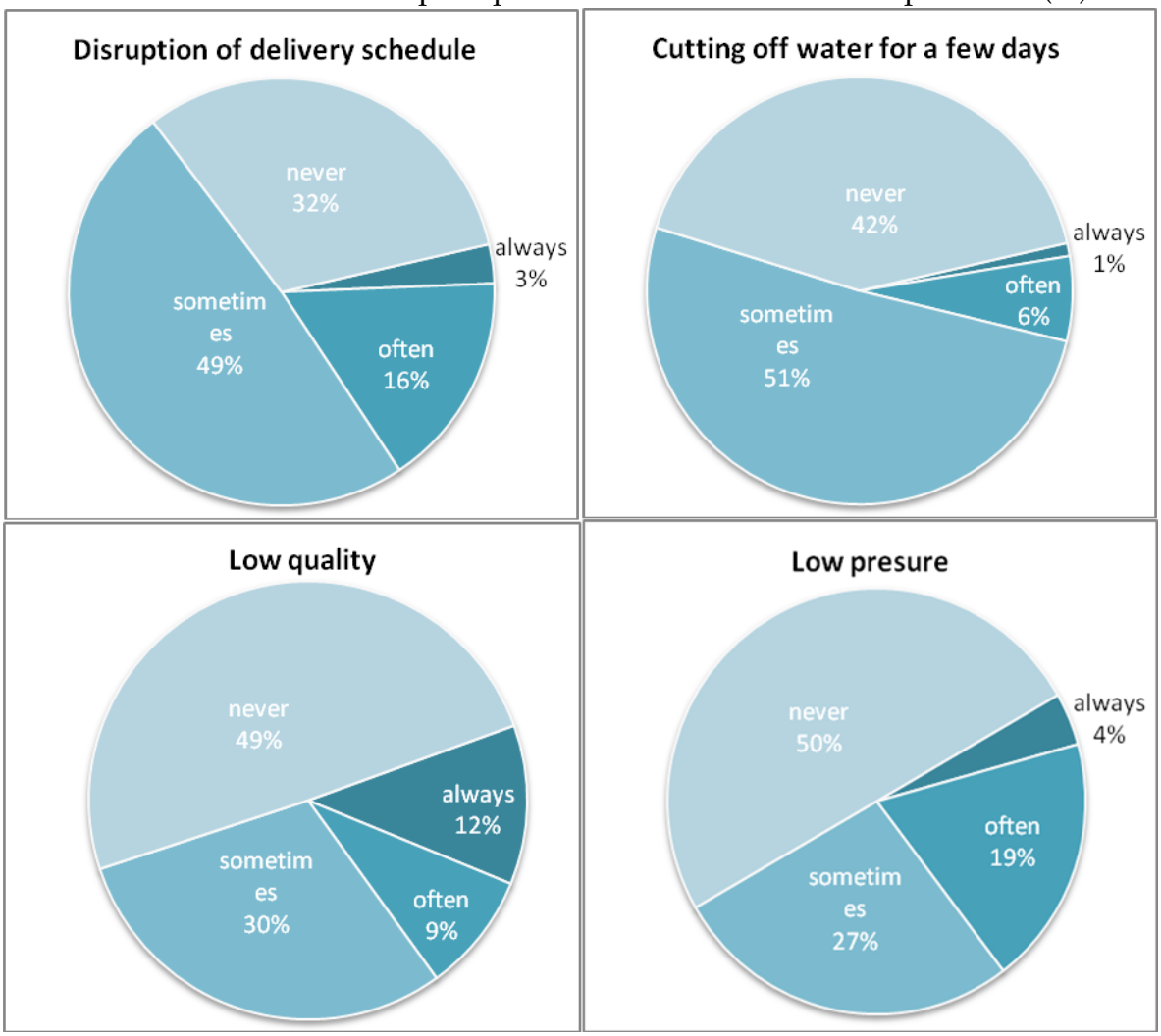


TABLE 6. Utility ranking based on occurrence of water quality issue

Rank	Water company	Grouped median	Mean
1	Shirak	3.72	3.65
2	Lori	3.63	3.60
3	Yerevan Djur	3.49	3.30
4	AWSC	3.13	3.03
5	Nor Akunq	1.33	1.53
	Total	3.36	3.17

error (Annex 4). Hence, we safely reject the null hypothesis of no difference between the water company group means.

As with the case on water service satisfaction, since there are five groups (companies) it is not obvious which particular companies have significantly different means. This requires a further step in the analysis with a post hoc comparison, which will enable to identify which pairs of groups have sufficiently large differences that are unlikely to be due to sampling error. The Scheffe test is used for this purpose (Annex 4). The mean differences marked with an asterisk indicate the pairs of companies that have real differences with their satisfaction level. The obvious thing in these post hoc comparisons is that the smaller the size of companies the more different they are from the other companies and that the households in smallest company Nor Akunq has significantly less water quality than households in other water company service areas.

For identifying the correlation of the household perception of water quality with the scale of water utilities shows that there is a substantial correlation (eta = 0.505) (Annex 4). The F-test for this pair of variables was significant at the 0.000 level, hence, we can be confident that an eta of at least this high is found in the population. Furthermore, the eta-squared figure of 0.255 indicates that 25.5 percent of the variance in households' perception of water quality is explained by difference in water company size. According to Cohen rule of thumb, this is a large measure of size.

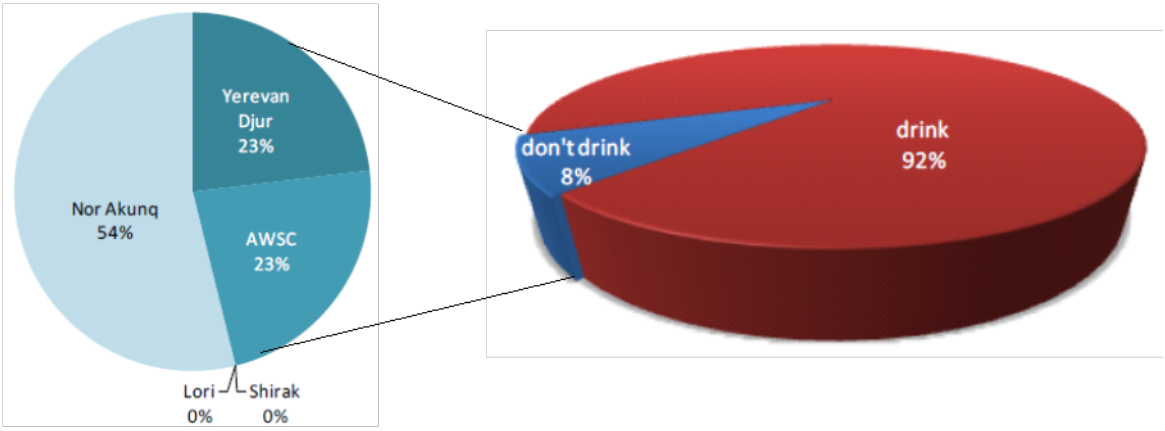
Estimation of the correlations coefficients for identifying the extent to which the water quality is related to the degree of urbanization shows a tiny negative correlation (Spearman rho = -0.031) (Annex 4). In this case again, taking into account the direction of the coding the interpretation of this correlation coefficient is as follows: the more urban the area the higher the water quality is. However, the further test of significance at $p < 0.05$ shows that this correlation is too likely to be due to sampling error. Therefore, we continue to assume that, despite this correlation of 0.031, the real correlation is 0.

The households that had water quality issues were asked to indicate the types of issues. About the half of those households mentioned excess of chlor or other smell issues after cut (Table 7). Transparency (12%) and sand after rains (12%) issues were next important

TABLE 7. Distribution of water quality issues

Water sources	No of households	Percentage
Chlor or other smell after cut	42	47%
Transparency issues (particles)	12	13%
Sand after rain	12	13%
Color	10	11%
Content of salts (sediments after boiling)	8	9%
Other	5	6%
Total	89	100%

FIGURE 13. Tap water drinking behavior (%)



issues mentioned. Indeed, because of sediments and bad water quality some households mentioned of buying and installing new water meters.

Even in the view of water quality issues that households have, on the question whether they drink tap water, 92% of households responded positively (Figure 13). The majority (54%) of those who do not drink tap water are registered with Nor Akunq utility, which is also reflected by the high degree of vended water purchases in Nor Akunq service area.

A number of households commented that water quality was not good since pipes were old. As a coping strategy, after cutting some people leave the water to run for some time before using it for drinking purposes. Others, on rainy days, do not drink tap water or do not use equipment such as washing machines.

TABLE 8. Utility ranking based on perception of occurrence of low pressure issue

Rank	Water company	Grouped median	Mean
1	Lori	3.63	3.45
2	Yerevan Djur	3.43	3.32
3	Shirak	3.32	3.20
4	AWSC	3.31	3.21
5	Nor Akunq	2.60	2.67
	Total	3.35	3.23

3.8.2. *Pressure.*

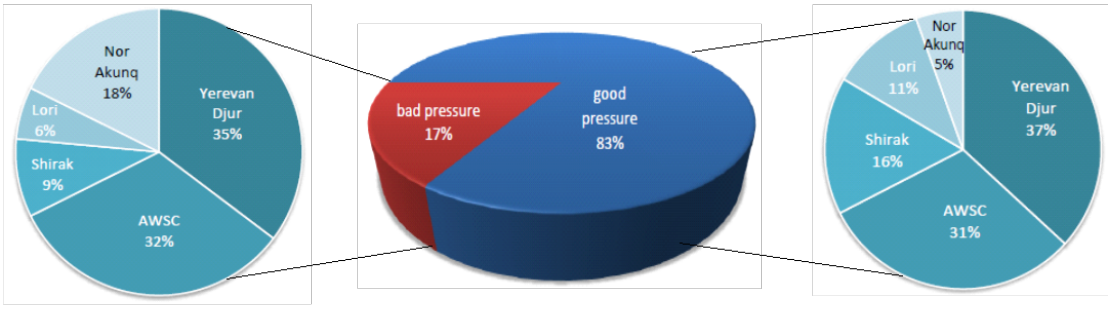
As it was mentioned earlier, within the questions on assessing the frequency of problems with water services, households were asked to estimate the occurrence of low pressure. More than half of households have not faced problems with pressure (above Figure 12). At the same time, 23% of residents have low pressure problems often or always.

Overall, households sometimes face problems with low pressure issue (3.35 grouped median) (Annex 5). The mostly unsatisfied with low pressure are households in Nor Akunq area with 2.6 grouped median, the highest record is in Lori area where households almost never have low pressure issues with 3.63 grouped median. Based on these results the ranking of water companies is done according to household perception of water quality (Table 8).

Are the differences between the means of companies likely to be due to sampling error or reflect a real difference in the population? The F- test output shows a F-test figure of 2.041 with a significance level of 0.09 indicating that there is a chance that the differences between the mean perception of five water companies on low pressure problem is due to sampling error (Annex 5). Hence, the null hypothesis of no difference between the water company group means is not rejected. Since the F-test is not significant neither will eta be making it unnecessary to further analyze the correlation of the household perception of low pressure with the scale of water utilities.

Interestingly, the correlation analysis reveals that there is a negative association (Spearman rho = -0.008) between the floor of the dwelling and the pressure level issue (Annex

FIGURE 14. Perception on water pressure by utilities (%)



5). The correlation coefficient is so small that can be assumed as no correlation without a need for further test of significance.

For identifying the details on the water pressure issue, the households were given other questions as well. Interestingly, it rendered a little bit different picture. Thus, on the question whether the pressure level is good or bad more than 17% of households complained for bad pressure with their municipal connection (Figure 14), of which the highest level of pressure complaints is registered in Yerevan Djur area. The small water utilities have a much lower level of pressure issues, of which the lowest is in Lori.

Among the households that have pressure issues 51% mentioned to have daily pressure variations and 57% have yearly pressure variations with bad pressure in the summer time. Some households noted that because of water cuts and pressure deviations it is not possible to operate water heaters or washing machines properly.

3.8.3. *Schedule.*

Continuing the exploration of households' perception of occurrence of water service related problems, one third of households mentioned to have never had disruption of water delivery schedule (above Figure 12). About 19% of households suffer disruption of water supply hours often or almost always.

Overall, Armenian households sometimes face problems with the water schedule disruption (3.15 grouped median) (Annex 6). The answers this question show the lower

TABLE 9. Utility ranking based on occurrence of schedule disruption

Rank	Water company	Grouped median	Mean
1	Lori	3.39	3.35
2	Yerevan Djur	3.25	3.19
3	Shirak	3.24	3.20
4	Nor Akunq	3.20	3.13
5	AWSC	2.90	2.84
	Total	3.15	3.09

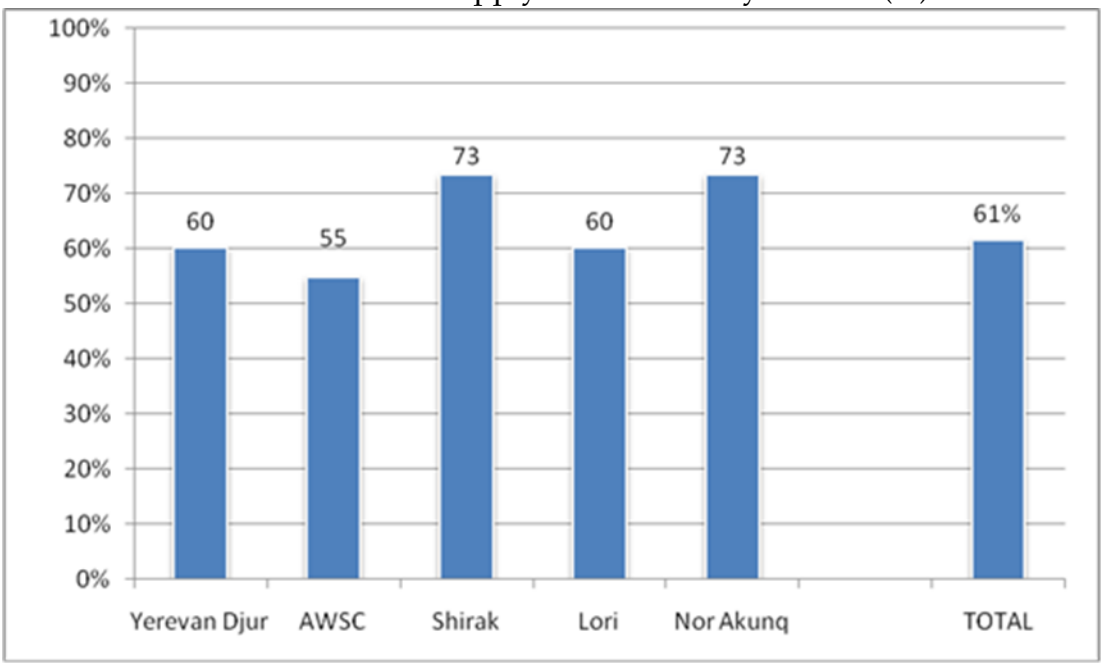
variance compared to other questions related to occurrence of pressure and quality issues. Households in all five water utilities homogeneously mentioned of sometimes having disruptions with the schedule of water supply. Based on these results the ranking of water companies is done according to household perception of water quality (Table 9).

Are the differences between the means of companies likely to be due to sampling error or reflect a real difference in the population? The F- test output shows a F-test figure of 2.774 with a significance level of 0.028 indicating that there is a low chance that the differences between the mean satisfaction of five water companies is not due to sampling error (Annex 6). Hence, we reject the null hypothesis of no difference between the water company group means. The post hoc comparison analysis with Scheffe test shows that no single pair of companies has sufficiently large differences that are unlikely to be due to sampling error (Annex 6).

For identifying the correlation of the household perception of schedule disruption with the scale of water utilities shows that there is a moderate correlation (eta = 0.231) (Annex 6). The F-test for this pair of variables was significant at the 0.028 level, hence, we can assume that an eta of at least this high is found in the population. Furthermore, the eta-squared figure of 0.053 indicates that 5.3 percent of the variance in households' perception of schedule disruption is explained by difference in water company size. According to Cohen rule of thumb, this is a small measure of size.

The analysis goes further for estimating the correlations coefficients for identifying the extent to which the water delivery schedule is related to the floor of the dwelling. Hence, there is insubstantial positive correlation (Spearman rho = 0.03) between the floor of the

FIGURE 15. Water supply for 24 hours by utilities (%)

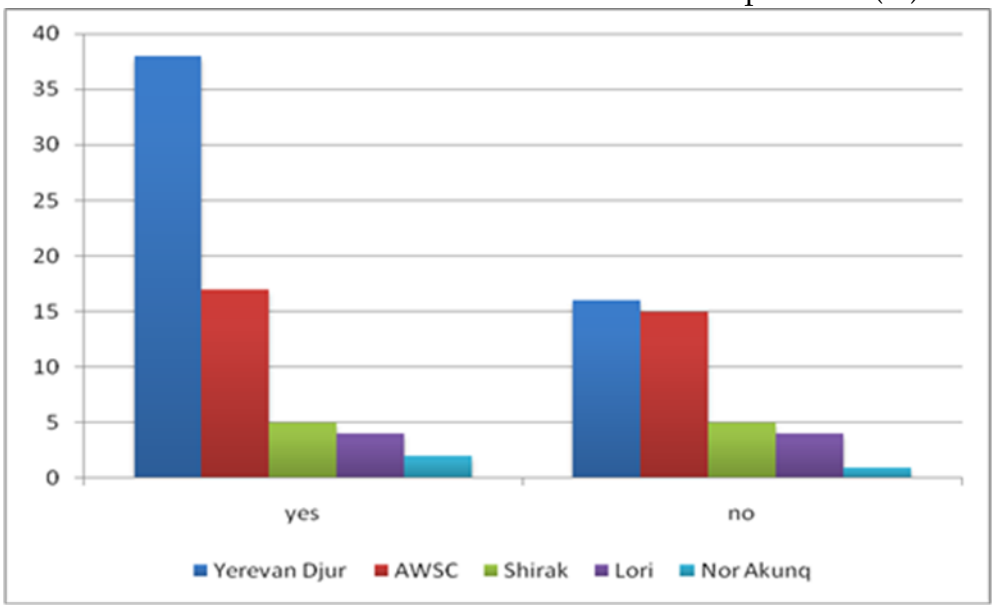


dwelling and the disruption of delivery schedule. The further test of significance at $p < 0.05$ shows that this correlation is too likely to be due to sampling error (Annex 6). Therefore, we continue to assume that, despite this correlation of 0.03, the real correlation is 0.

The mean for the water supply schedule is 18 hours per day. At the same time, the median (over 50% of households) is 24 hours. Over 61% of households in all five water companies have 24 hours of water supply per day (Figure 15). Interestingly, Yerevan does not have the highest records, ceding to Shirak and Nor Akunq utilities. However, over 4% of all surveyed households do not have water supply every day. On average, they have water supply 4 times per week. There are cases that households have water supply 3-4 days and then they may have no water up to one month.

Overall, 62% of households are satisfied with water schedule. The highest records for both satisfaction (38%) and dissatisfaction (16%) with water schedule are recorded with Yerevan Djur utility, followed by AWSC (Figure 16).

FIGURE 16. Household satisfaction with water pressure (%)



Out of 49 surveyed households, 2 noted that the schedule deficiency does not disturb their domestic life, which may reflect the memory of a poor schedule and recent improvements, as well as the culture of coping with problems by their own means. Out of remaining 47 households, some (4) also noted that it is disturbing to have sudden cuts especially while doing some activities such as taking baths or washing dishes or cloths. Some households mentioned having difficulties in having guests due to bad schedule, especially from abroad that are accustomed having frequent water services, such as taking showers. There was also a note that in the summer people in villages may not have water for several months, if there is a summer house of state officials who fill their pools at the expense of others.

3.8.4. *Cutting off water for a few days.*

Only 7% of households reported of having water cut for a few days frequently, while 42% never have it (above Figure 12). Overall, households sometimes face problems with cutting off for a few days (3.37 grouped median) (Annex 7). The answers this question show the least variance compared to questions related to occurrence of all other water issues

TABLE 10. Utility ranking based on occurrence of cutting off for a few days issue

Rank	Water company	Grouped median	Mean
1	Shirak	3.70	3.70
2	Nor Akunq	3.40	3.40
3	Yerevan Djur	3.38	3.35
4	AWSC	3.24	3.18
5	Lori	3.17	3.15
	Total	3.37	3.33

(pressure, schedule, quality). Households in four water utilities homogeneously mentioned of sometimes having issue with cutting of water supply for a few days. Households in Shirak area almost never have this problem with 3.70 grouped median. Based on these results the ranking of water companies is done according to household perception of cutting off issue (Table 10).

Are the differences between the means of companies likely to be due to sampling error or reflect a real difference in the population? The F- test output shows a F-test figure of 17.070 with a significance level of 0.004 indicating that there is almost no chance that the differences between the mean satisfaction of five water companies is due to sampling error (Annex 7). Hence, we safely reject the null hypothesis of no difference between the water company group means.

The post hoc comparison analysis with Scheffe test shows that very few pairs of companies marked with asterisk that have sufficiently large differences that are unlikely to be due to sampling error (Annex 7). The obvious thing in these post hoc comparisons is that the smallest and largest companies are not different from other companies.

For identifying the correlation of the household perception of water cutting issues with the scale of water utilities shows that there is a substantial correlation (eta = 0.276) (Annex 7). The F-test for this pair of variables was significant at the 0.004 level, hence, we can be confident that an eta of at least this high is found in the population. Furthermore, the eta-squared figure of 0.076 indicates that 7.6 percent of the variance in households' perception of water issues related to cutting off for a few days is explained by difference in water company size. According to Cohen rule of thumb, this is a small measure of size.

TABLE 11. Overall satisfaction score and utility ranking

	Shirak	Lori	Yerevan Djur	AWSC	Nor Akunq
Service	3.36	3.07	3.22	2.98	2.86
Quality	3.72	3.63	3.49	3.13	1.33
Pressure	3.32	3.63	3.43	3.31	2.6
Schedule	3.24	3.39	3.25	2.9	3.2
Cutting	3.7	3.17	3.38	3.24	3.4
Sum of scores	17.34	16.89	16.77	15.56	13.39
Overall Satisfaction Score	3.47	3.38	3.35	3.11	2.68
Utility ranking	1	2	3	4	5

Estimation of the correlations coefficients for identifying the extent to which the cutting off water for a few days is related to the degree of urbanization (Yerevan, other urban and rural) results in a small negative correlation (Spearman rho = -0.113) (Annex 7). Taking into account the direction of the coding the interpretation of this correlation coefficient is as follows: the more urban the area the higher the occurrence of water cutting for a few days. However, the test of significance shows that it is insignificant at the level of 0.055 ($p < 0.05$). Hence, this correlation is likely to be due to sampling error and it is unlikely that it reflects this kind of relation in the population.

3.9. **Overall satisfaction score.**

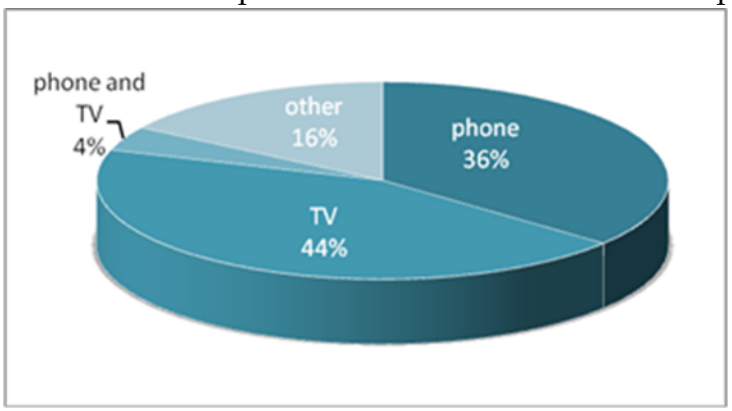
This section extends the analysis for getting the overall satisfaction estimation. It combines the above five satisfaction variables (quality, pressure, schedule, cutting, and service quality) into a summary index for presenting the overall satisfaction score (OSS) for each utility and developing scores for overall ranking among all the studied utilities. The applied approach for estimation is similar to that of the Apgar score presented in the previous chapter. Table 11 presents the satisfaction scores for each water utility based on the grouped median for each variable along with the overall satisfaction score and utility rankings.

The highest overall satisfaction score is recorded with Shirak utility. Interestingly, Nor Akunq utility that recorded quite high performance at utility level assessments (discussed in the previous chapter) evidences the lowest score based on household level assessment.

TABLE 12. Information provision about water service interruptions

		NO			YES	
	Frequency	Percent	Cumulative percent	Frequency	Percent	Cumulative percent
Yerevan	11	11.6%	11.6%	47	43.9%	43.9%
Other urban	37	38.9%	50.5%	33	30.8%	74.8%
Rural	47	49.5%	100%	27	25.2%	100%
Total	95	100%		107	100%	

FIGURE 17. Information provision mode on service interruption (%)



3.10. **Information provision by utilities.**

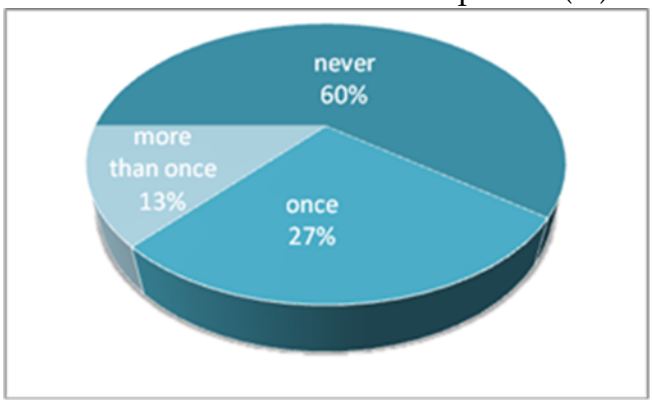
About 53% of households responded positively on the question of being regularly kept informed about the service interruptions in the water supply, of which in rural areas only 25% (Table 12). At the same time, over 50% of households that do not receive information about water service interruptions reside in urban area. The analysis of split among the water utilities shows that the highest percentage (65%) of those households that do not receive information of water service interruptions resides in AWSC service area, while the lowest percentage (27%) is registered in Yerevan Djur service area.

Regarding the mode of information provision, about the majority of households (about 84%) receive information either via phone and/or television (Figure 17). "Other" option which is more common in rural areas includes water service workers, neighbors or announcements at village administration.

3.11. **Household complaints.**

More than 60% of surveyed households have never complained to water utilities for water

FIGURE 18. Households complaints (%)



supply service problems (Figure 18). The remaining 40% complained once or several times. AWSC has the highest and Nor Akunq has the lowest records for complaints for once (33% and 7%, respectively) and more than once times (37% and 4%, respectively). Of those households who complained, about 54% made complaints individually to the local water supplier and 47% did it collectively.

The households were also asked about the reason of their complaints to water utilities. Figure 19 shows the distribution of reasons of household complaints. Complaints related to service hours are the most frequently mentioned reason (22%), followed by problem related to pipes or meters (for example, destroyed meters because of cold, problems with consumption records and bills, or the need for meter installation). Other includes a pool of variety of reasons such as low pressure, lack of drain cleaning, irrigation water, etc.

On the question whether water utilities responded to their complaint, 44% of households gave a negative answer. The highest non response (38%) is with AWSC, followed by Yerevan Djur (31%) (Figure 20). The highest response rate is with Shirak (32%) and AWSC (27%) utilities. Generally, households had various experiences with response of water utilities for their problems. For example, in cases of outside pipe restoration, which is a direct duty of water utilities, some households mentioned that after they addressed to water utilities, they came and restored it. Others mentioned that the households collected money from several neighbors and water workers did the restoration. There were

FIGURE 19. Reasons of households complaints (%)

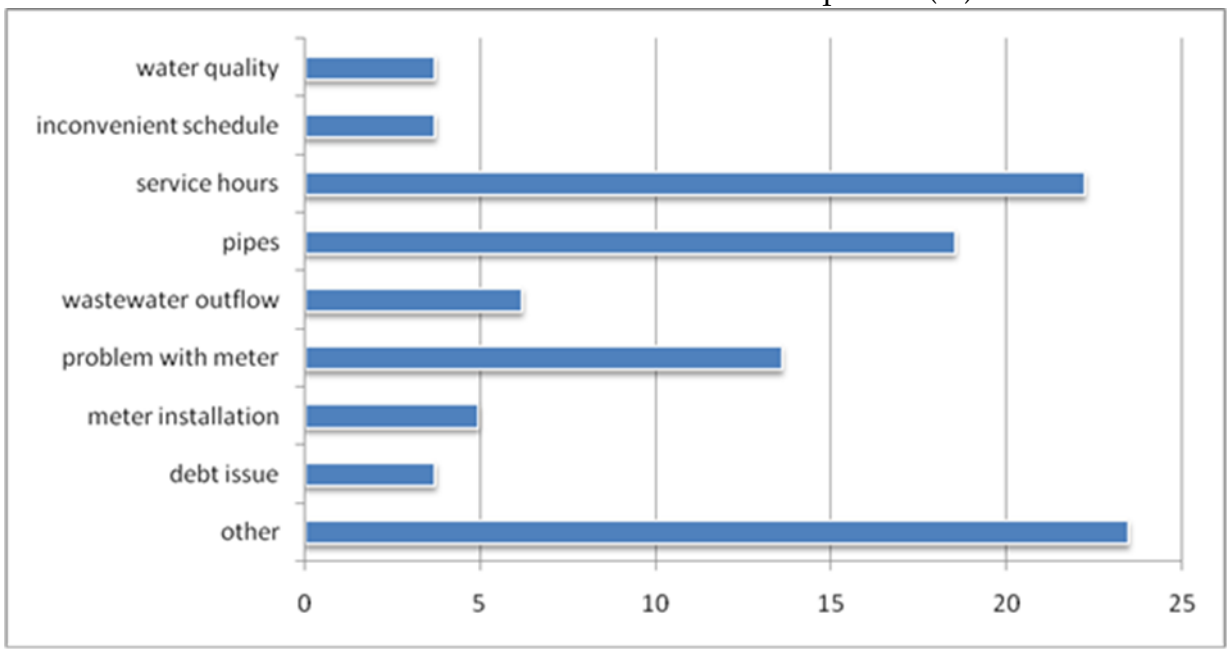
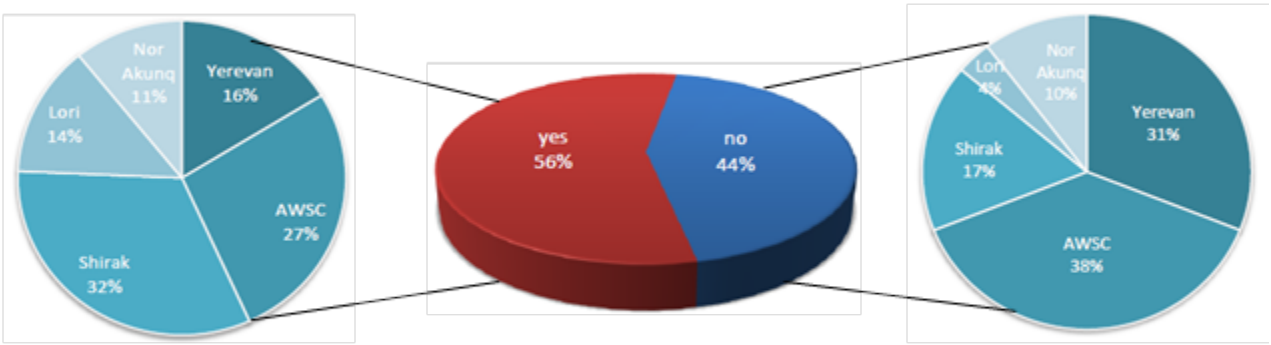


FIGURE 20. Water utility response to households complaints (%)



also cases that the outside pipe was restored by households by their own means without any support of water workers.

Those households that never complained were asked if they would complain in the case of insufficient services. Over 70% of respondents gave a positive answer. As far as

their belief whether in case of a complaint the services would be improved, again over 70% of households responded positively.

4. Conclusions

This empirical research based on household survey conducted throughout Armenia aimed at providing a bottom-up perspective on the state of affairs with municipal water services. The results show that urban areas consume and pay more for water services. At the same time, the size of water utilities is not related with water consumption and payment. On average households pay more in Nor Akunq service area, while in Shirak households pay less. In general, average water consumption of 75 litres per person per day in Armenia is higher than that of the short-term basic survival level of 20 litres. It meets the requirement of medium-term maintaining. Any policy decisions on price should be done very carefully taking into account the subsequent impacts on water demand which could be expected to be reduced at the expense of health. Another point to be considered is that with an increase of living standards water demand also increases and the quality required for each use can be reduced. This is especially challenging for rural water users that have wider range of needs for non-domestic use of water such as growing corps or livestock. Water for these activities can be of lower quality and does not have to be of the same quality as drinking water. Therefore, there is a need in rural areas to improve provision of irrigation water not only at fields but also irrigation water for crops and gardens in house land plots.

The unexpected discovery of the household survey was the wide-spread problem of water payment debt. Astonishing is the quite high percentage of indebted households and in some cases tremendously high amount of the debts reaching up to 20 times the minimum wage amount. Currently, a number of households have passed or are in court processes with water utilities for debt issues. Over 60% of those who have problems paying water bill reside in rural areas. The highest rate of indebtedness is registered within AWSC service area. The cases were found that poor families were disconnected from the

water supply due to the inability to repay water debts. There were also a number of cases that the households received debts bills and only after the household could present all the bills on water payment, water utilities canceled the debts. Taking into account the seriousness of the issue and created confusions, the clarification on water debts calculation and administration is of crucial importance, especially in the context of mitigating the impacts of debts on the poor families that are disconnected from water supply because of debts. Overall, Armenian households are satisfied with water services. At the same time more than half of households reported facing the problems with disruption of the delivery schedule, cutting off water for a few days, low quality or low pressure issues. Paradoxically, in rural areas where water services are usually worse and people bear more costs for better water services, households express more satisfaction than in urban areas. At the same time, in Yerevan, where water services in general are of a higher quality, overall satisfaction is lower, reflecting the higher expectation from water services and the opportunity to observe other districts in the city with better services. According to the ranking of water companies based on households' satisfaction with water service quality, Shirak records the highest and stands out as being significantly different from the other companies. Nor Akunq has the lowest rank. Interestingly, Nor Akunq utility that highly publicized as a success case with high performance at utility level assessments evidences the lowest score in households' assessments due to very bad quality of water. This increased the appropriateness of the research method that enabled to trace problems not quite visible in the top-down assessments.

Finally, within the past decade Armenian utilities have significantly improved water services echoed by general satisfaction on the side of households. However, the first generation reforms targeted at solving urgent needs and accompanied by high returns and low risk low hanging fruits are reached. For making further progress more efforts tailored to specific needs of each utility area are required for enhancing long-term sustainability and effectiveness, consistent with social and environmental needs, which in its turn require more significant capital investments and more effective governance and

management practices. The present empirical study broadens the understanding of the state of affairs in the water sector and contributes defining of further goals and strategies. As such it can be of benefit for scholarship, policy and practice.

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Annex 1. Water payment: urbanization

Table A1.1. Water payment

Region	Mean	N	Std. Dev.	Median	Minimum	Maximum	Grouped Median
Yerevan	2408.62	58	1367.195	2000.00	500	7000	2127.27
Other Urban	1895.74	68	1080.699	1800.00	200	5000	1826.67
Rural	1995.39	76	1330.568	1900.00	0	8000	1822.22
Total	2080.50	202	1274.887	2000.00	0	8000	1897.67

Table A1.2. Descriptive Statistics

	N	Mean	Std. Dev.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Err.	Statistic	Std. Err.
Water payment	202	2080.50	1274.887	1.422	.171	3.126	.341

Table A1.3. Multiple Comparisons

Scheffe Dependent Variable: water payment

(I) Region	(J) Region	Mean Difference (I-J)	Std. Err.	Sig.	90% Confidence Interval	
					Lower	Upper
Yerevan	Other Urban	512.885*	225.795	.078	25.52	1000.25
	Rural	413.226	220.257	.175	-62.19	888.64
Other Urban	Yerevan	-512.885*	225.795	.078	-1000.25	-25.52
	Rural	-99.659	210.871	.894	-554.81	355.49
Rural	Yerevan	-413.226	220.257	.175	-888.64	62.19
	Other Urban	99.659	210.871	.894	-355.49	554.81

*. The mean difference is significant at the 0.1 level.

Table A1.4. Correlations

			Region	Water payment
Kendall's tau_b	Region	Correlation Coefficient	1.000	-.115*
		Sig. (2-tailed)	.	.042
		N	205	202
	Water payment / AMD	Correlation Coefficient	-.115*	1.000
		Sig. (2-tailed)	.042	.
		N	202	202

Annex 2. Water payment: utility size

Table A2.1. Water payment

Water company	Mean	N	Std. Dev.	Median	Minimum	Maximum	Grouped Median
Yerevan Djur	2253.33	75	1307.394	2000.00	200	7000	2030.77
AWSC	1900.95	63	1022.004	2000.00	0	5000	1880.00
Shirak	1483.33	30	937.290	1450.00	200	5000	1414.29
Lori	2215.00	20	1723.300	2000.00	500	8000	1920.00
Nor Akunq	3050.00	14	1388.275	2850.00	1000	5000	2800.00
Total	2080.50	202	1274.887	2000.00	0	8000	1897.67

Table A2.2. Multiple Comparisons

Scheffe Dependent Variable: Water payment

(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Err.	Sig.	90% Confidence Interval	
					Lower	Upper
Yerevan Djur	AWSC	352.381	210.262	.591	-238.39	943.16
	Shirak	770.000*	265.782	.082	23.23	1516.77
	Lori	38.333	309.627	1.000	-831.63	908.29
	Nor Akunq	-796.667	358.198	.297	-1803.10	209.76
AWSC	Yerevan Djur	-352.381	210.262	.591	-943.16	238.39
	Shirak	417.619	272.919	.674	-349.20	1184.44
	Lori	-314.048	315.774	.911	-1201.28	573.18
	Nor Akunq	-1149.048*	363.524	.044	-2170.44	-127.65
Shirak	Yerevan Djur	-770.000*	265.782	.082	-1516.77	-23.23
	AWSC	-417.619	272.919	.674	-1184.44	349.20
	Lori	-731.667	355.166	.377	-1729.58	266.25
	Nor Akunq	-1566.667*	398.221	.005	-2685.55	-447.78
Lori	Yerevan Djur	-38.333	309.627	1.000	-908.29	831.63
	AWSC	314.048	315.774	.911	-573.18	1201.28
	Shirak	731.667	355.166	.377	-266.25	1729.58
	Nor Akunq	-835.000	428.729	.437	-2039.60	369.60
Nor Akunq	Yerevan Djur	796.667	358.198	.297	-209.76	1803.10
	AWSC	1149.048*	363.524	.044	127.65	2170.44
	Shirak	1566.667*	398.221	.005	447.78	2685.55
	Lori	835.000	428.729	.437	-369.60	2039.60

*. The mean difference is significant at the 0.1 level.

Table A2.3. Correlations

			Water company	Water payment
Kendall's tau_b	Company for water supply	Correlation Coefficient	1.000	-.050
		Sig. (2-tailed)	.	.360
		N	205	202
	Water payment	Correlation Coefficient	-.050	1.000
		Sig. (2-tailed)	.360	.
		N	202	202

Table A2.4. Correlations

			Monthly income	Water payment
Kendall's tau_b	Monthly income	Correlation Coefficient	1.000	.233**
		Sig. (2-tailed)	.	.000
		N	196	194
	Water payment	Correlation Coefficient	.233**	1.000
		Sig. (2-tailed)	.000	.
		N	194	202

**. Correlation is significant at the 0.01 level (2-tailed).

Annex 3. Water service quality satisfaction

Table A3.1. Satisfaction with water service quality

Water company	Mean	N	Std. Dev.	Variance	Grouped Median
Yerevan Djur	3.17	76	.700	.490	3.22
AWSC	2.89	63	.805	.649	2.98
Shirak	3.61	31	.615	.378	3.66
Lori	2.90	20	1.071	1.147	3.07
Nor Akunq	2.80	15	.775	.600	2.86
Total	3.10	205	.805	.647	3.19

Table A3.2. ANOVA Table: Service Satisfaction * Water company

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups (Combined)	13.495	4	3.374	5.692	.000
Within Groups	118.553	200	.593		
Total	132.049	204			

Table A3.3. Measures of Association

	Eta	Eta Squared
Satisfaction with water service quality * Water company	.320	.102

Table A3.4. Correlations

			Region	Service satisfaction
Spearman's rho	Region	Correlation Coefficient	1.000	.006
		Sig. (2-tailed)	.	.933
		N	205	205
	Service satisfaction	Correlation Coefficient	.006	1.000
		Sig. (2-tailed)	.933	.
		N	205	205

Table A3.5. Multiple Comparisons

Scheffe test Dependent Variable: Satisfaction with water service quality						
(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Err.	Sig.	90% Confidence Interval	
					Lower	Upper
Yerevan Djur	AWSC	.282	.131	.331	-.09	.65
	Shirak	-.442	.164	.128	-.90	.02
	Lori	.271	.193	.743	-.27	.81
	Nor Akunq	.371	.218	.574	-.24	.98
AWSC	Yerevan Djur	-.282	.131	.331	-.65	.09
	Shirak	-.724*	.169	.001	-1.20	-.25
	Lori	-.011	.198	1.000	-.57	.54
	Nor Akunq	.089	.221	.997	-.53	.71
Shirak	Yerevan Djur	.442	.164	.128	-.02	.90
	AWSC	.724*	.169	.001	.25	1.20
	Lori	.713*	.221	.037	.09	1.33
	Nor Akunq	.813*	.242	.026	.13	1.49
Lori	Yerevan Djur	-.271	.193	.743	-.81	.27
	AWSC	.011	.198	1.000	-.54	.57
	Shirak	-.713*	.221	.037	-1.33	-.09
	Nor Akunq	.100	.263	.997	-.64	.84
Nor Akunq	Yerevan Djur	-.371	.218	.574	-.98	.24
	AWSC	-.089	.221	.997	-.71	.53
	Shirak	-.813*	.242	.026	-1.49	-.13
	Lori	-.100	.263	.997	-.84	.64

*. The mean difference is significant at the 0.1 level.

Annex 4. Water service problems: quality

Table A4.1. Low quality

Water company	Mean	N	Std. Dev,	Variance	Grouped Median
Yerevan Djur	3.30	76	.994	.987	3.49
AWSC	3.03	62	.868	.753	3.13
Shirak	3.65	31	.709	.503	3.72
Lori	3.60	20	.598	.358	3.63
Nor Akunq	1.53	15	.990	.981	1.33
Total	3.17	204	1.015	1.030	3.36

Table A4.2. ANOVA Table: Low quality * Water company

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups (Combined)	53.390	4	13.348	17.070	.000
Within Groups	155.605	199	.782		
Total	208.995	203			

Table A4.3. Measures of Association

	Eta	Eta Squared
Low quality * Water company	.505	.255

Table A4.4. Correlation (quality)

			Region	Low quality
Spearman's rho	Region	Correlation Coefficient	1.000	-.031
		Sig. (1-tailed)	.	.331
		N	205	204
	Low quality	Correlation Coefficient	-.031	1.000
		Sig. (1-tailed)	.331	.
		N	204	204

Table A4.5. Multiple Comparisons

Scheffe test Dependent Variable: Low quality

(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval	
					Lower	Upper
Yerevan Djur	AWSC	.270	.151	.528	-.15	.70
	Shirak	-.343	.188	.510	-.87	.19
	Lori	-.297	.222	.774	-.92	.33
	Nor Akunq	1.769*	.250	.000	1.07	2.47
AWSC	Yerevan Djur	-.270	.151	.528	-.70	.15
	Shirak	-.613*	.195	.045	-1.16	-.07
	Lori	-.568	.227	.187	-1.21	.07
	Nor Akunq	1.499*	.254	.000	.78	2.21
Shirak	Yerevan Djur	.343	.188	.510	-.19	.87
	AWSC	.613*	.195	.045	.07	1.16
	Lori	.045	.254	1.000	-.67	.76
	Nor Akunq	2.112*	.278	.000	1.33	2.89
Lori	Yerevan Djur	.297	.222	.774	-.33	.92
	AWSC	.568	.227	.187	-.07	1.21
	Shirak	-.045	.254	1.000	-.76	.67
	Nor Akunq	2.067*	.302	.000	1.22	2.92
Nor Akunq	Yerevan Djur	-1.769*	.250	.000	-2.47	-1.07
	AWSC	-1.499*	.254	.000	-2.21	-.78
	Shirak	-2.112*	.278	.000	-2.89	-1.33
	Lori	-2.067*	.302	.000	-2.92	-1.22

*. The mean difference is significant at the 0.1 level.

Annex 5. Water service problems: low pressure

Table A5.1. Low pressure

Water company	Mean	N	Std. Dev.	Variance	Grouped Median
Yerevan Djur	3.32	76	.852	.726	3.43
AWSC	3.21	62	.852	.726	3.31
Shirak	3.20	30	.925	.855	3.32
Lori	3.45	20	.945	.892	3.63
Nor Akunq	2.67	15	.976	.952	2.60
Total	3.23	203	.890	.793	3.35

Table A5.2. ANOVA Table: Low pressure * Water company

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups (Combined)	6.340	4	1.585	2.041	.090
Within Groups	153.779	198	.777		
Total	160.118	202			

Table A5.3. Measures of Association

	Eta	Eta Squared
Low pressure * Water company	.199	.040

Table A5.4. Correlation (pressure)

			Floor	Low pressure
Spearman's rho	Floor	Correlation Coefficient	1.000	-.008
		Sig. (1-tailed)	.	.454
		N	205	203
	Low pressure	Correlation Coefficient	-.008	1.000
		Sig. (1-tailed)	.454	.
		N	203	203

Annex 6. Water service problems: schedule

Table A6.1. Disruption of schedule

Water company	Mean	N	Std. Deviation	Variance	Grouped Median
Yerevan Djur	3.19	75	.766	.586	3.25
AWSC	2.84	62	.751	.564	2.90
Shirak	3.20	30	.714	.510	3.24
Lori	3.35	20	.671	.450	3.39
Nor Akunq	3.13	15	.915	.838	3.20
Total	3.09	202	.770	.593	3.15

Table A6.2. ANOVA Table: Disruption of schedule * Water company

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups (Combined)	6.356	4	1.589	2.774	.028
Within Groups	112.857	197	.573		
Total	119.213	201			

Table A6. Measures of Association

	Eta	Eta Squared
Disruption of schedule * Water company	.231	.053

Table A6. Correlation (disruption)

			Floor	Disruption
Spearman's rho	Floor	Correlation Coefficient	1.000	.030
		Sig. (1-tailed)	.	.338
		N	205	202
	Disruption	Correlation Coefficient	.030	1.000
		Sig. (1-tailed)	.338	.
		N	202	202

Table A6.7 Multiple Comparisons

Scheffe test Dependent Variable: Disruption of schedule						
(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Err.	Sig.	90% Confidence Interval	
					Lower	Upper
Yerevan Djur	AWSC	.348	.130	.132	-.02	.71
	Shirak	-.013	.164	1.000	-.47	.45
	Lori	-.163	.190	.947	-.70	.37
	Nor Akunq	.053	.214	1.000	-.55	.65
AWSC	Yerevan Djur	-.348	.130	.132	-.71	.02
	Shirak	-.361	.168	.334	-.83	.11
	Lori	-.511	.195	.146	-1.06	.04
	Nor Akunq	-.295	.218	.767	-.91	.32
Shirak	Yerevan Djur	.013	.164	1.000	-.45	.47
	AWSC	.361	.168	.334	-.11	.83
	Lori	-.150	.218	.976	-.76	.46
	Nor Akunq	.067	.239	.999	-.61	.74
Lori	Yerevan Djur	.163	.190	.947	-.37	.70
	AWSC	.511	.195	.146	-.04	1.06
	Shirak	.150	.218	.976	-.46	.76
	Nor Akunq	.217	.259	.951	-.51	.94
Nor Akunq	Yerevan Djur	-.053	.214	1.000	-.65	.55
	AWSC	.295	.218	.767	-.32	.91
	Shirak	-.067	.239	.999	-.74	.61
	Lori	-.217	.259	.951	-.94	.51

Annex 7. Water service problems: cutting off

Table A7.1. Cutting off for few days

Water company	Mean	N	Std. Deviation	Variance	Grouped Median
Yerevan Djur	3.35	75	.626	.392	3.38
AWSC	3.18	62	.713	.509	3.24
Shirak	3.70	30	.466	.217	3.70
Lori	3.15	20	.587	.345	3.17
Nor Akunq	3.40	15	.507	.257	3.40
Total	3.33	202	.642	.412	3.37

Table A7.2. ANOVA Table: Cutting off for few days * Water company

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups (Combined)	6.292	4	1.573	4.052	.004
Within Groups	76.485	197	.388		
Total	82.777	201			

Table A7.3. Measures of Association

	Eta	Eta Squared
Cutting off for few days* Water company	.276	.076

Table A7.4. Correlation (cutting off)

			Region	Cutting for few days
Spearman's rho	Region	Correlation Coefficient	1.000	-.113
		Sig. (1-tailed)	.	.055
		N	205	202
	Cutting for few days	Correlation Coefficient	-.113	1.000
		Sig. (1-tailed)	.055	.
		N	202	202

Table A7.5. Multiple Comparisons

Scheffe test Dependent Variable: Cutting off for few days						
(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval	
					Lower	Upper
Yerevan Djur	AWSC	.169	.107	.644	-.13	.47
	Shirak	-.353	.135	.146	-.73	.02
	Lori	.197	.157	.813	-.24	.64
	Nor Akunq	-.053	.176	.999	-.55	.44
AWSC	Yerevan Djur	-.169	.107	.644	-.47	.13
	Shirak	-.523*	.139	.008	-.91	-.13
	Lori	.027	.160	1.000	-.42	.48
	Nor Akunq	-.223	.179	.819	-.73	.28
Shirak	Yerevan Djur	.353	.135	.146	-.02	.73
	AWSC	.523*	.139	.008	.13	.91
	Lori	.550*	.180	.057	.04	1.06
	Nor Akunq	.300	.197	.678	-.25	.85
Lori	Yerevan Djur	-.197	.157	.813	-.64	.24
	AWSC	-.027	.160	1.000	-.48	.42
	Shirak	-.550*	.180	.057	-1.06	-.04
	Nor Akunq	-.250	.213	.847	-.85	.35
Nor Akunq	Yerevan Djur	.053	.176	.999	-.44	.55
	AWSC	.223	.179	.819	-.28	.73
	Shirak	-.300	.197	.678	-.85	.25
	Lori	.250	.213	.847	-.35	.85

*. The mean difference is significant at the 0.1 level.