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Transition from public to private provision of public services: the case of water sector in Armenia

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Author's declaration

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

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Recent water policy reforms worldwide are highlighted with an emphasized role of the private sector participation in provision of water services with prospects for enhancing sustainable development through water resource and service management strategies. The present PhD research aims to investigate the process and impacts of transition from public to private provision of water services in Armenia and to explore the aspects of the supply side on the level of water utility performance and the demand side on the level of end-users (households) ensuring proper consideration of social and environmental demands and legal and institutional implications. In particular, the empirical research focuses on the effects of governance modes on the sustainability performance of water utilities currently operating in Armenia under various forms of public-private partnerships. The analysis explores the directional, magnitude and evolution impacts of water privatization in Armenia along sustainability dimensions: environmental, social, and economic performance. Next, the research is focusing on the impacts of water privatization on households (water access and consumption profile, service quality, coping strategies, etc.). The research also seeks to examine the structural and process changes in the water sector as an aggregate mechanism of policies, legal and regulatory procedures, organizational structures, financing and impact mitigation mechanisms.

The research is based on the mixed method approach with the application of several methodological tools. The major methodological components include ex-post benchmarking method, conversational/stakeholder interviewing, document analysis, and the household survey – bottom-up participatory approach that puts people at the core of the research.

Research results show that intensive marketization trends with related structural changes reinforced privatization in public services. Conditional technical and financial support from donor institutions and urgency dictated by the deteriorating infrastructure made privatization a "no other option". Even under the "forced" conditions, transition to the public-private provision of water services in Armenia had a positive influence on the sustainability performance of all water utilities. Armenian utilities also succeed in performing well internationally. However, the scale of impact of privatization depends on the initial state of the enterprise and the local context. Supportive legislation and regulation is needed for ensuring the attractiveness and incentives for the private sector participation and operation and for protecting consumers from monopoly abuse. Furthermore, although water supply services have been improved and people are generally satisfied with water services, there are still a number of service deficiencies that households face and try to cope with by implementing a number of measures that require additional costs and/or behavioural changes. Finally, after the high return and low risk low hanging fruits are reached during the first generation reforms to meet the most urgent needs, more efforts are required for enhancing long-term sustainability and effectiveness.

Keywords: privatization, transition, sustainability, ex-post assessment, water reforms, public services, infrastructure, household water consumption, coping strategy, willingness to pay, Armenia

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Abbreviation

AMD	Armenian Dram
AWSC	Armenian Water and Sewerage Company
CJSC	Closed Joint Stock Company
CMU	Contract Monitoring Unit
GNI	Gross National Income
GOA	Government of Armenia
AMD	Armenian Drams (currency)
AWSC	Armenian Water and Sewerage Company
EBRD	European Bank for Reconstruction and Development
EECCA	Eastern Europe, Caucasus and Central Asia
ha	hectare
IBNET	International Benchmarking Network for Water and Sanitation Utilities
IMF	International Monetary Fund
KfW	Kreditanstalt fur Wiederaufbau
MY	Municipality of Yerevan
NIS	Newly Independent States
NRW	Non Revenue Water
OECD	Organisation for Economic Co-operation and Development
OSS	overall satisfaction score
PMU	Project Monitoring Unit
PPP	Public Private Partnership
PRSP	Poverty Reduction Strategy Paper
PSP	Private Sector Participation
PSRC	Public Services Regulatory Commission
PWH	Protocol on Water and Health

RA	Republic of Armenia
SCWS	State Committee of Water Systems
SPI_{abs}	absolute sustainability performance index
SPI_{rel}	relative sustainability performance index
SPSS	Statistical Package for the Social Science
USAID	States Agency for International Development
WB	World Bank
WEI	water exploration index
WRI	World Research Institute
WRMA	Water Resource Management Agency
WTP	Willingness-to-pay
YD	Yerevan Djur
YWSC	Yerevan Water and Sewerage Company

INTRODUCTION

Public services have historically been provided by governmental or charitable institutions. By the mid-19th century, in most of Europe rapid industrialization and urbanization provoked sanitary and infrastructural problems and the need to regulate public services. By the mid-20th century, governments in both developed and developing countries expanded their responsibilities for providing a range of services in energy, water, health, and other sectors. However, state provision was criticized for failures such as insufficient investments, inefficiency, excess staffing, etc. (Ndandiko 2010). In response, in the past few decades new models of partnerships with the private sector have emerged. Some forms of private financing were believed to become the best alternative for the rehabilitation of deteriorating infrastructure and reducing the financial burden on governmental budgets (Kirkpatrick et al 2004).

Moreover, recent water policy reforms worldwide stress the importance of the private sector in the provision of water services while emphasizing sustainable development through water management strategies (Lieberherr and Truffer 2014; K'Akuhu 2006). Privatization as an innovative strategic management tool is increasingly considered for promoting sustainability in the water sector backed by the theoretical perspective of "market conservation" (K'Akumu 2006) and reinforced by the Dublin Principles on water and sustainable development that recognizes water as an economic good and emphasizes market-driven approaches for sustainable water resource management (Ouyahia 2006). Private sector involvement is believed to redress public provision failures and provide higher quality and more efficient services, and promote sustainability through the introduction of innovative management and technical competencies (Berrera-Orsorio and Olivera 2007, Kirkpatrick *et al* 2004).

Currently, the depth and models of private participation in the management and operation of public service systems vary based on contractual forms that differ in the degree of transfer of assets to private companies, allocation of risks, rights and obligations across public and private partners. The spectrum of public private governance models includes public, service contract, management contract, lease, concession, and build-operate-transfer models. Since water is regarded as an essential public good and key state responsibility, public provision of water services is the most common practice today (Medalye 2008). According to Hall and Lobina (2008) about 90% of the 400 largest cities worldwide are served by public water utilities. Exceptions are the UK and France, where water utilities are mainly run by private companies. Meanwhile, there are almost no 100% public utilities, and purely private water utilities are rare (Marin 2009).

Though escalating in trend, the private sector involvement is one of the most controversial issues, especially in the water sector (Clarke et al 2009, Marin 2009). Contrary to past optimism by economics, governments and donor institutions, private sector participation resulted in mounting criticism (Hukka and Katko 2003), especially after a series highly publicized contract terminations that raised resistance and doubts about the aptness of water privatization. This also led to the polarization of arguments over the merits and demerits of water privatization and heated up the political and academic debate on whether privatization and resultant newly emerged governance arrangements helped to improve the performance of water utilities in the provision of water services and properly address environmental and public interest issues. Indeed, due to the unique nature of water as one of the most essential elements of human existence and access to proper quality water as essential for health and bettering the living standards of people, the impact of privatization in the water sector is more complex than in other sectors of public service provision, emphasizing the particular need for more empirical studies in this area (Kirkpatrick et al 2004).

The existing literature reveals numerous studies on the private versus public provision of water services for industrialized economies. Representative studies among others are, for example, Renzetti and Dupont (2004), and Ruester and Zschille (2010). Similar studies are rather rare for the developing and transitional countries (Ndandiko 2010; Gassner et al 2007 Al-Madfaei 2009). At the same time, privatization has been a very significant phenomenon in the transition process from centrally planned to a market system in Central and Eastern Europe and the former Soviet Union counties. In these countries up to 90% of assets were state owned, which makes privatization a key aspect of building market economy in these countries (Estrin 2007). Large-scale privatization in these countries underpins research of private sector participation experiences in these countries in the context of essential public service provision such as water and sanitation (Gassner et al 2007).

The present empirical oriented research enriches the available literature by examining the process and impacts of water privatization on both the utility level and on the level of end-users (households) based on the experience Armenia, a country that experienced a rapid and deep penetration of privatization in the water sector within the past decade. It provides a comprehensive study for policy makers and scholars for broadening the understanding of the privatization process and its impacts and to learn lessons from a privatization experience in one of transitional country. Its conclusions are of particular importance for the transition countries which share similarities in terms of introduction of gradual liberalization, inheritance of common infrastructure pattern, specific public infrastructure policies and investment practices.

The rationale for the selection of the Armenian case is based on the following. First, Armenia has a significant record of private sector involvement in its various infrastructure networks and ranks among public-private partnership leaders in CIS countries in the ratio of public-private partnership investment to the gross national income of the country (Polischuk 2008). Secondly, according to the literature, Armenia is among the former socialist countries, which experienced the earliest and highest rates of penetration of private sector participation in the distribution of water services (Harutyunyan 2012; Polischuk 2008, UNDP 2006). Furthermore, there is a lack of comprehensive research with clear-cut results on water privatization in Armenia. The few existing studies are limited in terms of addressing specific aspects in the water sector. For example, Polischuk (2008) assesses privatization in all public sectors, and the water privatization is put in the context of general privatization trends in Armenia and as a result shallowly examined.

The aim of the research is to investigate the process and impacts of transition from public to private provision of water services in Armenia and to explore the aspects of *the supply side* on the level of water utility performance and *the demand side* on the level of end-users (households) ensuring proper consideration of social and environmental demands and legal and institutional implications. The three core research questions are:

1) What are the impacts of privatization on environmental, social and economic performance of water utilities in Armenia?
2) What effects did privatization of the water service have on households in Armenia?
3) What are progress, problem, and policy and institutional implications of introduction of water privatization in Armenia?

One of major strengths and innovation of the research is the methodology, which is based on mixed or *integrated research* strategies. It enables to employ a *holistic approach* to the research and better understand the complexity of interconnections between various components of the water management system. The research observes the developments in a dynamic. It covers the pre-privation period, the privatization process launched back in 2000 up to developments in recent years. Moreover, the research studies impacts on the water governance system and on macro-level the performance of water utilities and adds up bottom-up perspective based on participatory approach that allows to capture the picture from direct end-users' – households' stance. Finally, a number of assessment, such as sustainability index, ranking or international comparison of Armenian water utilities are done for the first time. Thus, the research design allows attaining innovation of conceptual framework and contributing to multi-perspective interpretations.

Hence, the present empirical research is based on the mixed method approach with employment of various methodological tools and multiple sources of data. The mixing in the research follows the "merging the data" design with elements of embedding the dataset with the supportive role within the major dataset (Greswell and Clark 2007). The methodological components tailored to the three main research questions are:

1) *Ex-post benchmarking* is employed to assess sustainability impacts of privatization of water utilities currently operating under various forms of the public-private partnerships. It follows two streams with appropriate techniques: disaggregate level (performance on the level of each indicator) and aggregate level (performance on each sustainability area and overall sustainability performance). The analysis explores the directional, magnitude and evolution impacts of water privatization. The assessment is performed along a number of key dimensions guided by the key sustainability principles. Both the relative and absolute measures on sustainability performance of water utilities are derived and relevant scores for overall sustainability ranking among all studies utilities are developed. Moreover, the

performance of Armenian water utilities is assessed on the international level. Apgar score for measuring the general health of utility operation supplements the assessment.

Indeed, the sustainability performance analysis allowed for the first time to calculate the weighted summary of selected performance indicators for each company. This in its turn enabled to rank all water companies and communicate their relative performance, which was never done before making it a pioneering study.

2) *Household survey* was conducted to collect data from all eleven marzes (regions) of Armenia making it a national survey: pan-Armenian survey. The unit of analysis in the survey research is the household water consumers (or households) in urban and rural areas. 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 used the face-to-face interview as the survey procedure. Data collection was done through the standardized questionnaire that contains a limited number of open questions. The survey research employed various univarite, bivariate and multivariate methods of data analysis, such as frequency distributions, totals, means, percentages, range, standard deviation, crosstabulations, correlation, comparisons and regression. Two models based on multivariate techniques are designed: multiple linear regression model and multiple logistic regression model.

3) *Conversational/stakeholder interviewing* was carried with the following stakeholder groups: villagers and general public, activists, civil society representatives, field

experts, representatives of local authorities, state officials, representatives from water utilities and international organizations. In total 47 interviews were performed. The purpose was to obtain their views of on structural and process changes in the water sector related with introduction of commercialization of water provision, as well as the main challenges and the ways of overcoming them.

4) *Document analysis* is based on the source of documents including archives, files, public records, annual reports, surveys, studies, newspapers, and journals. The data is analyzed qualitatively through the narrative analysis to construct a consistent account out of a number of occurrences observed in talks and texts (Kvale 1996).

Before proceeding to the issues of water privatization, the study provides a short historical background and sets the stage for the issues and further discussions since it is quite important to understand the conditions and processes within the water sector and the economy in general that were behind it. The main discovery of this analysis is that in general Armenia can be classified as a water-stressed country with renewable water availability being a limiting factor for development with the requirement of massive investments to be devoted to the sustainable water management. This is particularly emphasized in the context of climate change impact scenarios and current water-related environmental problems. A revival in economic activities after a decade of low demand and no-pollution implies upward demand for resources, including water resources in all sectors with all related environmental and social implications.

Next, the research results show that the emerging need for water network restructure and rehabilitation, financial needs, structural changes in the whole governance environment and conditionality of international finance organizations were the main driving forces behind privatization. Moreover, there was a buildup of expertise in dealing with economic and legal aspects of privatization contracts in other sectors. Both the positive and negative privatization cases strengthen the experience and confidence to go into privatization in the water sector. At the same time, there is a dominance of international private operators though with the partial participation of local partner companies. One of the research highlights is Armenia's success in achieving unprecedented rapid and massive privatization: in a decade from zero reaching up to 63% of the population. This accounts the third highest level recorded in European countries, where on average 20.5% of the population is served through public-private partnership arrangements. Among NIS countries, Armenian case is also unique in terms of the earliest and highest rates of penetration of private sector participation in the water sector. But to do it politically acceptable, case-by-case rather than rapid mass privatization approach was adopted: while one utility was privatized, others stayed in state ownership. Currently, the continuum of public-private partnership contracts in the Armenian water sector is marked with a centralized lease contract and centralized and decentralized management contract frameworks.

The results of ex-post benchmarking assessment show that transition to the public-private partnerships positively influenced the sustainability performance of all utilities. In particular, all utilities improved their relative to pre-privatization performance. Considerable progress has been made in social followed by environmental performance. Furthermore, Armenian utilities also succeed in performing well internationally: compared to the minimum international performance all Armenian utilities recorded superior performance in both the "before" and "after" privatization cases. Moreover, two utilities succeed in outperforming average international performance. The Apgar score assessment also demonstrated improvement: there is no more utility operating in the critically low zone as it was in the pre-privatization case. The importance of these assessments is emphasized by the fact that this is a pioneer study since some of the assessments, such as overall sustainability assessment, international comparison, and ranking of water utilities is done for the first time.

Another concluding point is that under public-private partnership models both small and large scale companies can operate equally successful. Moreover, though privatization of water utilities may generally lead to sustainability of water utility performance, the scale of impact may depend on the initial state of the enterprise and the local context. Furthermore, after the low-hanging fruits are reached at the first stage, more efforts will be required for enhancing long-term sustainability and effectiveness, consistent with social and environmental needs.

The results of the household survey analysis show that even though the water supply services have been improved within the last decade and people are in general satisfied with water services, there are still a number of service deficiencies that households face and try to cope with. There is a lack of sanitation especially in rural areas and high willingness to pay for the improvement. Water payment debts are widely spread. In some areas, it is still partially satisfying the existing demand with the availability of water supply only for some hours per day or a week in some cases. Coupled with quality and pressure-related issues, it makes water supply not quite predictable especially in summer periods when households are forced to implement a number of service deficiency mitigation measures that require additional costs and/or behavioral changes.

The results of the study seek to be of benefit for scholarship, policy and practice. It particular, it can be used by policy makers to better understand the status, issues and challenges in the water sector and different opinions on advancements, and incorporate in their decision making process the estimates of the relevant conditions that make private provision of water services work effectively and efficiently.

The dissertation is structured in six chapters, of which four are result-based chapters. Each result-based chapter ends with a detailed summary on a set of key findings and conclusions. Major concluding statements drawn from all the findings from all chapters are presented in the final "Conclusion" section of the dissertation. A brief overview of chapters is as follows:

Chapter 1 presents the literature review and covers at the history of privatization and the theoretical background for the rational for and against it. It demonstrates the trend to privatization worldwide, focusing on water sector developments. It also presents the different modes of privatization that have been adopted. The chapter provides the rationale for the present research and research goals and questions.

Chapter 2 deals with the research design and methodological approaches. In particular, it presents relevant theoretical and conceptual frameworks, the research scope and limitations, operational definitions, validation and verification tests, as well as fieldwork administration and ethical considerations.

Chapter 3 provides a short historical background and sets the stage for the logic of the rest of the study. In particular, it describes the physical, geographical and hydrological features with due consideration of environmental issues, such as water pollution and quality, water-related climate change impacts, etc. The chapter also presents the analysis of water abstraction and use trends for the last two or in some cases several decades. Water stress and water poverty issues are also covered.

Chapter 4 presents the analysis of the changes in the water governance system that entails structural and process changes in the water sector. Then it turns to the transition process from state to public-private partnership modes of water governance in the supply of water services detailing each public-private partnership evolution and structure.

Chapter 5 examines the impacts of water privatization on the performance of water utilities. The top-down approach is used to scrutinize the privatization issue from aggregate (utility) level, in which the water utility is the unit of analysis. The analysis explores the directional, magnitude and evolution impacts of water privatization in Armenia along a number of key dimensions: economic, social and environmental performance. Moreover, the performance of Armenian water utilities is assessed on the international level.

Chapter 6 studies the impacts of the privatization of water services on households. The bottom-up approach is based on the household survey conducted in all regions (marzes) of Armenia and the household is the unit of analysis. It provides the results of the analysis of the household survey data with application of various statistical tools (descriptive and inferential). It starts with the presentation of the detailed analysis of household characteristics and households' water facilities. It then assesses water sources, consumption and payment patterns differentiated by utilities and rural and urban areas. Water debt and water quality and service issues are also referred to along with coping strategy costs that households bear for mitigating water service deficiencies. The assessment and ranking of the quality of water services delivered by water utilities in urban and rural areas is performed. The chapter also refers to water service improvement needs and willingness to pay for the improvements. Finally discussed in this chapter are the results of two models based on multivariate techniques (multiple linear regression model and multiple logistic regression model) designed for identifying the sensitivity to specific variable changes to be used further in policy analysis for water industry reforms.

CHAPTER 1 LITERATURE REVIEW

"In rivers, the water that you touch is the last of what has passed and the first of that which comes; so with present time."

Leonardo da Vinci

1.1 Introduction

This chapter explores the literature that is relevant for understanding privatization development trends, processes and outcomes, in the field of public service provision, particularly in the water sector. It presents the historical background of privatization and examines the modes of privatization and recent trends in the water sector, highlighting the debates about merits and demerits of privatization with theoretical underpinnings. Finally, the chapter presents the rationale for the case selection and the research goals and questions.

1.2 Historical and theoretical background

The history of privatization dates back to ancient times. For example, in Ancient Greece or Rome Empire there was a practice of transferring the provision of services, such as tax collection, construction or army supplies, to private individuals or companies (Parker and Saal 2003). However, historically, the provision of social services and the operation of public infrastructures were the main prerogative of governmental or charitable institutions. In the 19th century, in most of Europe rapid industrialization and urbanization provoked sanitary and infrastructural problems, which forced state authorities to take over the role of providing public services, such as energy, water and sanitation (Wollmann 2011). By the mid-20th century, the governments in both developed and developing countries enlarged their responsibilities for delivering a broader range of services, such as energy, water, health, transport, telecommunication, education, defense, etc. (Ndandiko 2010). Theoretically, the public provision of public services is justified by the existence of market failures and imperfections and the nature of public service provider characteristics, such as the natural monopoly of service provision through network infrastructure, creation of externalities, and, especially relating to water services, inelasticity of demand, which implies considerable price power to the provider (Gassner *et al* 2007, Ndandiko 2010).

Traditionally, the government was involved in the services provision as a whole or contracted a private company for delivering the service needed (Grout 2003). However, this mode of public service provision was criticized due to a number of failures, such as insufficient government investments, abuse of market power inefficiency, lack of innovation, inadequate pricing policies, corruption, excess staffing and stagnation (Ndandiko 2010, Parker and Saal 2003). Economists argued that in the conditions of natural monopoly the lack of effective competition restricts the benefits for economic performance, especially where the market for ownership rights is immature. Parker and Saal (2003) refer to *the principal-agent theory* (the lack of effective incentives and controls motivated utility management to pursue its own interests instead of its agents/owners) and *the public choice theory* (self-interest as a driver of decision making and lack of incentive and information asymmetries within the state sector) for justifying a powerful critique for state provision and a strong rationale for privatization to increase economic efficiency.

As a result, in the past three decades, governments in industrialized (especially in the UK and US that deliberately adopted privatization policies), developing and transitional countries have been introducing privatization programs and transferring from the traditional frames with the state as a primary provider to alternative modes of public service provision with private sector involvement (Parker and Saal 2003, Ndandiko 2010, Kirkpatrick *et al* 2004, Marin 2009). According to Parker and Saal (2003), in the 1990’s, the total global privatization proceeds hit almost 937 billion USD, making privatization program an extremely lucrative business for international banks. The largest privatization was implemented in the utility sectors, especially in telecommunication, transport, energy, and water.

An important thing to note is that privatization was steadily urged by international financial institutions under the Washington Consensus policy reform priorities (Ndandiko 2010, Marin 2009). The Washington Consensus refers to a set of broadly free market economic reforms mainly targeted at developing and transitional countries that international financial institutions believed were necessary as "first stage policy reforms" that countries should adopt to increase economic growth. The three main pillars of the Washington Consensus are: fiscal austerity, liberalization and privatization (Stiglitz 2002). The rationale for the transfer from public to private provision was based on the arguments of proponents that it would lead to cost reduction and efficiency improvement driven by profit motives. Economic theory suggests that when price exceeds marginal cost, profit oriented companies will increase sales, which in competitive markets will lead to cost savings and increase in labor productivity and service quality (Gassner *et al* 2007). However, being appealing theoretically, in practice implementation of private involvement in developing countries does not seems to be as straightforward as theory suggests and the process is accompanied by continuous debates and mixed results on the viability of private versus public delivery of public services (Ndandiko 2010). Indeed, the literature review provides different stories about the merits and demerits of privatization. Overall, the results are mixed and in a theoretical and empirical sense the real gains of privatization are not clear cut. Regardless of this, the privatization as "policy transfer" extends internationally under the Washington Consensus agenda (Parker and Saal 2003).

1.3 Policy reforms and privatization trends in the water sector

Recent water policy reforms are marked with a special emphasis on the role of the private sector in the provision of water services and on the need for strengthening the prospects for sustainable development through water resource and service management strategies (Leiberherr and Truffer 2014; Barraque 2003; K'Akuhu 2006). Sustainability challenges that the water sector has to tackle today and in the future are formulated into protection of water resources (environmental dimension), security and affordability of water supply (social dimension) and operating and financing obsolete water systems (economic dimension) (Leiberherr and Truffer 2014). Privatization as an innovative strategic management tool is increasingly considered for promoting sustainability in the water sector backed by the theoretical prospective of "market conservation" (K'Akumu 2006) and reinforced by the Dublin Principles on water and sustainable development that recognizes water as an economic good and emphasizes market-driven approaches for sustainable water resource management (Ouyahia 2006). Competitive markets may lead to cost savings through improved labor productivity and efficiency and to increased opportunities for conservation (Gassner et al 2007; K'Akuma 2006). Private sector involvement is believed to redress public provision failures and provide higher quality and more efficient services, and promote sustainability through the introduction of innovative management and technical competencies (Barrera-Orsorio and Olivera 2007, Kirkpatrick *et al* 2004).

The analysis of public-private partnership development trends in the water sector shows that in the 1990s many countries undertook a number of water sector reform measures accompanied by the introduction of privatization elements in the provision of water services. This process was pushed by the international finance institutions and was broadly adopted in both industrialized and developing countries (Ndandiko 2010, Marin 2009). Some forms of private financing were expected to become the best alternative for the rehabilitation of the deteriorating infrastructure and reduction of the financial burden on governmental budgets. It was also perceived that the private sector could provide higher quality and more efficient services. As a result, a decade later, private investment in the water sector rose to almost $30 billion with over 90 countries having some of the water provision services transferred to the private sector (Kirkpatrick et al 2004).

Currently, the water sector is characterized by the presence of various water governance modes ranging from complete public, to quasi-public (public-private partnership) or to fully private arrangements. Since water is regarded as an essential public good, and consequently a key state responsibility, public provision of water and wastewater services is the most common practice today (Medalye 2008; Foster et al 2005). According to Medalye (2008), only 5% of the world's population receives water supply services through private operators, accounting for around 10% of the sector's total investment (Al-Madfaei 2009). Hall and Lobina (2008) report that more than 90% of the 400 largest cities in the world, including those in high income countries, are served by public sector operators. Exceptions are the United Kingdom and France, where water utilities are currently mainly run by private companies. In the meantime, there are almost no 100 percent public utilities, and purely private water utilities are rare (Marin 2009). An interesting example is the Netherlands, where in 2004 a law was adopted prohibiting any privately owned firm from provide drinking water services to the public (Hall et al 2004). Generally, many countries abstain from going into full privatization. Therefore, the delegated public-private partnership arrangements are the most widespread type of privatization, under which the government keeps the asset ownership right.

Though escalating in trend with prospects of considerable acceleration by 2025 worldwide (Hukka and Katko 2003), the private sector involvement is claimed to be one of the most controversial issues especially in relation to the water sector (Gleik *et al* 2006:131, Clarke *et al* 2009, Marin 2009). Contrary to economists past optimism, governments and donor institutions, private sector participation especially in developing and transitional countries have resulted in a growing number of complexities and criticism (Hukka and Katko 2003), especially after a series highly publicized contract terminations both in developed and developing countries that raised resistance to and doubts about the appropriateness of privatization in the provision of water services (Marin 2009). This resistance is currently considered by proponents and critics of privatization as one of the major failures of private investment in public services (Hall *et al* 2005). Overall, the criticism is related with operation or economic, social and environmental consequences following privatization in water sector.

The crisis of confidence emerged as a result of factors, such as a series of economic crises, badly designed projects, and resistance to liberal economic policies and price rises (Marin 2009). For example, highly advocated in Latin America, the “Chilean Model” of radical and rapid privatization led to the monopolization of water provision by hydroelectric generating firms to the harm of the agricultural sector and extremely high water prices in urban areas (Howe 2011). Dissatisfaction from the privatization process scaled up also because progress in general was lower than expected: investment was much below predictions, household connections especially for poor households were much below agreed levels, and water quality was not meeting standards. Even on the background of positive effects on water access and quality, privatization is often related with increased price of water, particularly to the lower quintiles (Barrera-Osorio and Olivera 2007). For example, in Cochabamba (Bolivia) mass riots resulted in the cancellation of the water privatization contract, because even though after privatization water became available to people, they could not access it because they could not afford it due to increased water rates (Hukka and Katko 2003). Another example was highlighted with non-controlled excessive abstraction of ground water that resulted in growing environmental problems, such as lower ground water and river flow levels, greater risks for flooding, etc. (Pelling 2003). At the same time, many multinational private operators failed to generate reasonable returns and raise funds on the necessary scale, and started withdrawing from developing countries (Hall and Lobina 2008:7).

This led to the heating up of the political and academic debate over the private sector participation in water supply and sanitation service delivery and the polarization of arguments in search of proof or disproof of benefits and costs of private provision. Medalye (2008) claims that the privatization process proved to be one of the major and most controversial developments in the water sector and the pressing question is whether privatization and the resultant newly emerged governance arrangements helped to improve the performance of water utilities in the provision of water services and in properly addressing environmental and public interest issues. Moreover, due to the unique nature of water as one of the most essential elements of human existence and access to proper quality water as inevitable for health and better living standards, the impact of privatization in the water sector is more complex than in other sectors of public service provision, emphasizing the particular need for more empirical studies in this area (Kirkpatrick et al 2004, Davis 2005, Barrera-Osorio and Olivera 2007).

There is abundant literature on the theoretical state of the art and "advocacy research" in identifying the impacts of privatization in the water sector (Davis 2005; Chong et al 2004). A large body of literature has tried to empirically explain the impacts of private versus public provision of water services. However, due to such factors as various standpoints, variations in methodology and data availability, the studies offer mixed results, often ambiguous and contradictory (Parker and Saal 2003, Marin 2009) and in a theoretical and empirical sense the real gains of privatization are not clear cut yet (Parker and Saal 2003).

Some studies highlight the publicized failures as evidence for concluding that public-private partnerships *per se* are not applicable in the water sector in developing countries (Marin 2009, Parker and Saal 2003). Others challenge perceived superior performance of private over public utilities in relation to various performance dimensions, such as efficiency, service quality, larbor productivity, etc. For example, the empirical study of Renzetti and Dupont (2004) of performance indicators of water utilities in the United States, the United Kingdom, and France found no compelling evidence of private utilities' better performance than public water utilities. In these countries, private sector involvement in water service provision is the most established (Hall and Lobina 2008). In general, these countries are viewed as cases of positive impacts of water privatization (Howe nd, Al-Madfaei 2009), even though private provision in these countries is related with greater prices and higher transitional costs (Chong *et al* 2004, Hall and Lobina 2008). Bruggink's (1982) study on water utilities demonstrates that publicly owned utilities are more cost efficient. Bhattacharyya *et al*'s (1995) study suggests that private operators tend to be more inefficient than public utilities. Ruester and Zschille (2010) find higher retail prices in cases of private sector participation in Germany.

In general, the literature has a great deal of studies on the effects of private versus public provision of water utilities in industrialized economies. Similar studies are rather rare for the developing and transition countries (Al-Madfaei 2009, Ndandiko 2010, Gassner *et al* 2007). This gap in the literature is explained not only by the fact of earlier introduction of private involvement in the public service provision in industrialized economies, the nascent stage of institutional and legal environment in developing and transitional countries, but also by the traditional lack of comprehensive data, which brings the empirical studies on effects of private involvement in water sector in these countries to inconclusive and not clear-cut results (Gassner *et al* 2007, Parker and Saal 2003). Even though in the past decade the situation has gradually improved with more empirical studies on impacts of privatization in developing countries, they are mainly focused on Latin American countries (Gassner *et al* 2007, Lin 2005, Clarke *et al* 2009, Romero and Ferro 2007).

An obvious need emerges for further empirical evaluation to get evidence on water privatization impacts in the transitional economies. Privatization has been a very significant phenomenon in the transition process from centrally planned to a market system in Central and Eastern Europe and the former Soviet Union counties. In these countries up to 90% of assets were state owned, which makes privatization a key aspect of building market economy in these countries (Estrin 2007). These countries underwent drastic structural changes and are still experiencing utility reforms accompanied by massive investment in public infrastructure facilities and services, and gradual (instead of immediate) liberalization (Hirschhausen and Meinhart 2001). Large-scale privatization in these countries during the last two decades opens up prospects for studying private sector participation experiences in these countries in the context of essential public service provision such as water and sanitation (Gassner et al 2007).

1.4 Operationalizing privatization

Private sector participation or public-private partnership (PPP) in provision of water services, so called "privatization" process implies transferring some assets or functions of public utilities to private companies under various contractual forms. Accordingly, the operationalization of privatization is delimited by the depth and modes of private participation in the operations of water utilities that vary across countries, depending on various contractual forms that differ in the degree of transfer of assets or functions of public utilities to private companies, allocation of decision prerogatives, risks and revenues, and rights and obligations across public and private partners. Table 1.1 presents the spectrum of water governance modes. As the table shows, private sector participation or the public-private partnership mode of water governance involves operations under various contracts: the management contracts and lease contracts with private firms operating the facility but not investing, concessions with private companies required to make investments, greenfield investments, such as Build-Operate-Transfer schemes or divestitures under which the private company buys some or all the equity from the state, or even the transfer of publicly owned water rights to the private company (Kirkpatrick et al 2004).

Table 1.1 Spectrum of water governance modes and their dimensions

	Asset ownership	Capital investment	Commercial risk	Revenue collection	Mana-gement	Operation	Duration (years)	Selected examples
Public	Public	Public	Public	Public	Public	Public	Indefinite	Germany
Service contract	Public	Public	Public	Public	Public	Public/ Private	1-2	Mexico
Management contract	Public	Public	Public	Public	Private	Private	3-5	Armenia
Lease or affermage	Public	Public/ Private	Shared	Private	Private	Private	8-15	South Africa
Concession	Public	Private	Private	Private	Private	Private	25-30	Argentina
Build-operate-transfer	Public/ Private	Private	Private	Private	Private	Private	20-30	Malaysia
Full or partial divestiture	Private	Private	Private	Private	Private	Private	Indefinite	England

Source: built by the author based on Bakker (2003)

1.5 Rationale for case selection

The research seeks to expand the investigation on private sector involvement in the provision of public services in the water sector in transition countries by focusing on the case of Armenia. The selection of the case was based on a number of reasons:

- First, Armenia has a remarkable track record of private sector involvement in its various infrastructure networks, which according to the World Bank's Private Participation in Infrastructure Database, ranks among public-private partnership leaders in CIS countries in the ratio of public-private partnership investment to the gross national income of the country (Polischuk 2008).

- Secondly, according to the literature, Armenia is among the former socialist countries, which experienced the earliest and highest rates of penetration of private sector participation in the distribution of water services, covering about 65% of the population (Harutyunyan 2012; Polischuk 2008, UNDP 2006). Indeed, this is the third highest level after the UK (88%) and France (75%) recorded in European countries, where on average 20.5 percent of the population is served through public-private partnership arrangement (Harutyunyan 2014a; Bakker 2003). In the USA, 86% of households receive water services from public water systems. Private operators are responsible only for 13% of household water service provision (Bakker 2003).
- Thirdly, non-revenue water (water that is produced and “lost” before it reaches the customer) is the highest among the former soviet countries reaching up to 80% (OECD 2007) signaling unsustainable water management practices.
- Fourthly, based on Falkenmark and Lindh’s (1976) approach for water stress assessment, Armenia falls into the category with withdrawals greater than 20% of total renewable resources indicating about water stress as a limiting factor on development with requirement of massive investments to be devoted for water management. According to another estimation under Water Exploitation Index (WEI), Armenia is water-stressed exceeding with 45% the threshold value of 40% (PWH 2012).
- Another important factor is the climate change prediction. According to the UNDP (2009) developed climate change scenarios, by 2100 Armenia will experience an increase of average annual temperature by about 4.5 C^{o} in the lowlands and 7 C^{o} in the highlands, which means more evaporation and

consequently less soil moisture and skimpy river flows reduced by 24%. Average annual precipitation is projected to drop by 9%, with the biggest (30%) reduction impact for the area of Yerevan and the Ararat Valley. Taking into account the Ararat Valley comprising 13% of the territory of Armenia provides more that 40% of gross agricultural production in the Armenia, the drastic climate change will significantly hit agricultural production and endanger food security in the country. With this regard, introduction of proper water management systems with the provision of more efficiency use of water resources and integration of climate adaptation measures represent imperative ingredient of social and economic development strategies of the country.

- Moreover, availability of water resources on a per capita basis indicates that Armenia falls within the low[1] water availability category. Per capita water resources are less than in other South Caucasus countries - Georgia and Azerbaijan. Also, as of 2002, Armenia ranked the lowest among the former Soviet countries and in the region for the water poverty index[2] - an interdisciplinary measure for assessing the impact of water scarcity and water provision on the population. This is against the background of the general public perception among the population in Armenia, that Armenia is water abundant and that water should be given to the people for free. Nonetheless, even having rich water resources – inefficient water resource management may put the country under water stress and increase water poverty.
- Furthermore, there is a lack of comprehensive research with clear-cut results on involvement of the private sector in the provision of water services in Armenia. The few existing studies are limited in terms of addressing specific aspects in the

[1] The ranges are: Extremely low, Very low , Low, Medium, Above medium, High, Very high 000 (the Dobris Assessment, EEA and UNEP 1997)

[2] Based on the database of the World Resources Institute (WRI)

water sector. For example, in his assessment of public-private experience in Armenia, Polischuk (2008) covers all the sectors, including energy, telecommunications, transport, postal service, and water distribution where private involvement was introduced under various forms. Due to the coverage of a wide range of sectors and the general focus of the study, public-private experience in water distribution was put in the context of general trends in public-private partnership development in Armenia and as a result shallowly examined. In her study Mkhitaryan (2009) focused only on drinking water service provision in urban and rural areas.

- Finally, the researcher had good access to the research site considered appropriate with respect to language, cultural knowledge, the resources and the timeframe available for the research that incorporates implementation of a wide-range household survey throughout the country.

1.6 Research goal and research questions

The ultimate goal of the present research is to provide a comprehensive empirical oriented study for policy makers and scholars for broadening the understanding of the privatization process and its impacts and for learning lessons from a privatization experience in one of the transitional countries.

The aim of the research is to investigate the process and impacts of transition from public to private provision of water services in Armenia and to explore the aspects of *the supply side* on the level of water utility performance and *the demand side* on the level of end-users (households) ensuring proper consideration of social and environmental demands and legal and institutional implications.

Based on this, the objective of the research is to answer the following *core* and *supportive* (not necessarily subordinate) questions:

Research question 1: **What are the impacts of privatization on environmental, social and economic performance of water utilities in Armenia?**

Supportive questions:

- What are the environmental, social, and economic performance levels of water utilities in Armenia?
- Is there a difference between public and private water service provision in Armenia?
- Is there a difference across private water service provision in Armenia?
- What are the directional and magnitude impacts of privatization on sustainability performance of water utilities?
- What are the changes of sustainability performance over time?
- What is the sustainability ranking among water utilities?
- What are the areas in which improvement may be needed to ensure better use of water resources?

The purpose of question 1 is to estimate the effects of governance modes on the sustainability performance of all five water utilities currently operating in Armenia under various forms of public-private partnership mode. To answer this question, a *top-down approach* is used with an attempt to look at privatization from aggregate (utility) level, in which the water utility is the unit of analysis. The analysis explores the directional, magnitude and evolution impacts of water privatization in Armenia along sustainability dimensions: environmental, social, and economic performance. The differences between the public versus private water service provision and differenced across various private service provisions are also explored.

Research question 2: What effects did privatization of the water service have on households in Armenia?

Supportive questions:

- What are the actual domestic water consumption patterns?
- How do water consumption and other water use related variables vary across households in rural, urban and utility areas?
- What is the actual level of water services and how satisfactory is it?
- How much do household pay for water services?
- What are water service provision issues?
- How are households coping with water service provision deficiencies?
- What are the costs of coping measures
- What are water service improvement expectations?
- How much are people willing to pay for service improvements?

Public resistance is one of the major issues of private sector participation process in the provision of water services highlighted in the literature (Spronk 2009, Hall *et al* 2005, Al-Madfaei 2009, Beltran 2004). Increased prices and inability to pay higher fees by the poor even in cases of improved services (Beltran 2004, Spronk 2009) and lack of proper mechanisms of public participation in privatization process may lead to opposition of customers, in some instances strong enough to cease privatization contracts and plans, as were the cases in Bolivia, Germany, Hungary, Paraguay, Peru, etc. (Hall *et al* 2005 Spronk 2009, Beltran 2004). Therefore, the 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 (Al-Madfaei 2009). Moreover, household survey is a method that permits to reduce the impacts informal connections on official counts of registered performances (Clarke et al 2009) and allows reducing the bias and attaining more pragmatic results.

The purpose of question 2 is to scrutinize the level of water services delivered by water utilities and households' satisfaction with it in relation to water quality, pressure level, number of hours and schedule of water supply; to identify the coping strategies that households adopt for overcoming water service issues, such as exploitation of private water sources, acquisition of bottled water, installation of pumps and filters, storage capacity, etc.; to depict household water consumption profile by rural and urban areas, and utility suppliers, etc.; to estimate the cost that households bear of water supply and sanitation services, including additional costs occurred as a part of coping actions; to measure the level of water service improvement expectations and willingness to pay for service improvements.

Research question 3: **What are progress, problem, and policy and institutional implications of introduction of water privatization in Armenia?**

Supportive questions:

- What were the context and prerequisites for transferring to private service provision in the water sector in Armenia?
- What were the structural and process changes in the water sector?
- How did privatization process evolved?
- What are the modes of private participation in the water sector?
- What level did privatization in the water sector in Armenia attained at?
- What the major challenges and issues in privatization process?
- What are the environmental, social and economic challenges of private sector participation in water service provision in Armenia?

- What are the improvement measures for ensuring better water resource management and policy in Armenia?

In order to capture a wider picture, the water privatization of service provision should be placed in a broader context of public sector reforms that entail conscious modifications to the structures and processes of public sector institutions with the aim of improving their operation (UN ECOSOC 2006). Hence, the study seeks to examine the structural and process changes in water sector as an aggregate mechanism of policies, legal and regulatory rules and procedures, organizational structures, financing systems and impact mitigation mechanisms. It also identifies the current challenges and possible improvement opportunities.

Methodological and data considerations for research questions in time continuum are presented in Annex I.

CHAPTER 2 RESEARCH DESIGN AND METHODOLOGICAL APPROACHES

2.1 Introduction

This chapter paints a detailed picture of the main methodological approaches of the research with pertinent theoretical and conceptual frameworks. It is worth noting that this is a multidisciplinary research that is more common in policy research, where the focus is on explicating the critical issues or topic rather than on the development and testing of theories adopted *per se* (Hakim 1987). The chapter also presents research limitations, operational definitions, validation and verification tests, as well as fieldwork administration and ethical considerations.

2.2 Mixed method approach

The accomplishment of the research objectives set out for this study required the application of a multi-faceted approach utilizing various methodological tools and multiple sources of data. Hence, the present empirical research is based on the mixed method approach. In general, the problems related to the mixed methods research approach is the lack of precision in defining the goals, and the issues of a logical basis for explanation (Bazeley 2004). At the same time, mixed methods enable expanding "the breadth and range of inquiry by using different methods for different inquiry components" (Greene et al 1989), counterbalance the weaknesses of methodological approaches (Greswell and Clark 2007) and combine the rationale which can bridge the micro-macro split (Hakin 1987). Bazeley (2004:8) describes it as "a process of piecing together bits of a puzzle to find answers to questions", where "numbers should be used where they help to answer questions, verbal comments should never be ignored."

The criticism of the mixed methods approach strengthens the need to follow a carefully planned process for designing and conducting mixed methods research and diminish potential confusion in the design phase of the study. Moreover, for increasing the viability of applying mixed method application, the research will seek to "give recognition to the full contribution of each method" (Patton 1988).

The mixing in the research follows the "merging the data" design with elements of embedment of a dataset with the supportive role within a major dataset (Greswell and Clark 2007) (Figure 2.1), when the quantitative phase and qualitative phase are brought together to derive more comprehensive results and depict a more complete picture of the research study. The results are based on the analysis that will "progressively unveil relevant evidence on a path to a common conclusion" (Bazeley 2004:9).

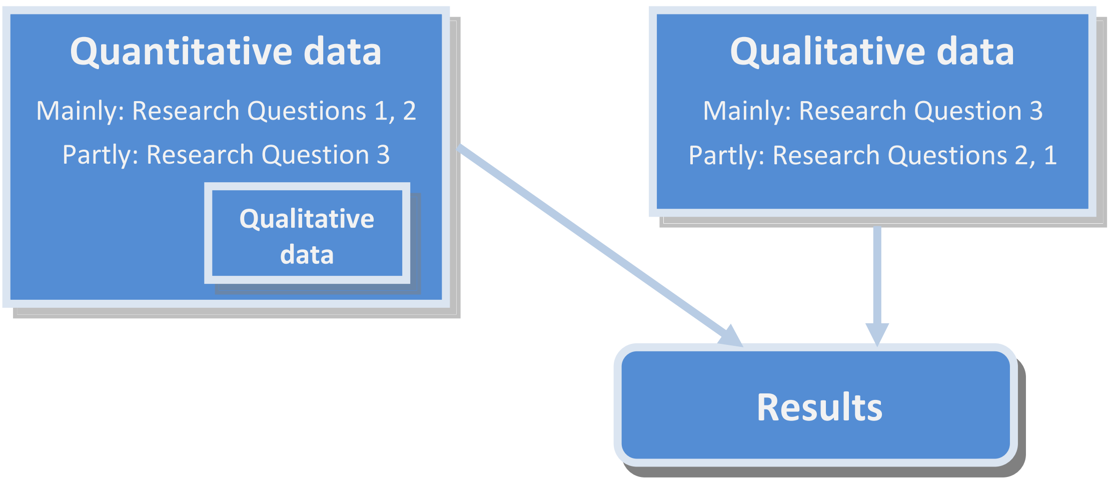


Figure 2.1 Merging design of mixing quantitative and qualitative data

The advantage of the mixed method approach is that it also enables to increase the *validity* of the research through *triangulation* (Silverman 1993), defined as the mixing of data and methods so that different perspectives and points of view elucidate the research topic (Olsen 2004). According to Pontin (2010), triangulation implies a combination of data drawn from various contexts, such as data source, methodology, theoretical approach, data type (qualitative and quantitative) with the purpose of making better sense of data.

The research adopted a profound way of triangulation within various contexts (Olsen 2004). Annex II illustrates the integrated approach to the research process. It presents the four principal areas pertinent to research questions in the research time continuum where all research methods (qualitative and quantitative) are consolidated for a good effect. In this case, triangulation is not only a way of validating the research results. Indeed, it is applied to attain innovation of conceptual framework and contribute to multi-perspective interpretations (Olsen 2004). Environmental, social and economic aspects of the privatization phenomenon are given proper consideration, making the research more interdisciplinary and holistic.

In accordance with the research design (Figure 2.1 and Annex II), the forthcoming chapters of the present research will cover in detail the following four major methodological components, tailored to the three main research questions:

1) ***Ex-post benchmarking method*****:** Research Question 1
2) ***Household survey*****:** Research Question 2 (supplementing Research Questions 1 and 3)
3) ***Conversational/Stakeholder interviewing*** Research questions 2 and 3 (supplementing Research Question 1)
4) ***Document analysis***: Research question 3 (supplementing Research Questions 1 and 2)

The first two components (ex-post benchmarking method and household survey) are quantitative methods. The last two components (conversational/stakeholder interviewing and document analysis) are based mainly on the qualitative analysis with application of few quantitative techniques.

2.3 Operational definitions

The *operational definitions* for key concepts in the research are as follows:

- *Public-private partnership* (PPP) or private sector participation in provision of water services, the so called "privatization" process implies transferring some assets or functions of public utilities to private companies under various contractual forms.
- *Water governance modes* or arrangements imply various types or options of responsibilities in the provision of water and sanitation services, ranging from complete public, to public-private partnership or to fully private arrangements.
- *Municipal water* refers to water supply provided from a central point and piped to water final users (domestic, institutional or industrial). It is an alternative to an individual or separate water source or pressure system.
- *Indoor water use* refers to indoor water uses (toilet, bath, etc.) that are usually not dependent on climate. It may also include water use that is physically located outdoors of the household, such as pool filtering. This differs from *outdoor water use* that refers to outdoor-type water uses that depend upon climate conditions, such as vegetation evapotranspiration (RAU 2004).
- *Non-revenue water* denotes water that was produced and is "lost" prior to getting to the customer (IBNET 2005). The losses include leakages, metering inaccuracies, (unbilled) illegal usage, or free authorized use, such as for firefighting or free water distributed at fountains or outside standpipes.

2.4 Validation and verification

The accuracy of research results is checked by verification and validity reliability tests. *Verification* is a process of ensuring that "any calculations, inputs, or computer code are correct or true" (Mazzotti and Vinci 2010:2). *Validity* is the extent to which a test measures what it claims to measure (Burns 2000), more simply the accuracy of the measurement. There are a number of validity approaches that contribute to the overall validity of a study, such as face, content, concurrent, internal, etc. According to Tsang (1992), the purpose of the model validation is to guarantee that the modeling results give a good representation of the actual processes occurring in the real system. It has to be applied in all the steps of the modeling process – starting from selection of the sample size and questionnaire design, data review and evaluation and ending up with validation of final results (Tsang 1992). In the current research the following verification and validation approaches are followed:

- *Pilot testing* of the survey questionnaire with a small sample group is used to increase the reliability and the validity of the test measures before implementing the large scale survey (De Vaus 2002). Pilot testing covered variation, redundancy, scalability and non-response rate of questionnaire answers, as well as flow, timing, question skip of the questionnaire as a whole.
- Findings of the study were compared with the results of other studies with due attention to methodologies, and assumptions of the compared studies.
- *Face validity* test (Tsang 1992) is conducted as a part of peer review with seeking for the opinions of competent experts about the research results. Several peer-reviewed research papers based on the research results have already been published, with some others being in the publication pipe-line.
- *Cross-checking* of final results with qualified experts on various levels was also done. This is similar to the *Turing validity* test suggested by Tsang (1992), when knowledgeable people in the field are requested to differentiate the model results with field observations. The research results were shared with various experts and stakeholders during conferences, specially organized seminars and workshops. This enabled to identify if the findings of the particular technique can be generalized to be

suitable to larger settings, to discuss and verify the research findings publicly, thus obtaining greater validity and setting the stage for broader public discussion on issues and challenges of water governance practices with the opportunity of taking appropriate measures in areas that need urgent actions.

- Finally, another opportunity for validation checking is as Tsang (1992) suggests the open-literature publication of the research results that may expose the work to public scrutiny, whereby errors can be pointed out by experts from various related fields. Some of the research related publications are freely accessed.

2.5 Limitations and delimitations

The limitations in the present research are mainly reflected in the scope of the research, where the application of the survey tool is limited to residential users leaving components, such as industrial, institutional, commercial and agricultural water uses beyond the scrutiny. The justification is that the residential sector is the second largest water use, after agriculture (Gleick 2003). Moreover, the study focuses on indoor and outdoor water use, as well as household sanitation in both urban and rural areas, which will ensure more comprehensive data collection on a major component and achieve a sharper focus for the analysis. Furthermore, it is in line with the goals and questions of the research to reflect a bottom-up and participatory approach. This is intrinsically essential because public resistance is the major factor for the success and failure of privatization projects (Al-Madfaei 2009).

Another aspect of the delimitation of the scope is that the research is not examining the centralized hot water provision because of a low level of connection to centralized district heating and inferior operation of networks (Fankhauser and Tepic 2007).

2.6 Significance of the study

The present empirical oriented research enriches the available literature by examining the process and impacts of water privatization on both the utility level and on the level of end-users (households) based on the experience of Armenia, a country that experienced a rapid and deep penetration of privatization in water sector. It provides a comprehensive study for policy makers and scholars for broadening understanding the privatization process and its impacts and to learn lessons from the privatization experience in a transitional country. Its conclusions are of particular importance for the transition countries which share similarities in terms of introduction of gradual liberalization, inheritance of common infrastructure patterns, specific public infrastructure policies and investment practices.

One of the major strengths the research pertains to its methodology, which is based on mixed or *integrated research* strategies. It enables to exert a *holistic approach* to the research and better understand the complexity of interconnections between various components of the water management system, identifying the influencing factors, and outcomes of the intervention process. First, the research views developments in a dynamic, starting from the period when private sector participation was planned and then introduced back in 2000. Second, it studies its impacts on the water governance system and the performance of water utilities. Third, it adds the bottom-up perspective based on participatory approach that allows to more thoroughly depict the situation at present from direct beneficiaries (households) point and to gauge the expert opinions of other stakeholder groups. This way the research also sheds light on both the supply and demand sides of water utility operations and explores the directional, magnitude and evolution impacts of water privatization in Armenia along a number of key dimensions. Thus, the research design allows innovation of the conceptual framework and contribution to multi-perspective interpretations.

It is important to note that this study will be the first done in Armenia with an attempt to cover in a single framework not only urban but also *rural* areas, which are often bypassed in empirical studies due to a number of reasons (Marin 2009, Barrera-Osorio and Olivera 2007). Even though the wastewater services are explored in a limited scope, it still allows to shed light on it and consider it a common framework rather than focusing only on water, the way most studies do (Clarke *et al* 2009, Mkhitaryan 2009). Moreover, the household survey that contains information on household income enables to explore how private sector participation impacted poor and disadvantaged households. In particular, the results of the analysis of the questionnaire were also used for designing multiple regression models for identifying the sensitivity to specific variable changes to be used further in policy analysis for water industry reforms. They can also be used for further deeper study based on water demand. Finally, the household survey, a method that permits to reduce the impacts of informal connections on official counts of registered performances (Clarke *et al* 2009), allows reducing the bias and attaining more pragmatic results.

The results of the study seek to be of benefit for scholarship, policy and practice. In particular, they can be used by policy makers to better understand the status, issues and challenges in the water sector and different opinions on advancements, and incorporate in their decision making process the estimates of the relevant conditions that make private provision of water services effective and efficient.

2.7 Administering the fieldwork

The present research applied household survey and stakeholder interview instruments for data collection in the field. The stakeholder interview was based on the interview protocol that includes introductory open-ended questions and specific areas for follow up questions. For each stakeholder group, a more targeted thematic interview protocol was constructed. Post-interview scrutiny helped to identify the main themes/observations from interviews and adjust the follow-up interviews.

The survey research 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. Pretesting of the questionnaire was done for identifying potential problems in questions.

The survey was conducted through face-to-face interviews. Even in view of rapid developments of information and communication technologies that opened up new opportunities for survey administration, the face-to-face interview still has a reputation of a being a good technique (De Vaus 2002). The choice is dictated by the following reasons.

- Face-to-face interviews enable 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 lower the response rate, the lower and less representative the sample size and the higher *sample error*. 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. For improving the response rate, a number of considerations were taken into account, including presenting the student card and the proof of university sponsorship for increasing trust. Even though using the laptop or a recorder could facilitate data entry and the coding process, during the survey and stakeholder meeting the interviews were "paper and pencil" based in order to facilitate the rapport and confidence building with respondents. In case the respondent was not at home, the replacing of the respondent was based on the next random selection technique.

- Personal interviews enabled more flexibility in questionnaire design and administering more complex questions with skip and filter questions. Moreover, it was possible to answer respondent questions and give some clarification. This is an important factor for reducing *measurement error* resulting from mistakes by respondents (Cui 2003).
- Last but not least, is that the survey covered all the regions of Armenia where availability of information and telecommunication technologies and quality and reliability of posting services drastically reduces with increasing distance from the capital city. Therefore, face-to-face administration was the most feasible, if not the only possible option, which significantly reduced the *non-coverage error*.

The researcher did all the interviews by herself. The main reason was to have the opportunity to disclose some interesting or unexpected facts and observations on the spot and to direct the conversation with the respondent in way of better understating the situation. This advantage of face-to-face administration was used to the best possible extent yet keeping in mind the ethical considerations to be discussed in the next section. Taking into account the extensive experience of conducting surveys throughout Armenia and an advantage just for the purposes of the current research of a small size of Armenia itself increases the viability of conducting pan-Armenian survey even under time and other resource constraints. Finally, the pilot testing helped to clarify the work schedule. In case of difficulties, there was the opportunity to engage other interviewers for whom *training* and careful supervision was planned. To be on the safe side, there was an option for the potential interviewers to be selected from the

Institute for Political and Sociological Consulting, where interviewers are mostly students with a background in sociology.

Special consideration was given to the *quality* of answers. Clear definitions of concepts used in the questionnaire were developed in order to limit individual interpretations on questions, which were designed in a way to be unambiguous and easy to understand and be tested as a result of the pre-test and pilot study analysis. One of the main requirements for the standardized interviews is that the interviewer follows the question wording exactly and record the responses exactly, because it may not be known how the responses may be coded before processing (Babbie 1990). Another important rule of standardized process followed was that the interviewer should have been interpersonally neutral and nonjudgmental to the answers of respondents – showing neither agreement, nor surprise or discontent – in order to avoid biases in answers (De Vaus 2002). According to the general rule on appearance, the interviewer was dressed in a rather similar way as the people to be interviewed (Babbie 1990). Despite being one of the most effective survey administration tools, the face-to face approach is one of the least safe. Therefore, special attention was given to *safety* issues (there were some unpleasant cases with meeting dogs). This included checks for mobiles to be charged and switched-on, availability of contact person and emergency numbers, availability of site maps and street directory, introduction with identity card and checking for the permission before entering the dwelling, etc (UCD 2009).

2.8 Ethical considerations

The survey was conducted with due consideration of ethical aspects. The following ethical norms (De Vause 2002) in relation to respondents were observed:

- *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.
- 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. Used in rare cases, but presentation of student or identification card and an official letter on university sponsorship with official translation increased trust and facilitated rapport. The respondents were informed of their right not to answer any particular question for any reason. In cases that the respondents preferred not to participate after completing the questionnaire, the uncompleted questionnaires were destroyed on the spot.
- *No harm principle*. Even though the survey research did not involve any experimental studies with participants with possible physical harm, there could be respondents that may be sensitive to some of the questions (for example, income level). Therefore, the pre-tests and pilot study were carefully analyzed in terms of identifying this kind of questions and either eliminating them or developing a special approach for asking the question – for example, by reminding about the confidentiality of the responses.
- As an important part of the survey, the respondents were assured about the c*onfidentiality* 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.

- *Privacy* principles are fairly similar to the issues of confidentiality of data. The mode of data collection may impact privacy. For example, in face-to-face interviews the presence of other people or sensitive questions are likely to influence the privacy of the setting, as the respondents' answers become known by third parties (Groves et al 2009). Therefore, due efforts were made to design the survey administration process to cover all the related aspects including privacy considerations.

CHAPTER 3 SETTING THE STAGE: PHYSIOGRAPHIC AND HYDROLOGIC CHARACTERISTICS

And the waters returned from off the earth continually and after the end of hundred and fifty days, the waters were abated. And the ark rested in the seventh month, on the seventeenth day of the month upon the mountains of Ararat.

- Genesis VIII:4

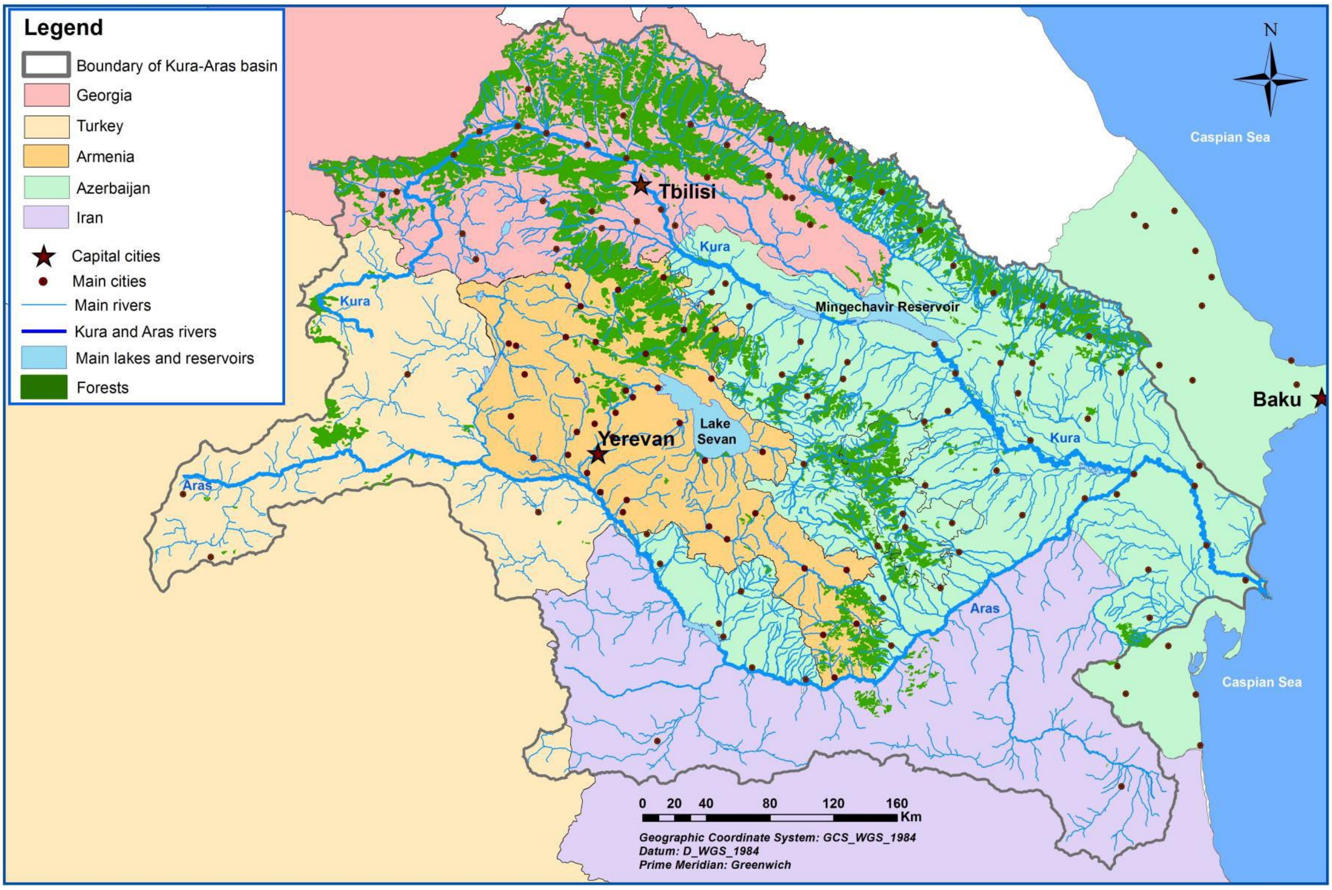
3.1 Introduction

Before proceeding to the issues of water privatization it is important to understand the conditions and processes within the water sector and the economy in general that were behind it. This introductory chapter provides a short historical background and sets the stage for the issues and further discussions. In particular, the chapter describes the physical, geographical and hydrological features with due consideration of environmental issues, such as water pollution and quality, water-related climate change impacts, etc. The chapter also presents the analysis of water abstraction and use trends for the last two or in some cases several decades. Finally, water stress and water poverty issues are discussed.

3.2 Water resource

Starting about 2000 B.C., the Assyrians used *Nairi* ("land of rivers"), a synonym for Armenia in their reference to the land and the people coming from the "land of rivers" – the northern part of Mesopotamia between the Euphrates and the Tigris rivers, that flow from sources near Mount Ararat. The Nairi were one of many tribes that dominated the region of the Armenian Plateau in that period.

Nowadays, Armenia is a landlocked mountainous country in the South Caucasus region with a total area of 29,800 km^2 located between the Black Sea, the Caspian Sea, the Mediterranean Sea and the Persian Gulf. The territory of Armenia covers over 10% of the Armenian plateau located 500 m higher than the neighboring Asia Minor and Iranian plateaus. The Ararat Valley, one of the lowest areas in Armenia, is one of the largest of the Armenian Plateau, extends west of Lake Sevan basin, at the foothills of the Geghama Mountains. In the South and North the Ararat valley adjoins Mount Ararat and Mount Aragatns, respectively. Recent volcanic activity on the Armenian plateau brought about the large volcanic formations, consisting of a number of small and large mountains, valleys and lakes (MNP 1999). The country is divided by two major river basins: the Araks and Kura that originate in the Armenian highlands and converging downstream to flow into the Caspian Sea (Figure 3.1).

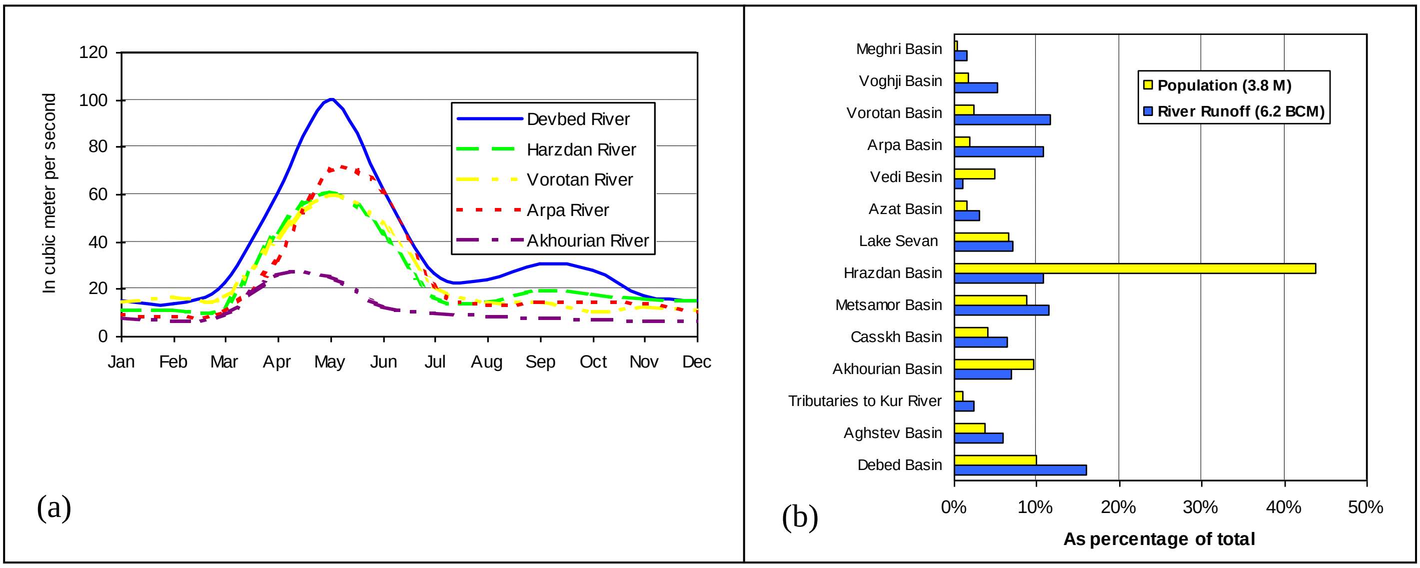


Source: Gevorkyan 2014

Figure 3.1 Regional map

The climate in Armenia is highland continental with six climatic zones ranging from dry subtropical to rigorous high mountainous. Having numerous rivers and lakes, the country still is prone to arid (desert and semidesert) conditions. The average annual temperature varies geographically from 2 to 14 C° in summer. Average minimum temperatures in winter vary from -3 to -19 C° (MNP 1999). Since the late 1980s average annual precipitation has fallen by about 10% and currently averages 530 mm.

The country has an uneven geographical and temporal distribution of water resources. Most precipitation occurs in the spring (Figure 3.2a). In relation to population distribution, uneven spatial distribution of water resources is presented in Figure 3.2b. Long-lasting snow covers the mountains over 1300 m, whereas in the lower plain areas snowfall reaches 0.5 m. High mountain areas receive the maximum precipitation of more than an annual 1000 mm, whereas the driest but fertile Ararat Valley and the Meghri regions receive average annual rainfall of 220 mm (MNP 2009). Overall, the hydrological cycle of the country can be characterized by a total of 17.6 billion m^3 of water received throughout the year, mainly from rainfall.



Source: WB 2001

Figure 3.2 Seasonal (a) and spatial (b) distribution of river runoff

According to FAO Aquastat data total renewable water resources in Armenia amount to 7.8 km^3 per year. Although water is a renewable resource, the rate is neither constant nor foreseeable. Therefore, the long-term availability of water for meeting the needs of an economy makes it important to have efficient water storage and effective distribution systems (Graig et al 2001).

3.2.1 Rivers

Armenia is densely covered with rivers with an estimated river network density coefficient of 0.8 km/km^2. Rivers of Armenia belong to the Caspian Sea basin and are tributaries of the two main transboundary rivers in the South Caucasus: the Araks in the southwest with the basin covering 22,790 km^2 of rivers (Akhuryan, Kasakh, Metsamor, Hrazdan, Azat, Vedi, Arpa, Vorotan, etc.) and the Kura in the northeast with the basin covering 7890 km^2 of rivers (Debed, Pambak, Aghstev, Tavush, etc.) (MNP 2002) (Figure 3.1). These two main river basins are divided into 14 sub-basins and five basin management areas: Akhuryan, Northern, Sevan-Hrazdan, Ararat and Southern basins. In total, there are about 9500 rivers with a total length of about 23000 km. Of these, seven (Akhuryan, Debet, Vorotan, Hrazdan, Aghstev, Arpa and Metsamor-Kasakh) are longer than 100 km and 379 rivers are about 10-100 km (FAO 2008).

The rivers have mixed feeding through melting snow, rainfall and drainage of groundwater. Overall, river flow accounts for about 7.15 billion m^3, of which the average annual flow rate originating within the country's borders is 6.25 billion m^3 including 1500 million m^3 of groundwater from groundwater springs (WB 2001, MNP 2003). Rivers in Armenia are a strategically important resource not only for domestic water use but also for irrigation and hydropower generation estimated at 1.7 million kWh (MNP 1999).

3.2.2 Lakes and reservoirs

Reservoirs

Reservoirs in Armenia were mainly built during the Soviet period with the purpose of using and regulating river flows for irrigation, industrial, recreation, fishery and hydropower production. At present, there are more than 80 reservoirs operating in Armenia with the total capacity of 1399 million m^3 (FAO 2008). With construction of a dam for irrigation purposes one of the largest lakes Arpi was turned into a water reservoir which is now the largest reservoir - Akhuryan with the capacity of 535 million m^3 (MNP 2003).

Lakes

On the territory of Armenia there are more than 100 lakes which are relatively small with the exception of Lake Sevan. Some of the lakes run dry during the hot seasons.

Lake Sevan

In terms of size and importance Lake Sevan is the most significant. The Law on Lake Sevan (2001) provides that Lake Sevan "has a strategic significance and economic, social, scientific, historical-cultural, esthetical, recreational and spiritual value for the Republic of Armenia". Lake Sevan is also included in the list of 156 priority lakes world-wide identified by the Global Terrestrial Observation Panel for Climate for collecting and distributing data on area, level, freeze and break-up dates with the further purpose of monitoring and climate modeling. The selection of sites is based on such considerations as water use, quality, pollution, as well as available long-term, historic and palaeoclimatic records (Vuglinskiy et al 2009).

Located in the central part of the country at an elevation of 1,916 meter above sea level, Lake Sevan has a surface of 1250 km^2 and occupies about 4% of the total territory of Armenia. Morphologically Lake Sevan consists of the deeper Minor Sevan and relatively shallow Major

Sevan. Lake Sevan is fed by 28 rivers and streams and the River Hrazdan is the only one that flows out of the lake (Babayan et al 2003).

The vital role of Lake Sevan can hardly be overestimated. It is one of the greatest freshwater high-mountain lakes of Eurasia and is the greatest lake of the Transaaucasus Region playing an essential role in the water balance of the region. It contains 80% of Armenian water resources, thus playing an important role in the country's water balance (MNP 2003). The unique features of the lake basin is in its relatively high rate of endemism of flora and fauna. There are about various species of vascular plants (50% of Armenia's flora) and species of amphibians and reptiles, mammals and birds, many of which are registered in the Red Data Book of Armenia or covered by international conventions. The lake is also an important site for migratory birds (Babayan et al 2003).

Lake Sevan waters are used for many purposes in many sectors of the economy in Armenia like agriculture, hydropower, domestic and industry water supply. For example, Sevan is important for fishery providing around 90% of the fish and 80% of the crayfish catch in the country. Its basin territory provides more than 20% of livestock production (Babayan et al 2006). Historical and architectural relicts ranging from the Stone Age to the Middle Ages, the beautiful landscape, fresh air and cool water make it one of the most popular sites of recreation, especially in hot summer time. Through the artificial regulation of the surface outflow into the River Hrazdan, waters of Lake Sevan are a major source for irrigation in Armenia, providing around 25% of annual irrigation water for the croplands in the Ararat Valley (Sargsyan 2007). It is also a strategic source of hydro-energy production.

Indeed, intensive use of Lake Sevan waters for irrigation and power generation has caused the level of the lake to drop dramatically since 1930's resulting in so-called "Sevan Issue".

Higher location of Sevan in relation to the fertile and dry Ararat Valley and absence of energy resources took many scientists and engineers to the idea of finding the ways of using the resources of Sevan (Sargsyan 2007). Back in 1910, civil engineer Soukias Manasserian in his study "*Evaporating Billions and Stagnation of the Russian Capital*" made a recommendation to decrease the level of Lake Sevan by 50 metres and use the water for irrigation and hydroelectricity purposes. The idea was to decrease extremely high (over 1 billion m^3 annually) evaporation of the lake water by 6 times and decrease large water losses by completely draining the Major Sevan and reduce the lake to the size of the Minor Sevan of about 240 km^2 compared to 1416 km^2 of the original lake (Babayan et al 2003; Greenwood 1965). The newly acquired lands were supposed to be used for agriculture and plantation of trees. Forty-seven agricultural communities in the Ararat Valley signed the petition in favor to this project. However, the Caucasus governor of those tsarist times, Count Vorontsov-Dashkov, rejected the project justifying that the concession on Lake Sevan had been already given to an English entrepreneur who was going to carry Sevan waters by canals to the Kura river and to build a hydroelectric power station with the purpose of supplying Baku with cheap electricity, depriving Armenian farmers of the opportunity to irrigate their lands (Promptov nd) . If not the First World War, who knows how things would have developed.

It is worth noting is that Manasseryan's ideas were also behind the interventions on Aral Sea - the dramatic example of the ecosystem disaster caused by intensive water withdrawals for irrigation from the inflowing Amu-Daria and Sir-Daria rivers (Babayan et al 2003).

In the 1930's a plan was further developed to start the project on decreasing Lake Sevan waters through the Hrazdan River by 55 meters and reducing its perimeter. The streambed of the Hrazdan River was enlarged and a tunnel was drilled 40 m below the lake level (Babayan et al 2003). Sevan water was intensively used for irrigation and electricity generation. The Sevan-Hrazdan Cascade comprising of 6 hydropower plants was built in the 1930-1962 with a total installed capacity of 556 MW (MNP 2003). From 1949, the level of Lake Sevan started falling 1 m per year, in total reducing it by 13 meters by 1962 (Hovhannisyan et al 2005).

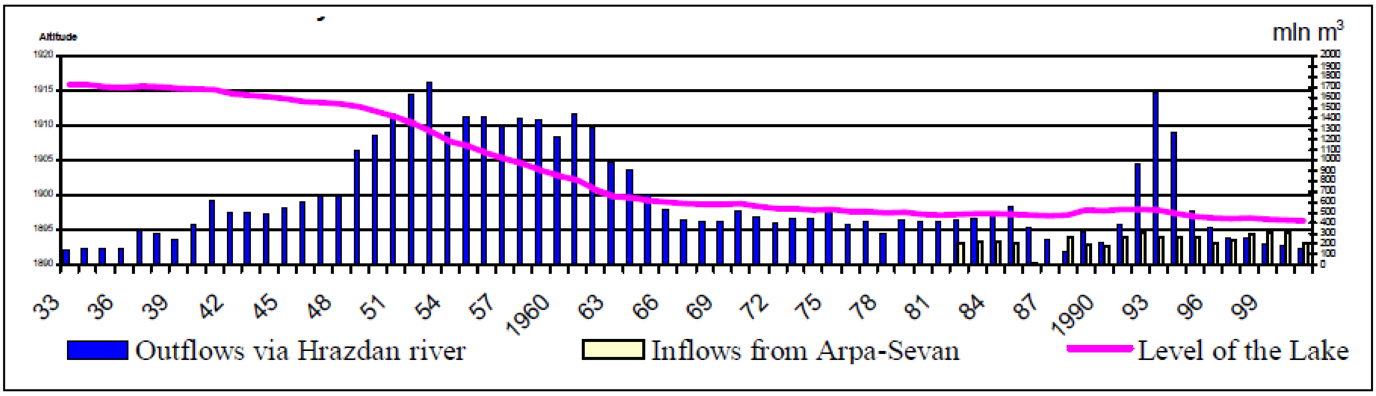
By the early 1960's the environmental consequences of the brutal use of water already became evident. Before the water level drop the lake was an oligotrophic reservoir with a renewal cycle of 44 year, high levels of water clarity (13-14 meters) and oxygen (MNP 2003). Typically, lake storage renews very slowly. Therefore, for ensuring the sustainable use of a lake, it is very important that the annual withdrawal does not surpass the annual renewable volume which depends on river inflow, precipitation and evaporation (Vuglinkiy 2009). However, the cruel exploitation and radical reduction of Lake Sevan water level resulted in a decline of average water temperature and intensity of horizontal and vertical flow mixings. The consequences included a substantial increase of the concentration of suspended and dissolved organic matters, the reduction of concentration of dissolved oxygen, the reduction of phosphorous and the increase of minerals and nitrogen concentrations, as well as the appearance of methane and hydrogen sulphide. This led to a substantial biological reorganization in the trophic chains of the lake's ecosystem (Hovhannisyan et al 2005, MNP 2003). A drastic reduction of biomass of large water plants (macrophytes) and blossoming of macroalgae was observed. The clarity of the lake reduced from 13 to 3 meters. Currently, the lake is in a mesotronic state, close to eutrophication (MNP 2003).

Changes of Lake Sevan condition caused a chain of ecosystem degradation. Many other species of flora and fauna disappeared, diminished or fell under the danger of extinction due to the decreased water level of the lake and related impacts. For example, the disruption of the spawning habitat significantly impacted many fish communities. In particular, two lake-spawning Sevan trout species disappeared (Hovhannisyan 2005). Degradation of more than 10,000 ha wetlands resulted in the disappearance of migratory birds: out of 167 species of endemic and migratory birds, only 18 are observed (MNP 2003).

But ecological crisis of Lake Sevan is not only the result of the anthropogenic restructuring of the lake's hydrological processes, but also by the intensification of industrial, agricultural, and other economic activities (Hovhannisyan at al 2005). The release of industrial pollutants, domestic sewage and agricultural run-off (excess fertilizers, animal effluence, or pesticides) into the lake added to the problem of increased organics loading causing a decrease of oxygen the concentration of the lake water (Babayan et al 2003).

It became obvious that environmental and economic consequences of water resource extensive usage were too detrimental to proceed in the same manner. Already in 1962, for remediation of the environmental consequences, another major infrastructure construction was launched to redirect part of the Arpa River flow to Lake Sevan. The construction took almost 20 years and in 1981, the 48 kilometer long Arpa-Sevan tunnel with a capacity of 250-270 million m^3 of water transfer started its operation. During this period, the level of Lake Sevan was persistently dropping. By 1980, water level reduction reached 18.5 meters, and the surface area and the volume of the lake decreased by 12 and 42 percent respectively, compared to figures in the 1930' (Hovhannisyan 2005). In 1978, the lake water use for energy generation was stopped. In the same year, the Sevan National Park, the only national park in Armenia, was established to protect Lake Sevan and its surrounding areas (Hovhannisyan 2005). In 1982, for increasing the lake's level the second diversion scheme with the capacity of 165 million m^3 from the Vorotan River was approved (WB 2001). The construction of the Vorotan-Arpa Tunnel with a total length of 21.6 km in the 1990's due to the economic crisis following the breakdown of the Soviet Union stopped. Another plan of the government was to have the tunnel ready for operation by 2003. However, it is still not completed.

From 1981 to 1990, as a result of measures undertaken the water level in the lake increased almost by 1 meter (Figure 3.3). However, during the energy crisis of the 1990's, the lake's water was used as a strategic source of electricity production. The intensive use for agriculture due to consecutive drought summers added to the need for the increased release of water. The response of the lake did not wait long - by 2001-2003 the reduction of water level reached its peak of 20.2 meter with further destabilization of its fragile ecosystem. According to expert estimations the mitigation of eutrophication processes of Lake Sevan require an increase of the level of the lake by at least 6 meters, which will enable to buffer the lake from variations in connected watersheds and buildup of organic substances from sediments (MNP 1999).



Source: MNP 2003

Figure 3.3 Lake Sevan water flow and level change

Lake Sevan water level still remains one of the major debatable environmental issues. The Law on "Approval of Annual and Complex Measures on Conservation, Restoration, Reproduction, and Use of the Ecosystem of Lake Sevan" stipulates the maximum 170 million cubic meter water release threshold, set based on perennial research of scientific-research institutes. Later, the National Assembly issued a decision on increasing water intake from Lake Sevan up to 360 million cubic meters, which caused strong public resonance.

3.2.3 Surface water quality

As for the quality of rivers in Armenia, there are no comprehensive studies on water quality assessment. In general, during the transitional period due to a decline of industrial and agricultural production water quality improved. In the past rapid agricultural and industrial development caused severe pollution and a reduction of the water amount of some of rivers with the subsequent destruction of river ecosystems. For improving the situation with river water flow there is a regulation in Armenia that sets minimum flow (called "sanitary flow") requirements for rivers to protect nature and maintain the multiple functions of rivers for fishing, aesthetics, human health and a healthy water ecosystem. Currently, except for the downstream of cities especially Yerevan where organic pollution holds back the self-purification capacity of rivers, surface water conditions can be considered relatively good. However, if proper measures are not undertaken with the increase of economic activities, water pollution may quickly worsen (WB 2001).

3.2.4 Groundwater

Groundwater is an important source of water in Armenia especially for drinking purposes. Almost 96% of drinking water is provided from groundwater sources (MNP 2003). Groundwater amounts to 19% of irrigation of the equipped area in the country (FAO 2008).

Underground waters in Armenia are distributed unevenly. They appear as springs, wetlands, groundwater flows, including artesian waters. The total estimated renewable groundwater resources in Armenia are 4.1 billion m^3 per year. 1.6 billion m^3 of groundwater occurs as springs and 1.4 m^3 groundwater discharges into surface rivers and lakes. Deep groundwater sources account for about 1 billon m^3. They are usually of high quality. Largest deep groundwater sources are located in the Ararat Valley, which is also the largest artesian basin, where artesian wells produce 5-100 liters per second without pumping (WB 2001).

Artesian water pressure in the Ararat Valley resulted in the formation of around 1500 km^2 of wetlands and swamps. In the 1950's the wetlands were dried out to be transferred into agricultural lands. Due to reduction of Lake Gilli water level, about 80 km^2 of swamps were dried out in its area. Inefficient agricultural practices, poor drainage and leaking irrigation systems flooded low-lying areas leading to the rise of the water table in the Ararat valley. This in turn resulted in soil alkalinization and salinization (MNP 2002).

Recently, concerns were raised about groundwater depletion in the Ararat Valley due to the growth of fish farming in the area. More than 234 farms use about 800 million m^3 of water per year – almost 50% of total allowed annual water discharge of 170 million m^3 from Lake Sevan. Experts claim that the absence of water meters, inefficient drainage systems, the lack of water reuse practices (fish farms discharge water into rives or drains after one use) coupled with the absence of proper licenses for fishing activities put the situation out of control, causing a brutal exploitation of water resources. This endangers the use of water for drinking and irrigation purposes in the region. For example, out of 80 wells in operation since the 1990's in one of the villages 61 have already dried out. Moreover, there are also concerns about licenses on water use rights that drastically increased groundwater use in the country. Back in 1984, the regulation allowed a maximum of 1.25 billion m3 of water to be extracted from underground sources. Currently, license holders are allowed to extract 2.75 billion water – more than twice the level set during Soviet times (Nanyan 2010).

3.2.5 Groundwater quality

There are scarce data on the quality of groundwater in Armenia. In general, the quality is good and in many instances water from springs can be used for drinking without treatment (MNP 2003, WB 2001). However, there are springs (around 25%) that are not suitable for drinking due to high concentration of nitrates, nitrites and fluorides (MNP 2003). Nitrates are one of the most frequent groundwater pollutants in rural areas that originate from intensification of farming practices - from fertilizers, septic systems, and manure storage. Fertilizer nitrogen can be volatilized, or carried away by surface runoff and may appear in groundwater in the form of nitrate. Exposure to drinking water with a nitrate level above the health standard (10 milligram per litre by WHO standard) may cause potential health problems especially for small children, causing methaenoglobinaemia. An excess dose of nitrate and nitrite (which are more toxic than nitrate) may also be toxic for fish communities.

3.2.6 Climate change

Water is the principal medium through which climate change influences the ecosystems and consequently the means of living and well-being of people. Many countries in the world already experience water-related climate change impacts, such as harsher and more rapid floods and droughts, higher average temperatures and alterations in precipitation that affect the availability, quality and distribution of water resources (www.unwater.org).

According to the UNDP (2009) developed climate change scenarios, by 2100 Armenia will experience an increase of average annual temperature by about 4.5 C^{o} in the lowlands and 7 C^{o} in the highlands, which means more evaporation and consequently less soil moisture and skimpy river flows reduced by 24%. Average annual precipitation is projected to drop by 9%, with the biggest (30%) reduction impact for the area of Yerevan and the Ararat Valley. Taking into account that the Ararat Valley comprise 13% of the territory of Armenia and provides more than 40% of gross agricultural production, the drastic climate change will significantly hit agricultural production and endanger food security in the country. With this regard, introduction of proper water management systems with a more efficient use of water resources and integration of climate adaptation measures represent imperatives for social and economic development strategies of the country.

3.3 Water consumption

Back in Soviet times, under the conditions and perception of abundance of natural resources, water was intensively used in all sectors of economy. However, since the late 1980's water withdrawal in Armenia has radically dropped. According to data of the National Statistical Service of Armenia (NSSA), the lowest level of abstraction was registered in 2001 at the level of 1726 million m^3 (less than twice the level of 3942 million m^3 in 1990). Thereafter, the trend reversed its direction, increasing by 42 percent and reaching withdrawal level of 2465 m^3. Historic trends of water abstraction and consumption are presented in Figure 3.4 based on data of the National Statistical Service of Armenia and Ministry of Nature Protection. The analysis of water withdrawals by source suggests that on average 80% account for surface water withdrawal and 20% is from groundwater sources.

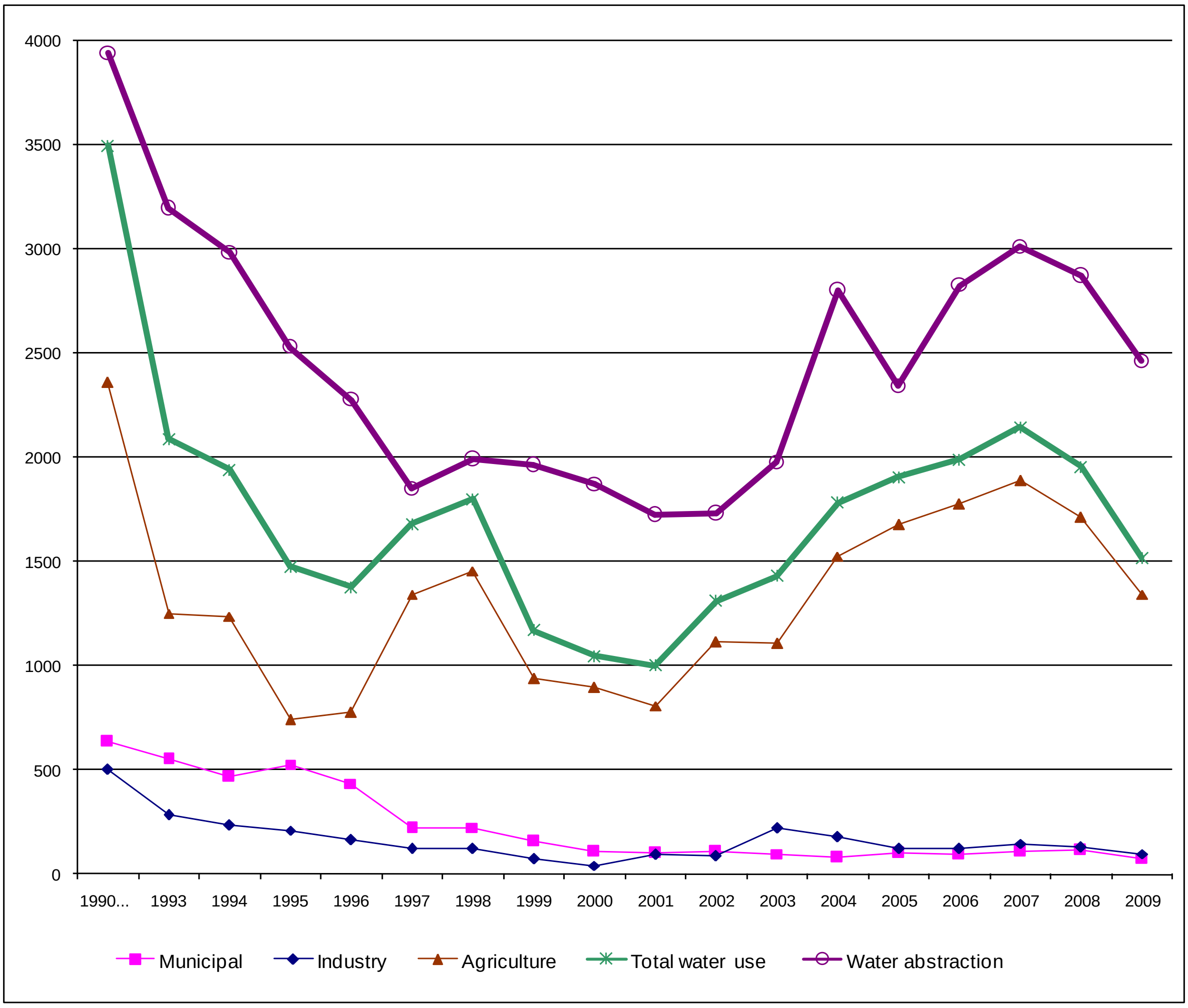


Figure 3.4 Historical trends of water abstraction and consumption (million m^3)

Water consumption is divided into agricultural, municipal, and industrial sectors. As seen in Figure 3.4, agricultural sector was and is the largest water user that includes fish breeding, forestry and other. Municipal consumption includes households, institutions and commercial water use. A considerable amount of water in the industrial sector is used in power production, which is however, not included in the estimations presented in Figure 3.4. The vast amount of literature, supported by figures, indicates a drastic decline in water consumption since the collapse of the Soviet Union followed by social, economic and energy crisis. Since 1990, water consumption in Armenia has dropped almost twice. Industry and irrigation have experienced the most radical decline. The sharpest drop in 2000 is explained by the severe drought, which resulted in a river flow drop of 40-50% that dramatically affected agricultural sector causing $USD 100 million damage. The impacts were accelerated by the poor irrigation water supply infrastructure and high water losses. Factors such as poorly regulated contractual agreements between irrigation water supply and water-user groups and lack of drought impact monitoring mechanisms further complicated the drought resistance capacity of the agricultural sector.

The analysis of water abstraction and consumption trends suggests that there are significant amounts of water lost in distribution systems. According to data available from the NSSA, water losses have significantly increased since 1990. In the late 1980's, on average water loses were 13%, while since 1990 on average water loses increased to 31% per year with a maximum of 44% observed in 2000.

Per capita water withdrawal and consumption

Figure 3.5 illustrates the world-wide picture on water withdrawal per capita for agriculture, domestic and industrial purposes based on FAO AQUASTAT data. Armenia fell within high range of 967 m^3/year. The absolute world leader in per capita withdrawal is Turkmenistan with 5321 m3/year followed by the next highest consumers being other Central Asia countries. To the point is to mention that in Turkmenistan water is paid from the public budget and is supplied free-of-charge to consumers (OECD 2003). The highest consumer in the EU is Portugal with 1089 m^3/year per capita.

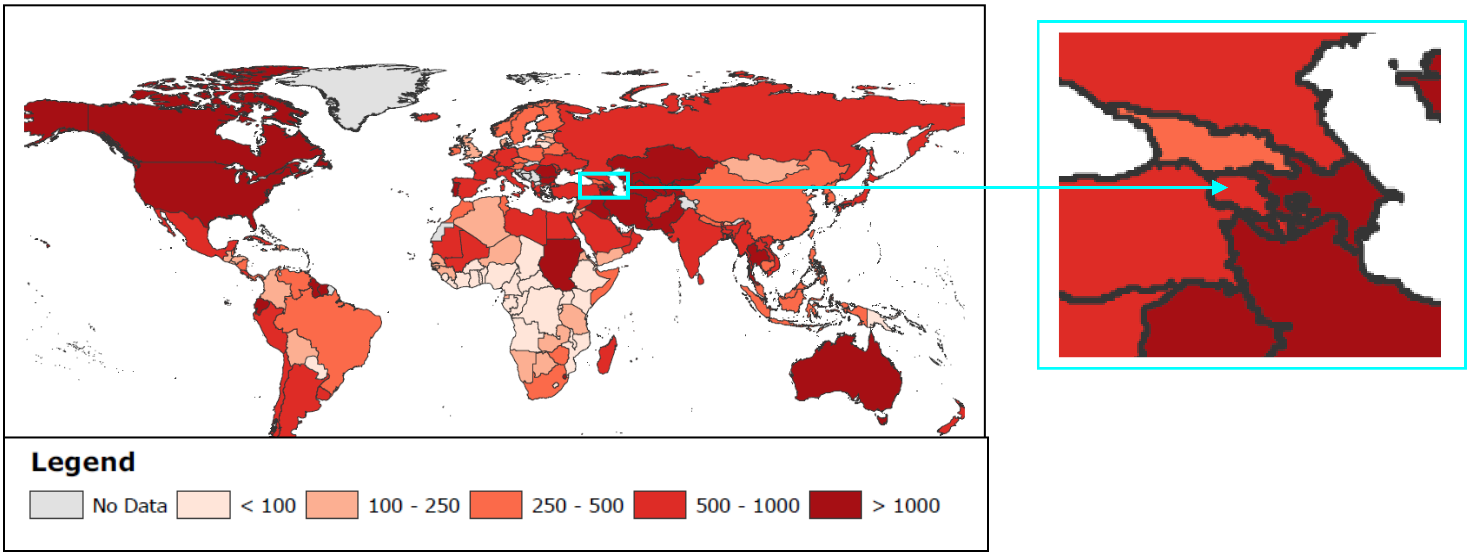


Figure 3.5 Water withdrawal per inhabitant (m^3/y), 2001 (based on FAO AQUASTAT)

As for per capita water consumption, Table 3.1 presents the extract of data for some countries. Armenian inhabitants use much less than those in Central Asia countries or even Australia, but more than in Russia and neighboring Georgia.

Table 3.1 Per capita water withdrawal for selected countries (2001)

Country	m^3/year per capita
Turkmenistan	5321
Iraq	2485
Kazakhstan	2352
Uzbekistan	2291
Kyrgyzstan	1982
USA	1654
Canada	1468
Australia	1226
Thailand	1391
Bulgaria	1331
Portugal	1089
Armenia	967
Hungary	750
France	668
Russia	527
Georgia	362
Zambia	157

Source: based on data from FAO AQUASTAT (2008)

3.3.1 Irrigation and drainage

Agriculture is by far the largest sector of water use globally. Large amounts of water use in irrigation is also a common feature in most of the former Soviet countries. For example, in Uzbekistan it accounts for 92% of total water consumption (UNECE 2007). As it is seen in Figure 3.4, agriculture which mainly refers to irrigation is also the largest water use sector amounting to 88% of total water consumption in 2009 (NSSA 2010). In contrast, in Europe as a whole water use in agriculture is only 26%, industry accounts for the largest share of 53% and households for 19% of water consumption (EEA and UNEP 1997). In the Baltic States, agriculture accounts for only 7% of annual water withdrawals with the domestic users being the largest water consumers of 65% (FAO 2008).

In Soviet times Armenia experienced intensive agricultural development regardless its limited natural resources. However, since the start of transition the contribution of agriculture has changed dramatically. In 2007, the share of agriculture in the GDP was 18 % down from the share of 41% in 1994. During the harsh years of economic and energy crisis in mid 1990’s agriculture was a sector that created possibilities for subsistence and employment for many economically active people transferred from the shrinking industrial sector. Despite the recent steady development trends, agriculture remains a vulnerable sector due to relative shortage of suitable lands, the lack of sufficient water resources, small size and estrangement of farms as a result of land privatization (FAO 2008).

Irrigation development

In Armenia agriculture has traditionally played an important role. The art of irrigation in Armenia traces 3000 years back in antiquity (Greenwood 1965; FAO AQUASTAT 2010). The valleys of Ararat were considered as the greatest wealth for the people. According to a legend even their number was kept secret for protecting them from harm. At the same time

Armenians were realizing that the wealth of the land depends on the effective use of water. There are a number of ancient channels constructed before the Christian Era that are still in use for present day agricultural purposes (Mays 2010; Chakhin 2001). The prominent example is the Menua Channel which was constructed back in Urartian times[3] by the Armenian Kind Menua (810-786 BC), in the heart of most ancient part of Armenia called Hayots-Dzor (Valley of Armenia) East of Lake Van (located in present day Turkey) (Chakhin 2001). The Menua canal with most dams constructed in the Urartian period are still in use for the purpose it was planned for in ancient times (Mays 2010).

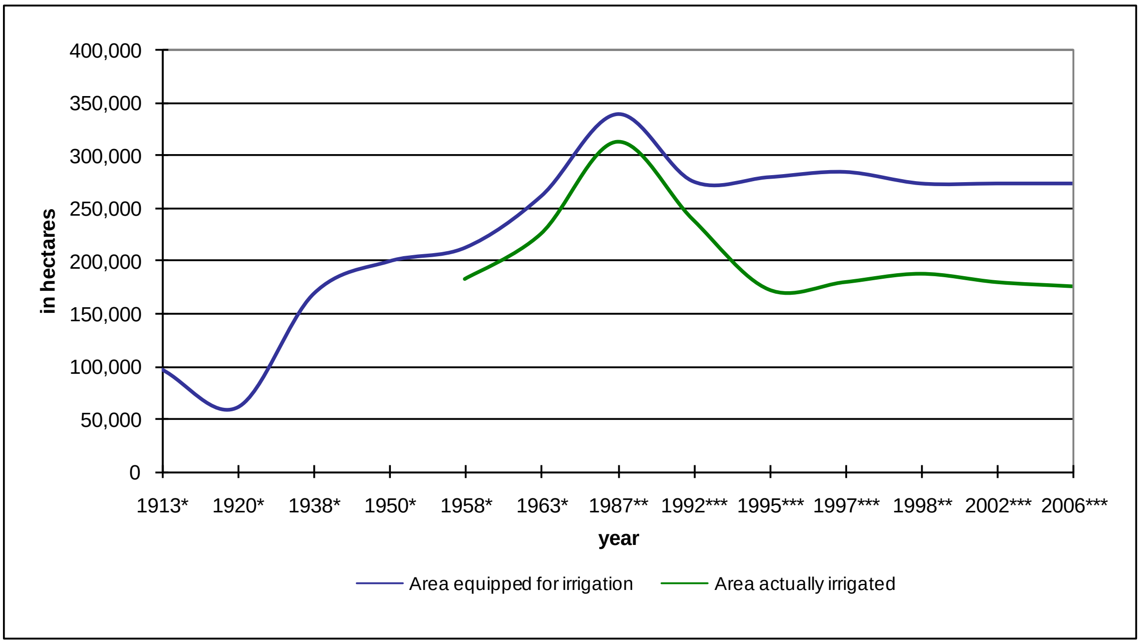
Picture 1. Menua canal today (constructed in 805-785 BC) (Source: Ozis nd.)

For more than 2500 years the Menua canal has been flowing uninterruptedly with some repair done in 1950 in the middle part of the canal. Currently, it is used as a part of a system irrigating 5000 ha and produces 5 megawatt electricity. The study of the Menua canal physical design features has revealed that the bottom slope of the canal is on a level that does not contribute to erosion. Urartian water engineers designed the canal of major flow in parallel to contour lines as it is done by engineers in our days (Kuslu and Sahin 2009).

Greenwood's (1965) estimates of irrigation development in Armenia since the beginning of the 20th century show that under Imperial Russia, in 1913 the irrigation network served the area of 97,000 hectares (ha), of which the major portion was located in the area constituting Soviet Armenia. During the Soviet period the irrigation network was significantly expanded, reaching 262,000 ha in 1963 (Figure 3.8). Within half a century the area equipped for

[3] The history of Urartian Kingdom (called also Kingdom of Ararat in many ancient manuscripts) is documented from 1250 BC in an Assyrian tablet, meaning a development period of centuries before it (Chahin 1987; Mays 2010; Kyle 1988, Garbrecht 1988). Urartu was destroyed in 585 BC and was replaced by Armenia (Van de Mieroop 2006:205; Kyle 1988:955).

irrigation almost tripled in Armenia. In 1958, the actually irrigated land covered 183,000 ha or more than 85% of the area equipped for irrigation, which was higher than the average for the Soviet Union. It is worth to emphasize the importance of the construction for irrigation purposes of the Lake Sevan-Hrazdan River Cascade and brutal exploitation of the lakes waters with its disastrous consequences. In 1963 underground water consumption did not play the important role for irrigation purposes and water use was based on surface withdrawals.



*Source: author's calculations based on data from *Greenwood 1965; **WB 2001; ***FAO AQUASTAT 2010*

Figure 3.6 Irrigation trends

As seen in Figure 3.6 above, the peak of irrigation was reached in late 1980's just before the collapse of the Soviet system. The total area with irrigation network reduced from 340,000 ha in 1987 to 274,000 ha in 1998. The actually irrigated area dropped from the peak of 314,000 ha in 1987 to 173,000 ha in 1995. As it can be seen, the utilization ration of the irrigation system also dropped from its maximum of 92% in 1982 to 64% in 1995 with a little recovery to 64% in 2006. Factors that played an important role in this were the aging and breakdown of water distribution, drainage and pumping systems, high costs of energy for pumping, inadequacy of the irrigation system built for large farms (WB 2001).

The irrigation infrastructure now available in Armenia was mostly constructed in Soviet times. It includes 80 reservoirs used for agricultural purposes, 8 major and a great number of small distribution systems served by over 3000 km of main and secondary canals, about 15000 km of tertiary canals, over 400 small and large pumps, 1276 tube-wells, and 945 artesian wells (FAO 2008). Around 75% of the distribution system is lined with concrete or pipes. About 42 % of the total equipped irrigation area is based on pumping for lifting water to higher systems that cannot be reached by gravity conveyance. Mechanical irrigation by pumping stations requires about 800 million KW/h of energy per year. The unreliable energy supply and a significant increase in energy prices hampered the use of mechanical irrigation. On average electricity costs comprise about 70% of costs of irrigation, making it unprofitable without state subsidies. In order to release the burden of energy costs, the government provides subsidies for covering the costs of operating pumping stations (Melikyan 2003).

Currently, the poor condition of existing pumps, pipes, and canals result in deterioration of the irrigation water conveyance infrastructure. Some of the literature suggests that the total water loss range on average within 40-50% (Haykazyan and Pretty 2006). Leakage amounts to over 30%, and about 15% is lost within the boundaries of farm lands (ABS 2010).

3.3.2 Industry

Water supply for industrial purposes is provided from surfaced and groundwater sources by independent water supply systems or municipal water supply networks. According to NSSA data, industrial water use has constituted on average 8% of total water use in Armenia within the last 20 years. The Armenian Nuclear Power Plant is the major water-using industrial entity, consuming about 35 million m^3/year (FAO 2008).

As seen in Figure 3.4 above, since independence industrial together with agricultural water registered that major decline due to drastic reduction of activities in these sectors and closing down of many enterprises. According to MNP (2000) report, the industrial water demand dropped from 512 million m^3 in 1985 to 120 million m^3 in 1998. Due to a lack of meters installed by industrial enterprises, industrial water use statistics is based on the figures that the enterprises are reporting to the authorities, which may not always be correct (WB 2001).

As opposed to agriculture, with economic revival industry share in GDP is gradually increasing. For example, between 2000 and 2007 industry's share in GDP increased from 35 to 44 % (FAO 2008). Even though industrial demand for water is low, there is an increasing concern with regard to industrial wastewater discharge and treatment. The major problem is that many industrial facilities do not have individual wastewater treatment facilities specific to their production processes. In many cases, industrial enterprises discharge their effluents either directly to nearby water streams or to municipal sewer networks to which they are connected, which can be especially insecure because the majority of wastewater treatment facilities are currently not operating and no new facilities were constructed since 1990's (WB 2001). Those that are active use mainly mechanical treatment methods which may not be proper for industrial pollution. Moreover, the industrial enterprises that are reopening are, as a rule, those that are most polluting (FAO 2008). Within the period 1997 to 2000, the average daily industrial discharge of organic water pollutants in Armenia was estimated at 10 metric tons per day (EarthTrends 2005). According to NSSA data, in 2009 total amount of wastewater discharge was 359 million m^3, of which 270 million m3 (75%) were pure or purified with the remaining 89 million m3 (25%) exceeding standard sanitary codes of water discharge.

3.3.3 Municipal water supply and wastewater

According to NSSA data, within the period from 1990 to 2009, municipal water use including household, institutional and commercial sectors significantly reduced by almost 88% - the highest relative reduction as compared to agriculture and industrial water, which dropped by 43% and 81% respectively. In 1990, municipal water consumption amounted to 634 million m^3 compared to 77 million m^3 in 2009. Within the same period, the share of municipal consumption in total water use also reduced from 18% in 1990 to 5% in 2009, making it the smallest water use sector. These figures include water losses which, as mentioned above, have considerably increased since 1990's. Reductions in water consumption can be partly explained by reduction of hours of water supply due to a number of factors such as deteriorating water distribution network, shortcuts in energy supply for pumping, reduction in population, etc.

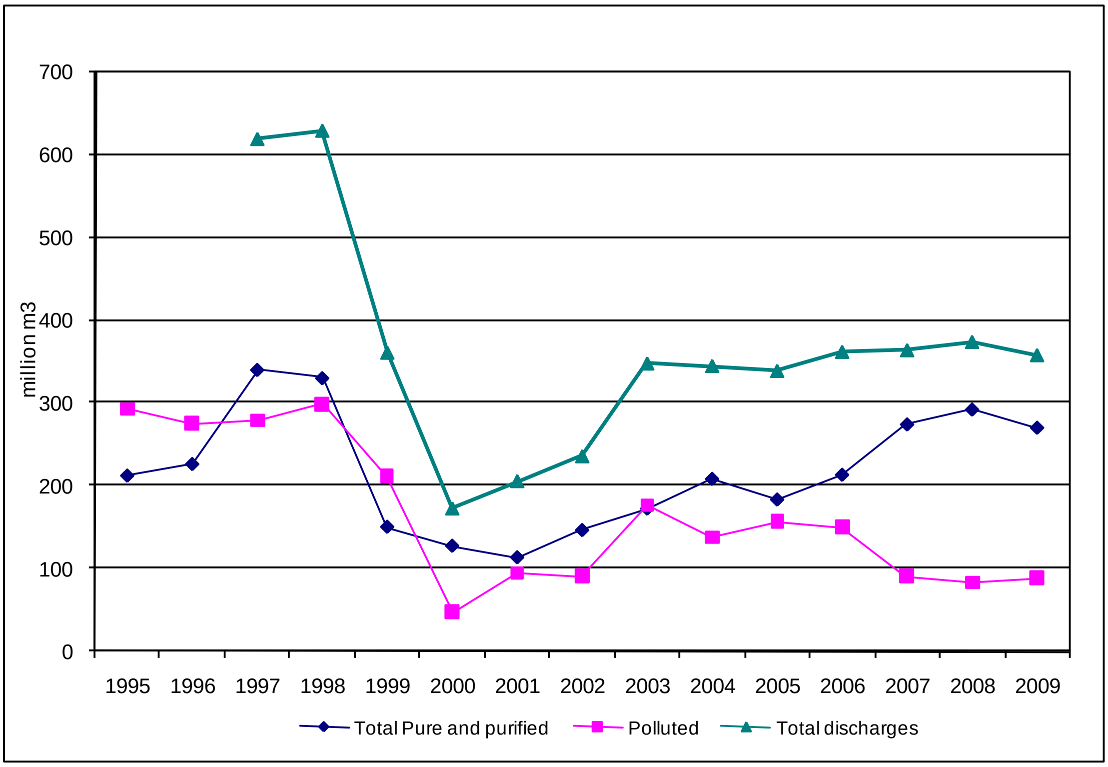
Based on the WRI database, in 2004 about 92% of the population in Armenia had access to improved water sources: 99% of the population in urban and 80% in rural areas. Groundwater is the major source of water supply for household purposes. WB (2001) reported that only 5% of drinking water supply is abstracted from surface sources. As of 2001, about 81% of the population (67% in urban and 14% in rural areas) has access to pipe water. At the same time, 87% of urban and 45% of rural population have indoor water taps. The lower connectivity of rural areas is explained by such factors as remote location, low-income communities and low population density, which makes these areas commercially unattractive for water infrastructure to expand. According to the IFAD study, in 2006 only 2% of rural communities had water systems in acceptable conditions and almost 50% of the water system required fundamental repair (Mkhitaryan 2009).

Wastewater system

According to the OECD (2008) report, 83% of the population in Armenia has access to sanitation system - 96% in urban and 61% in rural areas. There are about 4000 km of sewers, about 250 km in rural areas. In 1998, about 90% of sewage pipes were more than 10 years old and 60% more than 20 years old. On that period, a one-km pipe could have on average six cracks (ABS 2010).

Water treatment is supposed to be conducted in 19 wastewater treatment plants located across the country. The plants were constructed before 1990 and due to their age and lack of rehabilitation and high operation costs, most of them are in poor operating condition (OECD 2008). A study conducted in 1998 revealed that out of all wastewater treatment plants, the state of 5 plants was estimated to as average, 5 as poor and 9 as beyond repair. In many cases biological treatment could not be conducted due to high electricity costs (ABS 2010). OECD (2004) reports about only 5 treatment plants that are functioning. There is an urgent need for rehabilitation actions otherwise these plants will worsen to the point of no return. Outdated facilities based on high energy use technologies make water treatment extremely inefficient and expensive. OECD (2008) reports that about 41% of industrial and household wastewater is discharged without full (mechanical and biological) treatment. In many cases sewerage goes through incomplete mechanical treatment or even passes through a production process without treatment (OECD 2004). Environmental pollution is reduced at very slow rates. Untreated or deficiently treated sewage is one of the major sources of contamination of water bodies and the surrounding area of sewerage passage.

The trends in wastewater discharges based on NSSA data are presented in Figure 3.7. There was a drastic decline in wastewater discharges till the year 2000, which can be explained by the economic crisis accompanied by a decrease in volume of irrigation and cease in the operation of the majority of industrial enterprises. Even though there is scarce data on pollution levels in that period, overall, there was an improvement of water quality in water bodies as compared to the situation in Soviet times when there was a high level of surface water contamination. Currently, except for flows from the capital city Yerevan and other major cities, the quality of surface waters is considered sufficient (MNP 2003). Since 2000, with the revival of economic development there has been an increasing trend of water consumption (Figure 3.4 above) supported by increasing trend of wastewater discharges. As it is seen in Figure 3.7, the amount of polluted water released into water bodies is decreasing since 2003. However, alarming is the decrease of wastewater treatment. In 2008, only 3% of polluted wastewater was treated – the lowest level within the observed period. In 2009, treatment slightly increased to 6%.



Source: author's calculations based on NSSA data

Figure 3.7 Wastewater Discharge

Note: Total includes: a) *pure* water discharges that meet standard without treatment; b) *treated* water discharges that meet standard after treatment; and c) *polluted* water discharges that do not meet standard after insufficient treatment or without treatment

Municipal water quality

In Armenia, there are 107 drinking water intakes with total capacity of 570 m3 per year. In general, water quality at source is high that may need only simple treatment. It is featured by low mineral and fluorine content (OECD 2004). However, increased deterioration of water network, lack of repair and interrupted services result in intrusion of pollution including untreated wastewater from deteriorating wastewater pipelines into drinking water pipes. Water service interruptions cause addition issues: water left in water pipes, accelerated corrosion, increased deterioration of water mains and valves because of pressure variations, emergence of low pressure zones in pipelines that provokes absorption of other waters and the mentioned secondary pollution.

All this raises the problem of the quality of supplied water which does not comply with microbiological standards and the concerns about related health impacts. The test of drinking water for microbiological parameters revealed that in 99 % of samples that did not meet the standard, the reason was the secondary pollution in distribution networks. In 1990, the percentage of water pipelines not meeting sanitary standards was at the level of 21, in 1993 – 39.3, in 2000 - 57 (OECD 2004; WB 2001).

Tap water quality survey conducted in 1995-1996 revealed that 10-20% of samples did not meet the standards (ABS 2010). According to data of the Ministry of Health, on national level the situation with water quality has deteriorated from 1993 with some improvement reached in 2001. The percentage of tested samples of water quality that did not comply with microbiological standards is presented in Table 3.2.

Table 3.2 Water Quality

	1993	1998	2000	2001
Number of water samples investigated	8900	21700	20351	18431
% of not meeting standards	13	17	15	10

Source: based on data of the Ministry of Health from WB 2001 and Roe et al 2003

Deterioration of water supply and sanitation systems with resultant poor water quality gives rise to water-borne diseases. Outbreak of intestinal infections generally rare in Armenia, significantly increased since 1992 (OECD 2004). The situation is especially critical in rural areas where water systems are managed by local communities. About 60% of rural drinking water supply systems do not use treatment due to lack of disinfection equipment, high cost of disinfection processes, shortage of chlorine and poor operational condition of chlorination facilities, etc. (ABS 2010; WB 2001).

1999-2000 household survey showed that 26% urban and 18% rural population treat drinking water before use mainly through boiling, allowing particles to settle down and filtering. Urban households that had fewer hours of water service were more often treating water which relates to higher contamination in low-pressure water systems (Lampietti et al 2001).

3.3.4 Water stress

After the above description of water resources in Armenia a question may raise whether Armenia is water-rich or water resources are scare in the country. According to WB (2001), Armenia is not water stressed country. OECD (2004) ranks Armenia average in terms of water resource availability among Eurasia continent. According to the Ministry of Nature, Armenia has very limited water resources without providing justification for such a statement. This section provides more clarification on the issue.

Among the indicators showing the availability of water resources in the country is the water stress indicator. In general, there are a number of several indicators of water resource stress, including the amount of water available per capita. The IPCCC (2001) assessments of water stress are based on Falkenmark and Lindh (1976) approach: the ratio of volume of water withdrawn to volume of water potentially available. Table 3.3 presents water resources and the use in selected countries. If water demand is less near 5%, there is no risk of not meeting the need. Russia and to some extend Georgia and Hungary belong to this group. If demand is 5%-20%, the situation is there is a risk of temporary water shortages, which may require careful water management with large investments to meet the need, which is the case with Turkey and Moldova. Armenia falls into the category with withdrawals greater than 20% of total renewable resources indicating about water stress as a limiting factor on development with requirement of massive investments to be devoted for water management. Countries with withdrawals greater than 40% indicate high stress (Kirgizstan, and Iran). There are also countries, where water withdrawn exceeds the amount of natural recharge (Israel and Egypt). Overall, Armenia can be considered in medium water stress range. At the same time, per capita availability of water resources indicates that Armenia (3501 m^3/capita/year) falls within the low water availability category (water stress is problematic if a country has less than 1000 m^3/capita/yr). Per capita water is less than in other South Caucasus countries - Georgia and Azerbaijan, though higher than in two other neighboring countries – Iran and Turkey.

Table 3.3 Water resource stress

Countries	Total renewable resources (10^9 m^3/yr)	Total annual withdrawals (10^9 m3/yr)	Total actual renewable freshwater resources withdrawn (%)			Per capita renewable water availability* (m3/capita/yr)
	Source: WRI (1960-2007)	*Source: WRI (2000)*	*Source: WRI*	*Source: FAO Aquastat*		*Source: WRI (2006)*
Armenia	10.5	2.9	**28**	**36**	2003-2007	**3501**
Azerbaijan	30.3	17	**56**	**35**	2003-2007	**3574**
Georgia	63.3	3.6	**6**	**3**	2003-2007	**14282**
Iran	138	73	**53**	**68**	1998-2002	**1955**
Turkey	229	38	**17**	**19**	2003-2007	**2879**
Moldova	11	2	**18**	**na**	2003-2007	**2777**
Russia	4507	77	**2**	**1**	1998-2002	**31622**
Hungary	104	8	**8**	**5**	1998-2002	**10327**
Kyrgistan	21	10	**48**	**44**	1998-2002	**3865**
Kazakhstan	110	35	**32**	**31**	1998-2002	**7400**
Israel	1.7	2.05	**121**	**102**	2003-2007	**244**
Egypt	58.3	68.3	**117**	**119**	1998-2002	**773**
Middle East & North Africa	657	323	**49**			**1394**
Europe	7793	418	**5**			**10680**
World	54228	3828	**7**			**8467**

* Extremely low < 1000, Very low 1000 – 2000, Low 2000 – 5000, Medium 5000 - 10000, Above medium 10 000 - 20 000, High 20 000 - 50 000, Very high > 50 000 (the Dobris Assessment, EEA and UNEP 1997)

Source: author's calculations based on data from WRI and FAO Aquastat

Another indicator for assessing water stress is water exploration index (WEI) defined as a ratio of annual total water abstraction to long-term annual average renewable freshwater resources. The threshold for the WEI of 20% separates a non-stressed region from water stressed region. Severe water stress occurs with WEI more than 40%. Freshwater abstraction assessment for EECCA[4] region reports that 5 countries - Uzbekistan, Azerbaijan, Armenia, Turkmenistan and Kazakhstan – are considered as water-stress countries. In case of Armenia, within the period of 1990-2002 the WEI declined from 55% to 24%, and then started to increase reaching 39% and 32% for 2004 and 2005 respectively (UNECE 2007).

[4] Eastern Europe, Caucasus and Central Asia (EECCA)

3.3.5 Water poverty

The comparison of water availability in the country through the Water Poverty Index (WPI) opens up an interesting picture. The *Water Poverty Index* is an interdisciplinary measure for assessing the impact of water scarcity and water provision on population. It combines physical quantities relating to water availability and the socio-economic factors relating to poverty for reflection of various factors affecting water resource management. Thus, WPI provides holistic assessment of water availability based on five components water availability, access, management, water use and environmental impact. It provides more accurate assessments on how much actual and potential water stress exists for particular region and how changes in water availability and supply will help to eradicate poverty (CEH 2003).

Based on the database of the World Resources Institute (WRI), Armenia ranks in WPI 54 equal that of Israel and Kuwait (Table 3.4). Even Egypt has higher WPI 58. Worth noting here is that Egypt, Israel, Jordan and Kuwait are the countries that are commonly referred as water-deficient countries. Moreover, expect for Moldova that has WPI 49, Armenia ranks the lowest among the NIS countries including Central Asian countries. On regional level, again Armenia is more water stressed than the neighboring countries such as Georgia, Turkey and Iran (no data was available for Azerbaijan).

Table 3.4 Water Poverty Index (2002)

Country	Water poverty index (0-100)*
Djibouti	38
Jordan	46
Moldova	49
Armenia	54
Israel	54
Kuwait	54
Turkey	57
Egypt	58
Kazakhstan	58
Tajikistan	59
Iran	60
Georgia	60
Belarus	61
Hungary	61
Uzbekistan	61
Australia	62
Russia	63
Kyrgyzstan	64
Germany	65
Greece	66
Turkmenistan	70
Canada	78

* Index Number 0-100; lower scores indicate water scarcity and poor water provision

Source: based on the EarthTrends – WRI data

These results are particularly worth considering in view of the fact that there is strong perception among Armenian people that Armenia is water rich country and some also opinion that water should be given to the people for free. Nonetheless, even having rich water resources – inefficient water resource management may put the country under water stress situation and increase water poverty.

3.4 Summary of key findings and conclusions

This introductory chapter of the dissertation set the stage and background for the logic of the rest of the study. It presented physical, geographical and hydrological characteristics focusing on water related aspects, activities and environmental problems. In particular, the chapter emphasized a number of following important aspects.

Referring to the ancient name of the country – *Nairi* as "land of rivers", and the collective memory Armenians retain the perception that it is the water that is plentiful in the country and, based on it, water should be distributed free-of-charge for people. However, the easier access to fresh water should not be taken for granted. Inefficient water resource management may put the country under water stress situation and increase water poverty. This is especially true in the context of Armenia that faces a range of issues that needs to be addressed.

The chapter demonstrated that, in general, Armenia is not a water-rich country. According to some international classifications, it is a water-stressed country with renewable water availability being a limiting factor for development with requirement of massive investments to be devoted for sustainable water management. Moreover, on per capita bases, it falls within the low water availability category. Furthermore, the assessment of the *Water Poverty Index*, an interdisciplinary measure for assessing the impact of water scarcity and water provision on population, shows that expect for Moldova, Armenia ranks the lowest among the NIS countries including Central Asian countries. On regional level, again Armenia is more water stressed than the neighboring countries such as Georgia, Turkey and Iran.

Another factor is the impact of climate change. Water is the principal medium through which climate change influences the ecosystems and consequently the means of living and well-being of people. According to the climate scenario scenarios study for Armenia, climate change will significantly hit agricultural production and endanger food security in the country. With this regard, introduction of proper water management systems with provision of more efficiency use of water resources and integration of climate adaptation measures represent imperative ingredient of social and economic development strategies of the country.

The chapter also stressed the urgency of water related environmental problems and sustainability of water resources. In particular, inefficient agricultural practices, poor drainage and leaking irrigation systems led to the rise of water table in the Ararat valley and subsequent problems of soil alkalinization and salinization. Concerns were also raised about groundwater depletion in Ararat Valley due to the growth of fish farming in the area. Another major environmental issue is related to eutrophication of Lake Sevan.

As for surface water quality, currently, it is generally satisfactory with high level of the self-purification ability of the rivers. Currently, except for the downstream of cities especially Yerevan where organic pollution holds back self-purification capacity of rivers, surface water conditions can be considered as relatively good. The content of pollutants such as heavy metals, nitrates and nitrites, pesticides and other chemical compounds, in open water basins is within the standard limits. However, if proper measures are not undertaken with increase of economic activities water pollution may quickly worse.

As for ground water, there are springs that are not suitable for drinking due to high concentration of nitrates, nitrites and fluorides as a result of intensification of farming practices - from fertilizers, septic systems, and manure storage. The exposure to drinking water with a nitrate level above the health standard may cause potential health problems. Excess dose of nitrate and nitrite may also be toxic for fish communities.

Finally, the chapter displayed a drastic decline in water consumption since the collapse of the Soviet Union followed by social, economic and energy crisis. Since 1990, water consumption in Armenia dropped almost twice. Industry and irrigation have experienced the most radical decline. The impacts were accelerated by lack of repair, resultant deteriorating condition of water supply infrastructure and high water losses. With reduction of industrial and agricultural output of transitional years there was also a decrease of pollution. However, with recent trends of economic development the utilization of water resources in all sectors (industrial, municipal and agricultural) is returning again into the track of intensive use. Hence, the need for clever and sustainable water management comes forward. And with this regard, importance of research in this area is increasing.

CHAPTER 4 TRANSITION IN THE WATER GOVERNANCE

4.1 Introduction

Understanding privatization in the water sector begins with the recognition that it is not a stand-alone process but an integral part of the structural reforms package that entails changes in the water governance system. Global Water Partnership defines water governance as a "range of political, social, economic, and administrative systems that are in place to develop and manage water resources and the delivery of water services, at different levels of society". The analysis of water governance is, therefore, worthwhile in order to examine the privatization of water services within a border context of a reform package to identify the driving forces, goals and expectations. This chapter is divided into two parts: water sector reforms and transition to public-private partnership. The first part presents the analysis of the changes in the water governance system that entails structural and process changes in the water sector as an aggregate mechanism of policies, legal and regulatory rules and procedures, organizational structures, financing systems and impact mitigation mechanisms. The second part of the chapter elaborates the transition to public-private partnership modes in the water sector, detailing each public-private partnership evolution and structure. The aspects of stakeholder dialogue, sharing of information, and conflict resolution on various levels of planning and management procedures are given special attention.

4.2 Methodological and data considerations

This chapter is mainly related to answering *research question 3* that is mostly derived from conducting *interpretive policy analysis* (Yanow 2000:39). It is based on the postpositivist social theory which looks at representations through language, text and symbols in the organization of social life. "*But it is also relentlessly empirical, concerned with what policy* *makers do, with "the work of policy*" (Freeman nd). The methods of data assessment include conversational interviewing, document analysis and non-participant observation.

The *document analysis* is a vital analytical tool and an important part of triangulation designs (Heffernan 2001). Sources of documents include archives, files, public records, annual reports, surveys, studies, newspapers, and journals. The data is analyzed qualitatively through the narrative analysis to construct a consistent account out of a number of occurrences observed in talks and texts (Kvale 1996).

Conversational interviewing was carried out with the following stakeholder groups: villagers and the general public, activists, civil society representatives, field experts, representatives of local authorities, state officials, representatives from water utilities and international (donor) organizations. In total 47 interviews were performed. The purpose was to obtain their views of structural and process changes in the water sector about the introduction of commercialization of water provision, as well as the main challenges and the ways of overcoming them. The interview protocols included various open-ended core questions. This will be the main instruments for the qualitative data collection. The advantage of "semi-structured" interviews is that the answers of the respondents can be compared on the "core" questions, at the same time ensuring that other issues impulsively raised by the respondent can be taken into consideration (Herbert 1990:54).

The analysis of qualitative data was guided by the following steps based on Punch (2006):

1) *Combining of material.* This is a continuing process, during which all the available material from the review of literature, documentation, observation notes, and interview transcripts was combined and examined with the purpose of getting a sense of the data, identifying its textual, contextual and situational dimensions.

2) *Segregating problems, topics and themes*. At this stage, the goal was to highlight what message was delivered, and what was missing. Substantial messages and commentaries were highlighted and in case of need the meanings checked with the informants. The most important messages were formulated into themes to be explored further during the interviews or document reviews. In general, a common sense approach to the analysis of document and interview texts was used. The data was read through to get a general idea, to make some generalizations or make deeper interpretations, pick some parts into narrative or attempt a visualization of the findings in a diagram. Thus, the results of meaning creation helped to shape them into words, numbers, figures, and charts.

3) *Reviewing the results of the analysis*. For improving validity, some important interpretations were agreed with the respondents.

4.3 Water sector reforms

This section describes water sector transition and reforms in Armenia. It starts with examining the triggers for reforms and shifts in the water governance, specifying the main prerequisites behind the water reforms and then proceeds with detailing legal, policy and institutional transformations.

4.3.1 Prerequisites for reforms

Prior to independence in 1991, the water infrastructure in Armenia was overall quite satisfactory. During the subsequent transition to a free-market economy, the country faced an economic depression characterized by the collapse of the industrial base, a soaring inflation rate, dramatic welfare losses and increasing poverty. The water and wastewater infrastructure suffered neglect and under-investment, being heavily reliant on state subsidies. The decade of unhurried action has resulted in significant degradation of water and wastewater networks and facilities. Increased tariffs failed to cover operation costs not only because they were set below recovery level but also because of considerably increased levels of non-payment of water bills, especially among household users and state-owned organizations.

By the early 2000's, non-revenue water amounted to around 70% nationwide – the highest levels among the NIS. In terms of cost recovery, Armenia ranked the lowest, with less than 15% of utility costs as compared to average of 30-40% among the NIS (Efimova 2007). The remaining amount came from the state budget or accumulated in a form of utility debts. Subsidies were directed for covering financial gaps in the current operations of water utilities. The largest part of the debt was to energy utilities since the water infrastructure, which was built in Soviet times, was highly energy intensive. Water utility revenues were mainly coming from highly priced industrial consumption. However, due to a significant reduction in industrial output, the main source of utility revenue shifted from the industrial to the municipal sector, which in turn experienced low water payment collection. On average, water payment collection rates were about 20% for municipal and 40% for irrigation (Melikyan 2003). As a result, the Armenian water system fell into a *low-level equilibrium trap* characterized by aging and poorly maintained water networks, increased water losses, declining service quality, falling payment collections, almost inexistent bill payment enforcement mostly due to lack of metered consumption, falling utility revenues, debt accumulation and increased dependence on state subsidies (Lampietti *et al* 2001). Even though water pollution rates decreased mainly due to reduction in industrial output, the poor state of water supply and wastewater treatment, the increased rate of water system breakages resulted in increased incidences of pollution of supplied water and water-borne disease.

Taking stock of this, reforming water sector in Armenia became an urgent issue. Further delays in reforms would cause complete disruption of the system to the point of non-repair. After the reforms in the energy sector, in the early 2000s, reforms in the water sector in Armenia became uppermost in the policy reform agenda for the subsequent years.

4.3.2 Reforms of water governance and management functions

To prevent further deterioration of the water infrastructure and improve the management of the water sector, in 1999 the Armenian government launched large-scale water sector reforms (Melikyan 2003). The main objective of the reform program was: to reduce the dependence of the sector on state subsidies and donor assistance, to raise revenues from increased collections of water payments based on metered billing, to restructure water utility debts, to enhance the management efficiency of water utilities and to improve the availability and quality of water services (OECD 2008). It is important that environment related goals did not seem to be the priorities. They are more of declarative nature or veiled under the goals of reduction of operation costs.

The achievement of these goals required significant capital investments expected at the initial stage to be covered largely by loans. The water sector reforms were conducted in the context of the broader agenda of structural changes taking place in Armenia since 1994 backed by traditional conservative economic policy standpoints and the financial support of the Bretton Woods Institutions: the International Monetary Fund (IMF) and the World Bank (WB). Since 1995, a series of structural adjustment facility programs has been implemented in various sectors (Roe *et al* 2003). This entailed transition to a new governance scheme through modifying and establishing new institutional arrangements for decision making and policy implementation, regulations and economic incentives. Applied to the water sector, transition to the new water governance implied transition to a new set of systems (political, organization and administrative processes) that control the decision-making process in the area of water resource development and management (Norman *et al* 2010). Another important aspect is that the rehabilitation of public service infrastructures in Armenia was constrained by the design of the pre-existing infrastructure that was constructed to meet the requirement of the centrally planned economy, which contradicted the new needs under the transition to market economy. This was particularly relevant to water systems, where appropriate adjustments were also dictated by geo-political changes (Polischuk 2008).

Legal reforms

The legal foundation for the water sector reform in Armenia was provided by an array of laws. These laws and the established institutional settings have become an important base for launching and implementing reforms in the water sector. The main elements of the reform included introduction of the Integrated Water Resource Management Planning and adoption of the new *Water Code*[5] (2002) that incorporated contemporary concepts and mechanisms of water management, such as private sector participation, polluter- and user-pays principles, and accompanying financial, regulatory and institutional reforms. The Water Code regulates the management, use and protection of water resources and water systems. It covers conservation and protection of water resources, including mitigation of pollution, maintenance and supervision of water standards and water level of the national water reserve. An important innovative provision of the new Water Code was incorporation of the stakeholder information procedure for introduction of a decision on the proposed activity and description of the possible impacts with indication of the time and venue for public hearing and procedures for obtaining information and presenting the written comments (Water Code 2002: Public Notice).

[5] The previous was the 1992 Water Code

Other subsequent legislative improvements were the adoption of the National Water Policy in 2005 and the National Water Program in 2006. The National Water Policy sets the goals and issues for strategic development of water resource use and protection. It provides preliminary assessment of the quantity and quality of water available for distribution, defines innovative measures for improving water resource management, and presents the estimates of financial needs for implementation of the National Water Program with recommendations on sources of funding. The National Water Program for each water basin management area provides classification of water systems, emergency and environmental disaster zones, water demand based priorities, strategy for water storage, allocation and use, water standards and measures for improving water resources monitoring and pollution prevention, and mechanisms for ensuring public awareness (Water Code 2002).

In the context of the present research on water privatization, the Law on Privatization of State Property (amended 1999) and the Law on Foreign Investments. The Law on Privatization stipulates the conditions and procedures of the privatization of state property and the use of the means obtained from privatization. Article 11 of the Law regulates the relationship between the privatized company and its personnel after privatization. It states that in case of more than 50% of stock privatization, the owner of the privatized company is not allowed to fire the employees within the following six months. If dismissed, the employee shall be compensated for the losses based on the average wage of the last year.

Other legal acts that directly or indirectly shape the legal and regulatory bases the water governance structure in the water sector in Armenia include the Law on Fundamental Principles of National Water Policies, Law on Securing Sanitary-Epidemiological Safety of the Population, Law on Environmental and Natural resource Payments, etc.

Regulatory reforms

Regulatory reforms started with the separation of regulatory, standard setting, and operational functions and the creation of independent bodies (Roe *et al* 2003). A number of institutions were created in water governance, including the National Water Council, the Dispute Resolution Commission, the Public Service Regulatory Commission and the State Committee of Water Systems. The responsibilities for managing water resources and managing water supply and wastewater systems were detached and allocated to the Water Resource Management Agency and the State Committee of Water System, respectively (OECD 2008). Schematically, the current water management and governance modes in Armenia are presented in Figure 4.1, which represents a complex of institutions, functions and their mutual relationships. The relationships for water companies and state structures are explained in further sections.

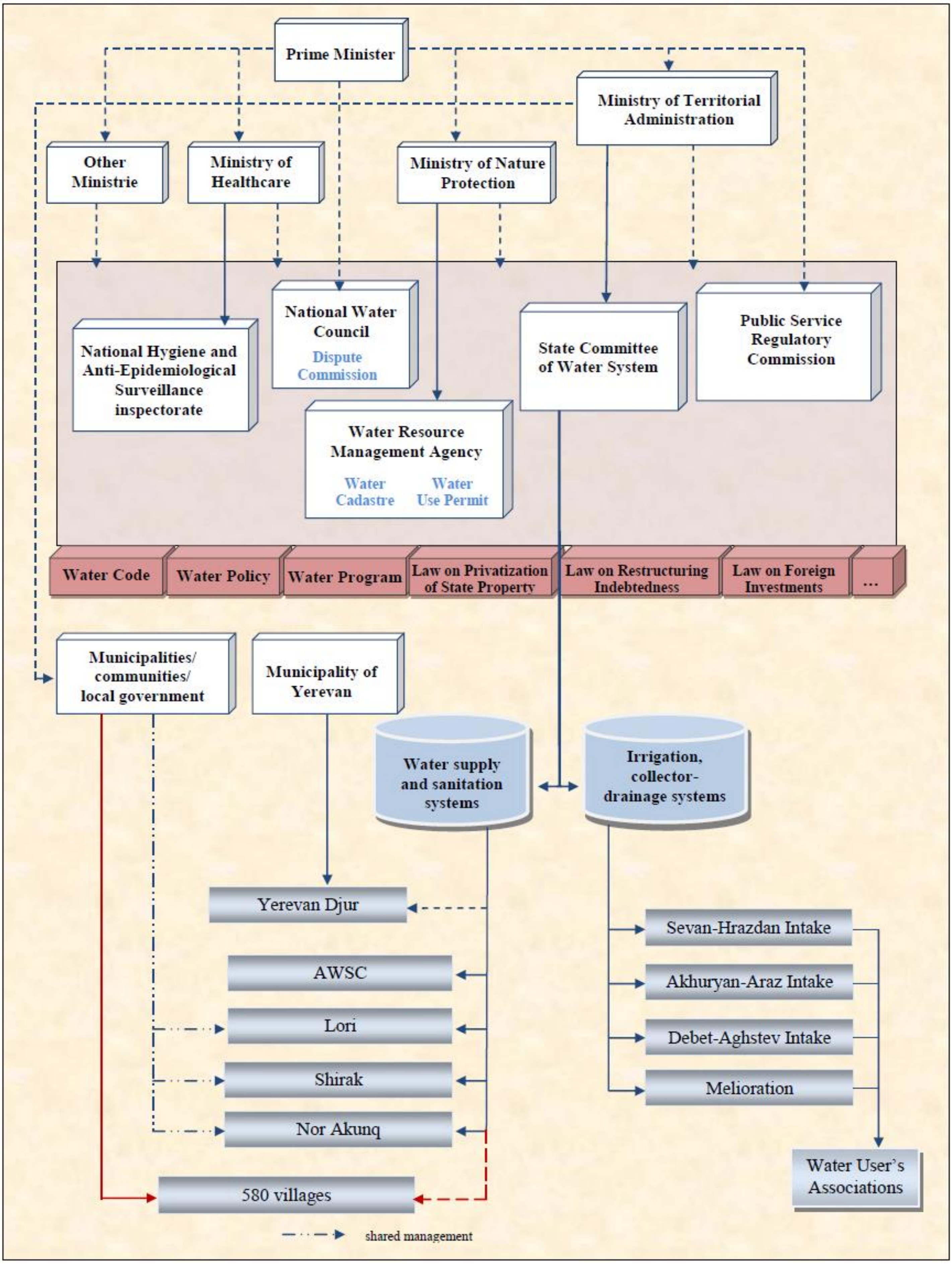


Figure 4.1 Core elements of water governance and functions in Armenia

The 2001 Water Code stipulated the establishment of an independent body that would determine tariff policy in water relations and issues water systems use permits. As a result, *the Public Service Regulatory Commission (PSRC)* was created in 2004 as an independent body for public utility regulation in the country. It carries the tariff setting functions for all types of public services, including water and wastewater services. Tariff setting for water is a three-level procedure. First, the water utility applies to the PSRC with the proposal for the revision of the tariff level. The water company proposal has to be coordinated with the State Committee of Water Systems. Second, prior to setting the tariffs, the PSRC publishes a notice in no less than 1000 copies, defining the principles of the formation of the proposed tariff, and requests comments and recommendations on the proposed tariff within 30 days (Water Code 2002). Lastly, after receiving all the comments from stakeholders, the PSRC makes the final decision on the tariff level (ADB 2008).

The PSRC is also accountable for utility activity licensing, monitoring utility operation according to regulatory functions and the license, standard setting for service provision, and providing integrated information for the public. The president of the Commission is appointed on a rotation basis every 5 years by the President of Armenia in the presence of the Prime Minister of Armenia. The meetings of the Commission are open to the public, unless the questions discussed are related to state secrets or internal regulation. The Commission is to declare the date and venue of the meeting and create an opportunity for stakeholder or civil society participation to get information on the discussed issues and to take part in discussions. This is especially the case with discussions on water tariffs. The decisions of the Commission can be taken to the court. The Commission has to publish its annual reports in the media. The Commission is financed from the budget. The members can participle in the meetings of the Government and present appropriate suggestions for economic and financial programs. The

Commission is also obliged to present its financial report for audit and to the appropriate authorities of the Government (Law on Public Service Regulation 2003).

Institutional reforms

The State Committee of Water Systems (SCWS) is one of the key agencies managing the water sector since 2001(ADB 2008). It was established to deal with the implementation of national water policies through optimization of water resource management. It is responsible for the development and implementation of water system investment policy, development of norms on water and wastewater system losses, improvement of water tariff policy, financial rehabilitation of water companies, and quality improvement of water services to customers. The assets and responsibility for resource usage and water services belongs to the state. It is the 100% shareholder and asset holder of two water utilities currently operating in Armenia. It also holds 51% of shares for three community water utilities (ADB 2008).

The SCWS is deeply involved in the management and operation activities of water utilities. In particular, the SCWS is responsible for development, bidding, and setting up public-private partnership arrangements, designing performance indicators, monitoring indicator-based performance of utilities and ensuring project management for all water operators. The SCWS manages all the utilities to different extent. The day-to-day contract compliance of each public-private partnership arrangement is monitored by the Project Management Unit established by SCWS (WB 2011:37). The SCWS holds the responsibility for management, monitoring and improvement of community water provision systems (56 water user associations), the transfer of these systems to specialized structures, selection of effective modes of water management for communities.

Ministry of Nature Protection is the primary body in charge of water resource management and policies. Some of the development, planning, and management duties are spread among other ministries, such as Ministry of Agriculture (development of irrigation and drainage policies), Ministry of Energy (management of water withdrawal from Lake Sevan), Ministry of Health (development of quality standards), Ministry of Urban Development (development and approval of design and construction standards), etc. (Roe *et al* 2003).

National Water Council is the top advisory body in the field of water resource management, composed of heads of a number of related ministries representing cross-sector collaboration in developing recommendations and proposals concerning the national water policy. It initiates discussions on various issues of water resource withdrawal, ownership and use, and makes recommendations to the National Water Policy, the National Water Program and other related legal documents. The Council is chaired by the Prime Minister (Water Code 2002). Establishment of the National Council on Water Resource Management chaired by the Prime-Minister increased the perception of the seriousness of the government for water reforms (Melikyan 2003).

Dispute Resolution Commission serves as a binding arbitrator for resolving disputes about water use permits. The Commission decisions are not compulsory and in events of non-compliance the case is to be resolved in the judicial order. Members of the Commission are appointed by the Prime Minister (Water Code 2002).

The Water Resource Management Agency (WRMA) of the Ministry of Nature Protection was established for formulating and managing the water resource policy, preparing national water programs and water basin management planning, supporting water resource management and protection, providing water resources quality and quantity monitoring, and maintaining the state water cadaster. It issues water use permits and monitors fulfillment of obligations.

The Water Use Permit regulates water extraction and discharge functions. Water companies are required to get permits for raw water and for wastewater discharge. Payments differ based on the origin of raw water and the company ownership type (OECD 2008).

The challenges and discrepancies in regulatory, administrative, financial and water operator management, including issues of shared management, are discussed in the subsequent sections throughout the dissertation within specifically related contexts.

Financial reforms

Financial reforms were backed with the adoption of a comprehensive "Reform Programme to Improve Financial Sustainability of the Companies Responsible for the Provision of Drinking Water Supply/Wastewater and Irrigation/Drainage Services". The goal was to establish realistic priorities, encourage financial planning in the water sector, provide an input to the budgetary process, increase the reliability of investment needs estimations, assist improvements in the water tariff policy, transfer of operation rights of water utilities to private operators (OECD 2007). The ultimate aim was to eliminate the dependence on budget subsidies. Recalling the situation before the reforms, collection rates were 20-50% for municipal and 35-50% for irrigation (Melikyan 2003). Water billing amounted to 0.9% of the GDP, whereas collection amounted to less than 0.2%. Taking into account that the state budget in 2001 was AMD 193.6 billion (based on data of the Ministry of Finance and Economy of RA), budget subsidies amounted to AMD 4.7 billion (based on data of Melikyan (2003)), making it around 2% of GDP. Hence, the reforms necessitated significant capital investments from loans on favorable conditions, improvement of water payment compliance through introduction of water metering systems, and introduction of tariff setting procedures that would enable to gradually remove state budget subsidies. The investment requirements were estimated at 200 million USD for the five year period (Roe *et al* 2003).

Another important aspect of the financial reform program was provision of a restructuring of debts accumulated by water operators. It incorporated rescheduling or deferring some of the payments beyond 2006, partial cancelation or clearance of cross-debts of water utilities to energy companies or the state budget (Roe *et al* 2003). For promoting metering and improving water bill payments from households, the Law on Establishing Privileges in Repayment of Debt for Water, Wastewater Services, Sewerage Treatment and Irrigation (hereinafter – the Law on Restructuring Indebtedness) was adopted in 2002. It stipulated partial cancellation of accumulated household debts for water payment on condition of 30-50% debt repayment and installation of water meters. In more detail, implementation of this law is described in the metering section of the next chapter.

Decentralization

It becomes increasingly common that water sector reforms pass through a horizontal restructuring process – decentralization – that entails improvements in water governance systems. Decentralization implies a transfer from the government of its decision making powers and management responsibilities to lower levels of government, private sector or community and civil society organizations. It occurs depending on different political structures of the country (Foster et al 2005).

In Armenia, economic reforms were accompanied by increasing decentralization of public services, including the water sector. In the water sector, responsibilities of operation and management of local water sources and reservoirs, water supply and wastewater treatment facilities, construction and operation of irrigation systems were devolved from the central towards local self-government bodies (Tumanyan 2002). Under this structure, there are more opportunities for community involvement in the decision making process. Accordingly, for the implementation of some measures or programs, the central government can issue grants to local governments. Even though there is a specific procedure for the central government to give credits and loans to municipalities/local government, in reality in it not widely practiced. The central government also sets the wholesale tariffs for water delivery to the community treatment facility, whereas the local community elders set retail water tariffs that vary for household and commercial users. The local governments are also responsible for the construction, maintenance and operation of water supply networks and treatment stations (UNDP 2006). In Armenia, however, low collection rates of water fees due to the widespread poverty of the population especially in remote rural areas and the low level quality of water services led to the accumulation of community debts to the central government. In some cases, the solution was found in a ten year rent of water systems to the Armenian Water Supply and Sewerage Company, which is under 100% ownership of the central government providing water supply services throughout Armenia. Another option was contracting with a foreign water operator for the management of water supply systems. Efforts were also made to seek donor support for financing repair and decentralization of water supply systems (Tumanyan 2002). Currently, there are two modes of water utility management in Armenia – centralized and decentralized. The centralized water management mode functions under the public-private partnership participation contract scheme, whereas the decentralized mode is based on local community management (Karapetyan 2006). The decentralized water supply systems are primarily in rural areas that receive water from water springs, wells, and open sources.

Privatization

One of the most important components of the water sector reform program that reshaped the water governance systems was the introduction of commercialization in the water sector. Involvement of the private sector and the use of performance-based contracts were among the major innovative approaches that the country undertook. By the time the water sector reforms started, Armenia had already a remarkable track record of private sector involvement in its various infrastructure networks. According to the World Bank's Private Participation in Infrastructure Database, Armenia ranks as a leader among public-private partnership (PPP) in Newly Independent States (NIS) in the ration of public-private partnership investment to the gross national income of the country. The public-private partnership modes were introduced in major public sectors, including energy, telecommunications, transport, and postal services. Remarkably, no PPP contract was canceled or re-nationalized. Privatization in energy is considered as successful, while in the telecommunication sector there were some obstructions, which through negotiations were practically resolved. There was a buildup of expertise in dealing with economic and legal aspects of privatization contracts. Both the positive and negative privatization cases strengthen the experience and confidence to go into deeper privatization with the existing contracts and start new ones, including in the water sector for which a strong political will was gradually formed (Polischuk 2008).

All of the above (the water sector reforms accompanied by structural changes in the water governance systems for solving the emerging need under market conditions to restructure the degrading infrastructure and the financial constraints, conditionality of international finance institutions for financial and technical support) created a firm ground for launching the privatization process of the water sector the Armenia (Harutyunyan 2014a). Schematically, a range of main driving forces behind the introduction of public-private partnerships in the water sector are summed up in Figure 4.2.

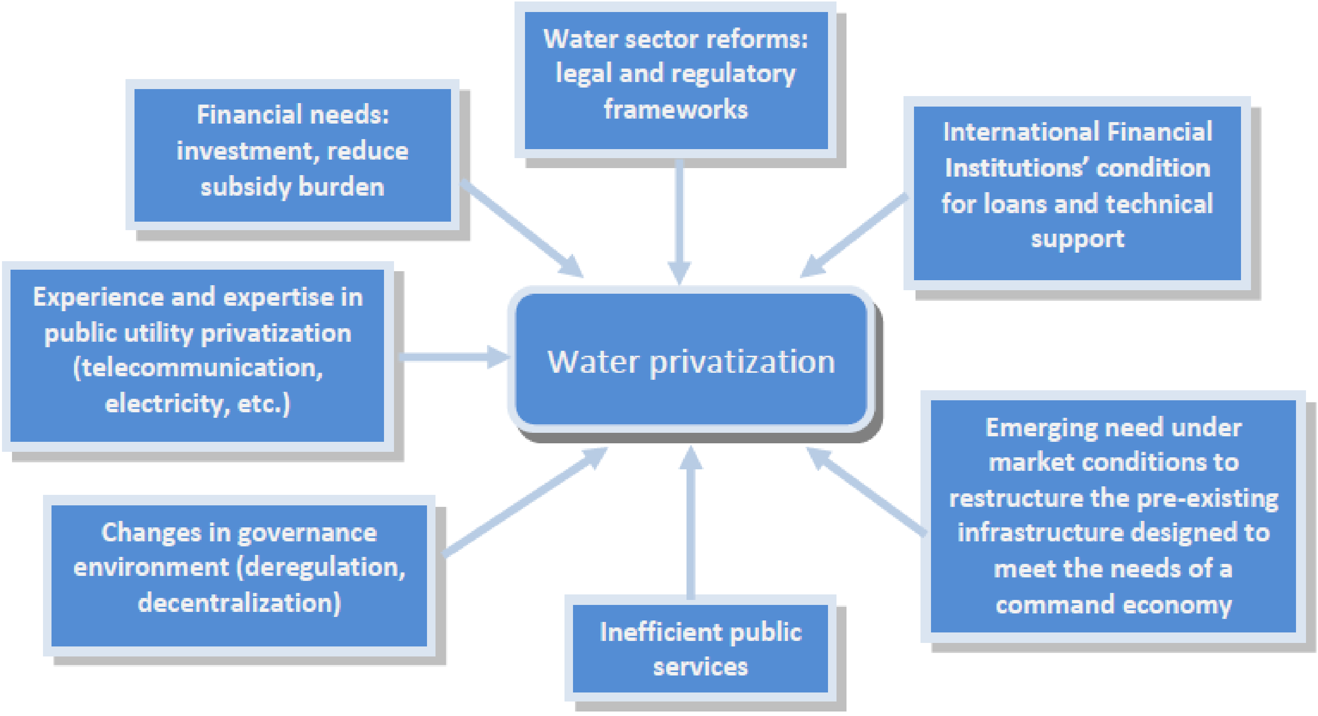


Figure 4.2 Driving forces behind water privatization in Armenia

4.4 Transition to public-private partnerships

This section is devoted to the analysis of the process of formation and evolution of the water privatization project in Armenia. It also describes the magnitude of penetration and the structure of public-private partnership modes along with the challenges and issues that arose. Special attention is given to the description of the community self-supply water system.

4.4.1 Step-by-step approach

Up to 2000, water utilities were exclusively owned and operated by the state. There were two companies, YerevanVodokanal and ArmVodokanal, providing water supply and wastewater services. YerevanVodokanal served the capital city Yerevan and the surrounding 52 villages. ArmVodokanal was responsible for water services to 47 towns and 250 villages. The rest was under the management of local governments. Before the establishment of the SWSC, the water sector was regulated by various national and local governmental institutions (OECD 2004). Significant modifications in the management arrangements of these water companies were introduced as a part of the water sector reform.

Even in view of the earlier success and accumulated experience with public-private partnerships, the Armenian government was careful in entering into public-private partnership arrangements in the water sector. 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. As a result, a decision was made to take a *step-by-step approach* in getting private participation in the provision of water supply and wastewater services. This approach supposed starting with a short-term management contract with the possibility of extension if the experience was successful. The first management contract 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.

The distinctive feature of privatization is the contract based on a list of performance indicators for the utility to meet. The list contains a number of indicators that are directly linked to metering, making it one of the main prerequisites for the further operation of water utilities.

4.4.2 First management contract: Yerevan Water and Wastewater Company

In 1998, the Government of Armenia and the World Bank negotiated for a Municipal Development Program that stipulated the Performance Based Management Contract for Provision of Water and Wastewater Services in Yerevan. As a result, a five-year *management contract* with Acea Spa Utility (afterwards A.Utility), a joint venture led by an Italian water operator, was signed in February 2000 and came into force in May 2000 (MY 2011). It provided water and wastewater services in the area of the capital city Yerevan.

The preparation of the contract lasted six months and cost 500,000 USD, which was financed by the World Bank loan to be repaid in later periods. Private company selection was done by two-envelop (technical and financial) approach. First, the technical bids were considered and selected. Then, the financial proposals were reviewed based on the sole criterion of the lowest price suggested by companies. Of eight shortlisted bidders three were selected for the final stage. The Italian A.Utility (Rome-based company comprising of Acea, C. Lotti and Associations and WRc) was finally selected. The total cost of this project was 35 million USD, of which 30 million USD was the WB loan support through its low-interest loan window for low-income countries. Indeed, it was a hybrid contract with elements of both management and lease contracts, which ensured participation of trustworthy water utilities in the bidding process (ADB 2008).

According to the contract, the private operator was responsible to manage a 25 million USD operational investment fund (financed by WB with further repayment condition) for ensuring the implementation of measures based on performance indicators. The private operator was also responsible for bringing in the international best experience in the operation and management of the Yerevan water utility. The contract stipulated 181 performance indicators, including metering, payment collection rates, energy consumption, water supply duration, etc. The operator was agreed to receive a 1.5 million USD performance bonus to cover salaries of the managing group with international experts. To ensure an adequate bonus payment, the PMU and A.Utility jointly hired an independent technical auditor as well as a financial auditor to review A.Utility's performance and calculate the required annual bonus (ESMAP 2011).

During the implementation of the first contract a number of issues arose relating to the identification of a clear baseline year data for performance indicators and the definition of the indicators. For example, the water quality indicator was not clear since the control points were not properly selected. The contract stipulated no change in the salary level of the company employees. However, between the bidding period and the start of the contract salaries were raised by 35%, which influenced the private operator's business plan. There was also complaint of too many indicators, which was initially set at 181 and later reduced to 125 indicators, of which 11 were used for defining the amount of compensation for performance achievements (OECD 2008). Thus, the implementation of the first management contract was not without problems, but allowed to learn much and get the experience to go further: a deeper and wider privatization in the waste sector.

It is very important also to bring the results of a quite an interesting report "Plundering the Yerevan Water Utility" by the Government Accountability Project, which gives a number of questions to be further explored in the field. According to the report, in 2002, the Major of Yerevan made a proposal to cancel the contract with the private operator because after two years of privatization there were no improvements stipulated by the contract and the number of complaint about unreliable services and contaminated water was escalating. As a result an Armenian Parliamentary Commission was established to make investigation. As a result, the following fraud and corruption practices of the private operator representatives and state officials were revealed using the WB money and under the WB's tolerance and collusion:

- *Manipulation of terms of project*

  During the first two years of the project implementation, the private operator did not succeed in meeting the targets. The performance level was quite below the agreed levels. However, the operator was awarded a bonus just by lowering the standards required. This was easily done, because the same person was the Director General of Yerevan Djur and the International Private Operator. The report describes how this unlawful actions also happened with the same person representing two parties.

- *Household water metering*

  Failed in meeting the targets, the private operator with the consent of local officials put the main focus of improving metering – as a primary and the most urgent implementation target. Households were made to install metering at their own expense. Yerevan Djur even registered a revenue of 13 million USD for selling the meters, which then disappeared from the financial documents of Yerevan Djur.

- *Damage to water infrastructure*

  The fraud practices benefited some individuals at the expense of the population. This negatively impacted the implementation of proper maintenance, rehabilitation and construction work. Technical experts were advising prior metering to improve the system pipes in order to avoid the total disruption of already the obsolete but still operating system due to "*closed taps*". The coping strategy of the population in Armenia for unreliable water services is to "open the tap" to immediately notice water supply moment for replenishing the containers. In many cases water tap remained open and water was running without care since water payments were fixed rather than consumption based. After installation of metering people started caring about water conservation. "Close the taps" on massive scales resulted back-pressure in water system, increasing pressure in the distribution pipes that did not stand higher pressure. As a result, within four years after privatization pipe breaks increased fourfold.

- *Old materials or cheap alternatives used for new constructions*

  There were cases documented with photographs, when the construction companies were installing old pipes (sold as scrap because of deterioration) rather than new pipes.

- *Constructions documented as done but not done in reality*

  Cases were documented and validated by site visits when construction worth 100,000 USD was claimed to be implemented but in reality was not in existence. There were cases documented with photographs when the construction companies were installing old pipes (sold as scrap because of deterioration) instead of new pipes.

- *Ghost international consultants*

  Other cases were documented and checked by site visits when instead of the 50 registered only 14 people were working during the reported period.

- *Financing of never diminishing electricity debts*

  The report presents a whole chain of a scheme for never diminishing electricity debt of Yerevan Djur. In short, starting from 2000, Yerevan Djur is almost every year receiving subsidies (3-5 billion AMD equivalent of 6-10 million USD) to cover its electricity debt which was actually canceled within the Integrated Finance Rehabilitation Plan by energy utilities, but which every year appears and then again disappears in the records of the water utility.

- *Manipulation with external auditors*

  The investigation also revealed discrepancy in the results of financial statement prepared by the international auditing company KPMG and Yerevan Djur accounting statement and with those of tax authorities. After request for further clarifications and information provision, the director of KPMG refused to cooperate

- *World Bank's tolerance and collusion*

  The report highlights evidence that the representatives of the World Bank were provided with evidence of unlawful and corruptive practices with tons of supporting documentation and evidence, but showed indifference or even collusion. Moreover, the Parliamentary appointee member of the Commission, who was constantly trying to draw the attention of WB officials to corruption issues, was himself put on the "blacklist" in the WB.

  The case was also brought to the attention of the WB official in Washington DC. However, the surprising answer was that it was a case of "medium" importance therefore the WB headquarter section would not follow it. Perhaps, the scales of fraud and money launder of several dozen million USD a year is not a considerable amount for the WB to bother much.

4.4.3 Going deeper: lease contract for Yerevan Djur

After the expiration of the management contract, backed by the support of the second World Bank loan programme, the government decided to build upon the achievements on the management contract and go into deeper involvement of the private sector in the Yerevan city water and wastewater service provision. The decision was based on the results of complex forecasting studies analyzing the impacts of various modes of public-private partnerships with consideration of various tariff options. As a result, an international announcement was made for a tender for the next period of the Yerevan city water service contract under the *lease contract*. In December 2005, a French water operator *Generale Des Eaux, Veolia Water* was awarded a higher-grade 10 year *lease contract* to manage water and wastewater system in

Yerevan. As a result, the Yerevan Water and Wastewater Company Closed Joined Stock Company were renamed as *Yerevan Djur*[6] company.

The analysis of the Yerevan Djur management contract has revealed the following aspects. Under the lease contract, the private operator is responsible for the operation and management of water and sewerage system in Yerevan, billing and collections of water payments from customers, and submission of reports according to the contract requirements. The government is the owner of the assets responsible for main extension and renovation. The private operator is already fully in charge of financing maintenance and repair investments, as well as acquiring new machinery. Contrast to the management contract, which was bonus based, under the lease contract the remuneration to the water operator is paid by water tariff in return to the lease fee (4 billion AMD) in total for duration of the contract paid to the contracting state agency. The contract also stipulates financial penalties for not achieving the performance indicators.

The lease contract framework of Yerevan Djur is presented in Figure 4.3. Initially, the lessor of the public-private arrangement was the Government of Armenia under the name of the SCSW. In 2009, the lessor rights and the day-to-day management were transferred to the Municipality of Yerevan. The SCSW is responsible for assets and project monitoring. The WB Yerevan Project Monitoring Unit (PMU) was established to manage the funds from loans. The PMU representatives participate and advise for investment projects, review and approve water utility reports. The regulator PSRC is responsible for tariff setting, the monitoring of the utilization of the tariff revision formulae, as well as controlling the quality of the water services supplied by water companies. An independent technical auditor is assigned by the contracting authority in consultation with the private operator. The auditor is

[6] Djur means *water* in Armenian

in charge of technical, operation and maintenance and management audit of the utility performance. As it can be seen, the system of a number of checks and balances provides a good base of transparency (Harutyunyan 2014a). Even if it can be regarded as a very important and significant achievement compared to the pre-privatization period, there is still a need for further improvements. In particular, the contracts need to better clarify the mechanisms for stakeholder participation in the project implementation and in procurement processes.

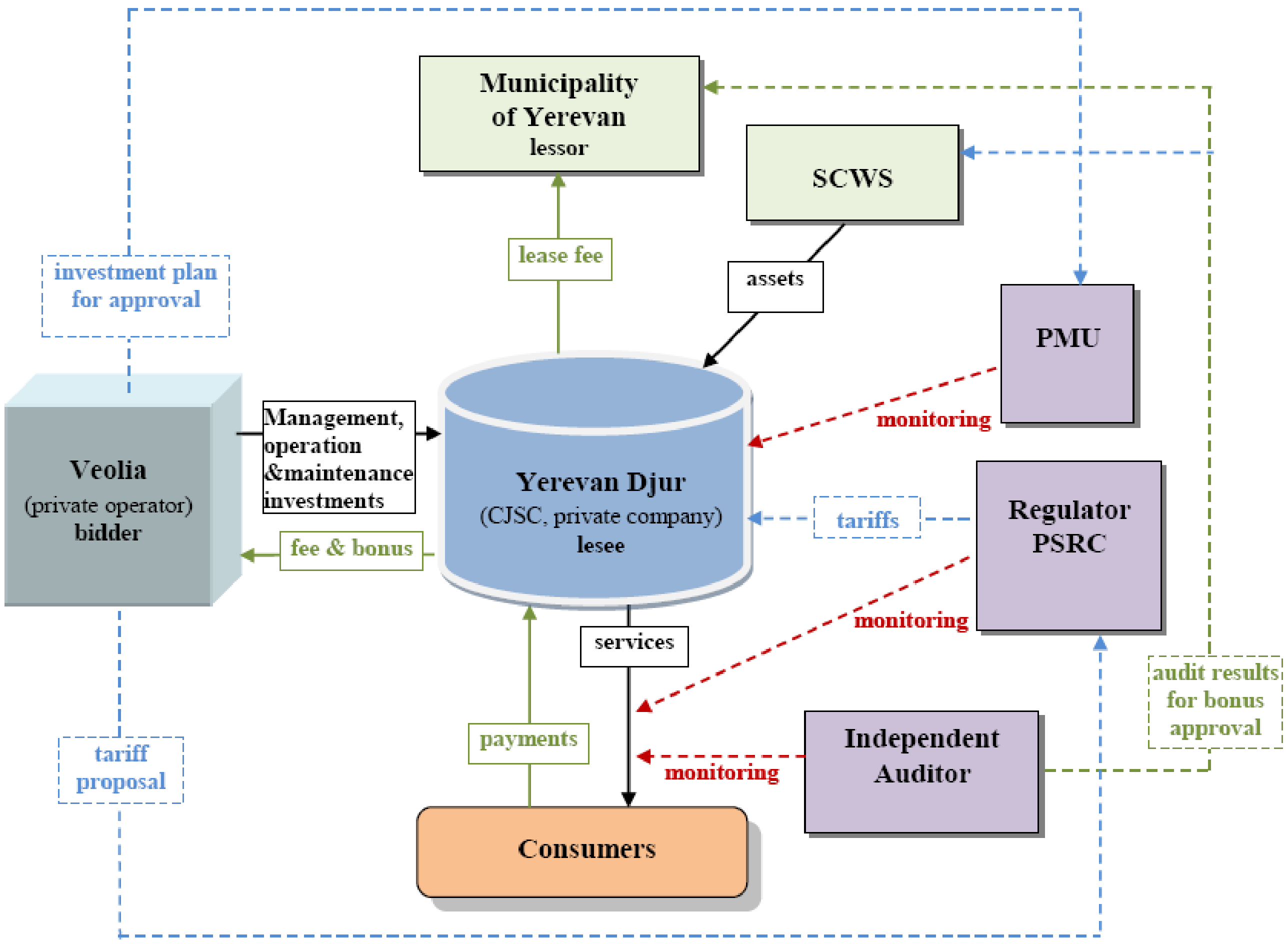


Figure 4.3 Centralized public-private partnership mode: lease contract framework of Yerevan Djur

A number During the fieldwork, a number of interviewed experts expressed the opinion that transfer to municipality introduced the conflict of interests and confusion in the management and monitoring process. The SCSW is an entity of state level, whereas the municipality is a commune. The loans for projects are governmental loans, and the municipality is not able to guarantee and take the loan, since they do not have the assets. Moreover, the municipality does not have the appropriate expertise and experience in managing water resources. They are more specialized in waste, street lighting and other services than water. They do not have a special department for it. Therefore, the experts were recommending returning Yerevan Djur management back to the SCSW. However, in view of the forthcoming parliamentary and presidential elections, no changes are envisaged in the nearest future. Hence, for dealing with institutional issues there is a need to better specify the roles and responsibilities between the national and municipal level to avoid the overlap of responsibilities. This will ensure more effective project management and enable water companies to perform their responsibilities more effectively.

There were also other issues revealed during the lease contract implementation period. For example, there were also disagreement between the PSRC and the Yerevan Djur on the matter of tariff revision since there was lack of clarity on water production and consumption estimation methodology based on which the tariff is set. The compromise was found and lower tariff was set (OECD 2008).

4.4.4 Going wider: other management contracts

After the successful design and implementation of the first management contract, the government gained confidence and accumulated significant expertise and experience. The continuum of public-private partnership contracts was supplemented with other management contracts for providing water supply and wastewater services in other regions of the country. These management contracts were of two types – *centralized* and *decentralized*. The centralized management mode was similar to the Yerevan Djur management contract described above. Under the centralized management mode, a private operator is employed or contracted for managing the operation of water companies. Under the decentralized management mode, the management and operation of the water service company is conducted with community involvement (Karapetyan 2006).

Armenian Water and Sewage Company management contract

The next management contract in the pipe-line was the Armenian Water and Sewerage Company (AWSC). The management contract was awarded to the French SAUR company in 2004 for operation till 2011. Tendering was again carried out in two stages based on technical and financial bids. Under this contract, revenue collection and commercial risks, as well as all capital and investment risks remain with the state (see Figure 4.6 in the subsequent section). The responsibility for assets management and sector investments lies with the government in the name of the SCWS. According to the AWSC contract, the private water operator is responsible for the management, operation, and maintenance of water supply and wastewater system in the service area. The AWSC is also responsible for developing and supervising investment projects.

Under the contract, the AWSC Management Board is assigned by the AWSC. It is in charge of the coordination and administration of all activities related to the fulfillment of contract requirements (Figure 4.4). The AWSC Management Board also approves the tariff adjustments before submission to the PRSC. The chairman of the Board is the chairman of the SCWS. Other members are the AWSC Direct, the head of the Contract Monitoring Unit and representatives of various ministries. The operations control and monitoring functions are carried out by the Contract Monitoring Unit (CMU) / Project Monitoring Unit. It is an agency with technical expertise assigned by the government to administer the management contract and advise the AWSC Management Board. The independent technical auditor validates the baseline values, monitors the implementation of performance indicators and estimates the amount of additional compensation for performance achievements. The auditor is selected by the CMU based on the tender. The CMU pays the auditor for its services.

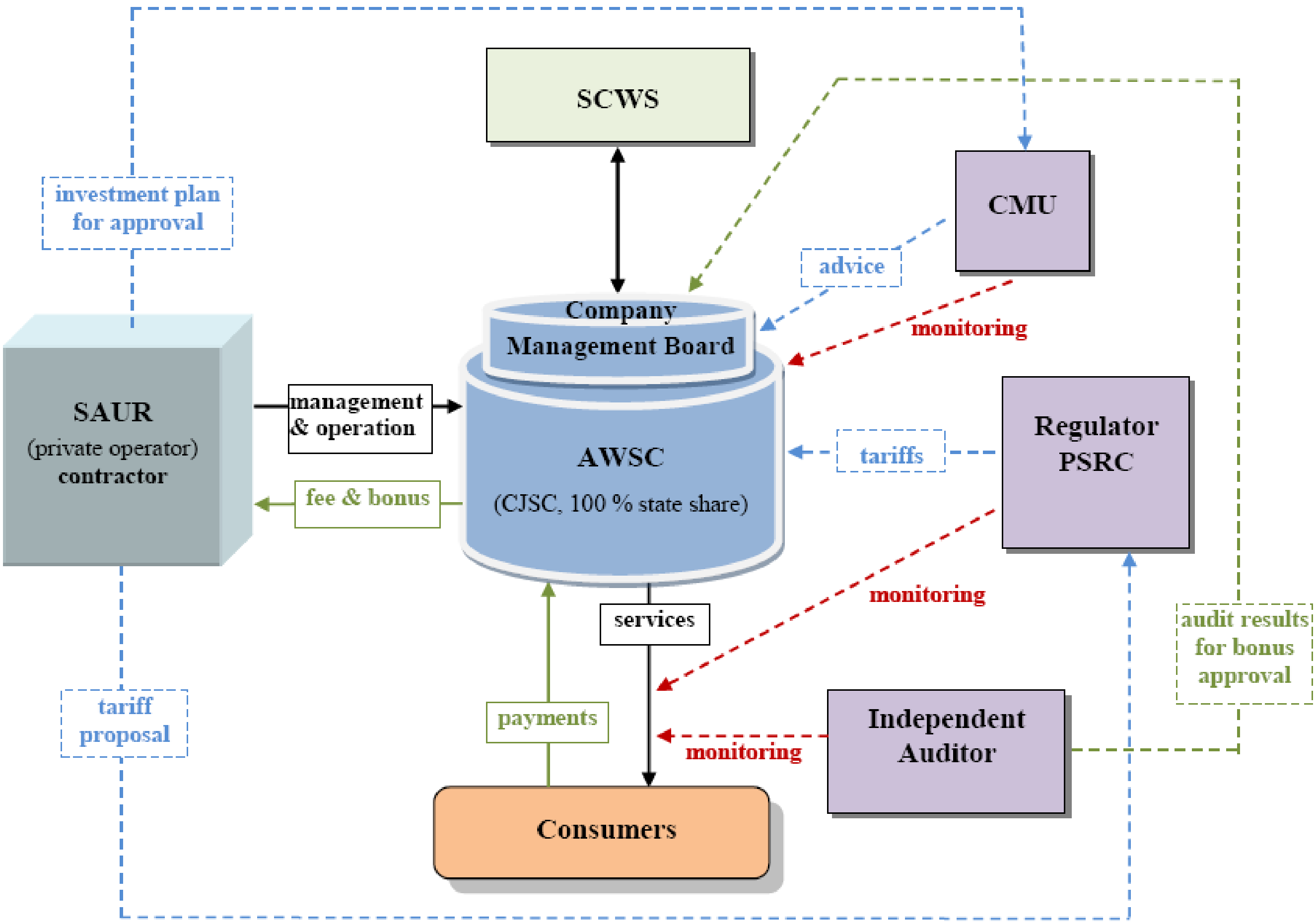


Figure 4.4 Centralized public-private partnership mode: management contract framework of AWSC

The management contract for the AWSC stipulates 25 performance indicators, of which 4 indicators are to be used for defining the compensation for performance achievements. It is argued that this simplification is required for better monitoring and incentive calculation. Moreover, AWSC area of service is largely spread in urban and rural areas with various infrastructure conditions. Therefore, the level of services varies. The recommendation is to set different targets for individual towns and regions to develop more targeted investment and action plans (WB 2011).

The contract stipulated two types of subsidies to be assigned to the AWSC for rehabilitation and upgrading of the water infrastructure. The operational deficit is to be covered by the Ministry of Finance. Capital investments are done with the support of a number of international donors – the World Bank, Asian Development Bank, European Bank of reconstruction, US Aid for International Development, etc. Remuneration of the private operator is done through a monthly fixed fee. Additional compensation is envisaged based on performance results.

Decentralized community partnerships

In addition to this centralized mode of public-private partnership, there is a decentralized community partnership mode functioning in three regions (marzes) of Armenia – Armavir, Lori and Shirak. There are three companies that are currently functioning under the decentralized management mode – Shirak, Lori, and Nor Akunq. These companies were established within the frameworks of cooperation between Armenia and Germany. The rehabilitation project is financed through the KfW Development Bank loan, grant and RA co-financing (Harutyunyan 2014a). Consultant services within the Project are provided by the German company GITEC Consult GmbH and construction works are being carried out by Dorozhnik LLC. Again as with the centralized public-private partnerships, a step-by-step approach was applied. After the successful implementation of the first privatization project in the Armavir region with the establishment of Nor Akunq company, two other similar public-private community partnerships were established. Three of these companies are operated by consortium of the MVV decon GmbH, MVV Energie AG (Germany) and AEG Service LLC (Armenia) (Figure 4.5).

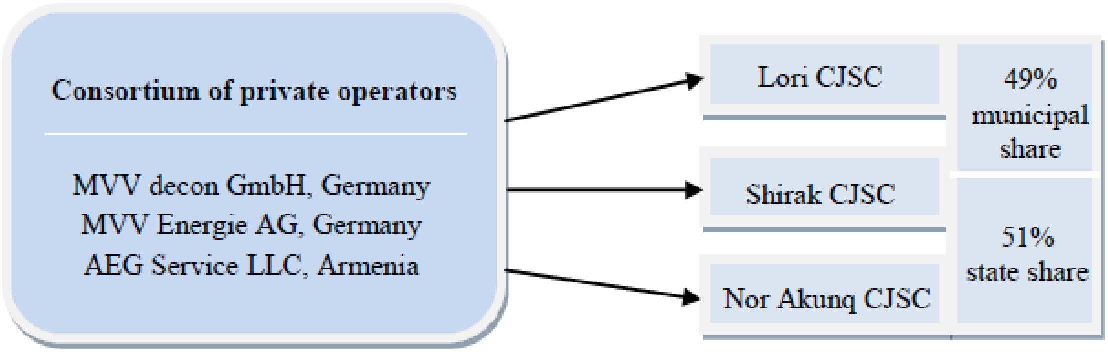


Figure 4.5 Mode of decentralized community partnerships

The institutional setup for these companies is similar to that of the AWSC. The difference is that instead of the AWSC Board, in this mode there is a Board of Directors, which jointly with the SCWS manages the operation of water companies. For each company, 51% of shares is state owned and 49% is community share participation with prospects of the gradual decrease of the state share. When the companies become fully operational and financially self-reliable, state shares will be transferred to the communities. The highest management body is the General Meetings of Stakeholders, General Directors of the companies are elected positions (Karapetyan 2006). The SCWS is responsible for assets and sector development with required capital investments to be funded by the government. The KfW also makes contributions to finance capital works. The control and monitoring of water company operations is conducted by the Project Monitoring Unit (WB 2011).

4.4.5 Risks

As it was noted before, the water sector in Armenia is currently characterized by the presence of two forms of the public-private partnership arrangements: management (centralized and decentralized community) contract and leasing. The primary difference between these forms of privatization is the degree of control by the state owner and the level of risk that is transferred to the private operator. Long-term contracts behind the water privatization processes involve risks such as operation and management risks, revenue collection and shared commercial risks, capital investment and financial risks and asset liability. These risks comprised an important part of the contract negotiation process that required careful consideration. They were allocated among the government and the private operator based on the technical expertise and the capability to mitigate them (OECD 2008). The deeper the privatization, the more risks the private operator has to take. As Figure 4.6 shows the higher-grade lease contract with Yerevan Djur entailed increased risks in return for allocation of more decision prerogatives, more control over the infrastructure and greater remuneration opportunities. The other water companies operating currently in Armenia are currently functioning under the management contract. Under these contracts, all the commercial risk and investment risk remains with the state. These management contracts still differ - centralized and decentralized community partnerships (Karapetyan 2006). Currently, the Government of Armenia is the owner of the assets and holds the responsibility of financial capital investments in the water infrastructure.

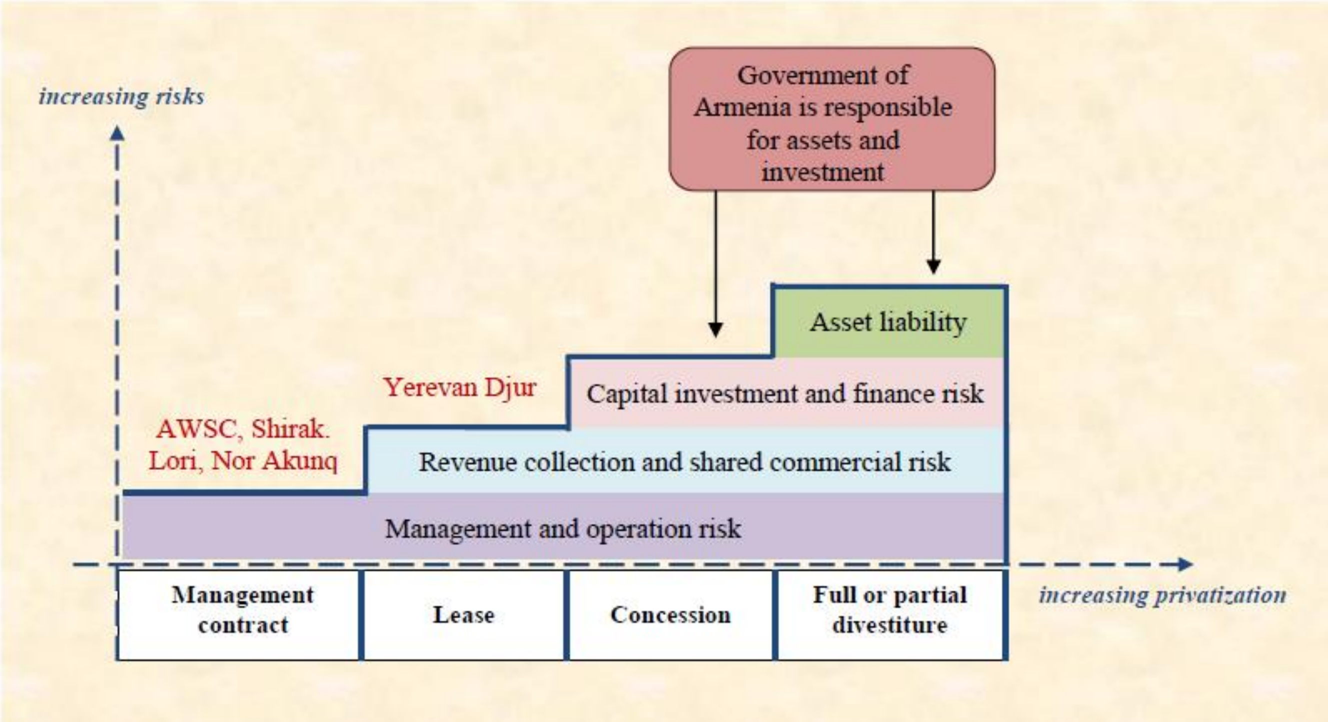


Figure 4.6 Continuum of risks and the depth and modes of public-private partnerships in the water sector in Armenia.

4.4.6 Magnitude of private sector penetration

The analysis of the privatization trends in the region has revealed that Armenia is among the NIS countries, which experienced the earliest and highest rates of penetration of private sector participation in the distribution of water supply and wastewater services. Figure 4.7 shows that 63% of the population in the country receives water services from water utilities that are operating under the private-public partnership arrangement (Harutyunyan 2014a). Remarkably, this is the third highest level after the UK (88%) and France (75%) recorded in European countries, where on average 20.5% of the population is served through PPP arrangements (Bakker 2003).

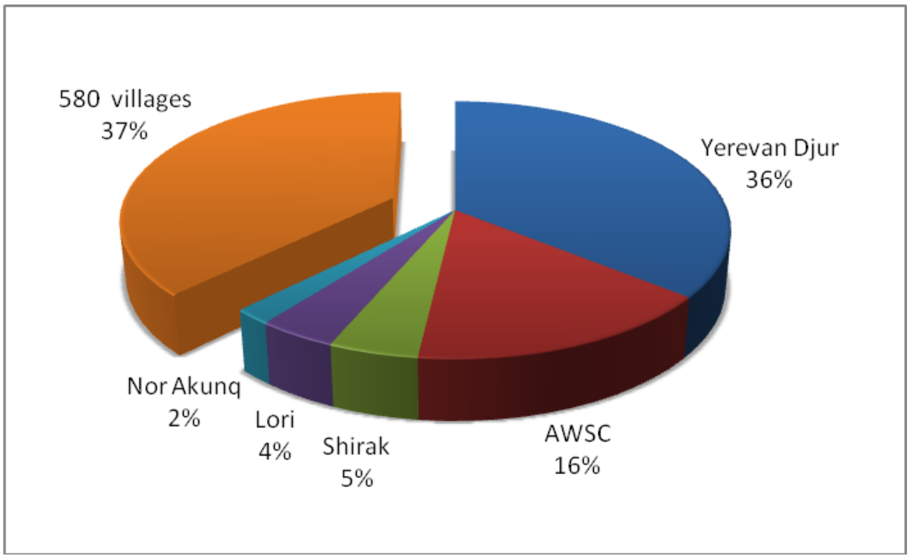


Figure 4.7 Population served by water utilities

Yerevan Djur is the largest water service company rendering services to Yerevan and neighboring communities, serving 36% of the population in the country. The service area of Yerevan Djur covers the capital city Yerevan and 32 surrounding villages. Next by size is the AWSC, which provides water services to 16% of the population in urban and rural communities in 10 regions (marzes). The three decentralized community partnership companies – Shirak, Lori and Nor Akunq – totally serve almost 12% of the population in the country (Harutyunyan 2014a). The rest of the population in 580 villages relies on their own independent systems to be described in detail in the next section.

4.4.7 Community self-supply water system: 580 villages

In Armenia, the majority of population is served by five water utilities operating under the private public partnership mode (Figure 3.2.5). Outside the service area of these utilities, there are 580 villages that rely on their own independent water supply governance system. There is limited information available on the management, regulation, and institutional structure of the 580 villages. This type of governance structure is the most unstudied (WB 2011). Hence, within the present research a special emphasis was done to elucidate water supply system in these settlements as well. The main methodological tool is personal observation and interviews with governors and local people of these villages.

Normally, the operation and management of village water supply is provided by local government or communities (hamaynks). They are also responsible for managing the assets and solving water issues on their territories (Roe et al 2003:89). The major issue with this type of governance is that communities or the local government has restricted legal influence on the utilization of their own water resources. Moreover, institutional and legal imperfections prevent them from implementing their direct responsibilities. For example, they do not have legal rights to charge water payments from the population. As a result, water supply is provided free of charge. As a number of interviewees mentioned, from time to time local government representatives are asking those who are relatively well-off to make some payment on a voluntarily basis. Thus, on the one hand, the village government is responsible for providing water to the population, on the other hand, it does not have legal bases to collect revenues and force people to pay.

The typical community *self-supply water system* in these villages is schematically presented in Figure 4.8. This scheme is based on the example of Akunq village in Syunik marz. The interview respondents confirmed that a similar system is in operation in almost all villages in Kapan (Tandzaver, Verin Khotanan, Nerqin Khotanan, Aradjadzor, Tortni Vaneq, Khlatagh, Norashenq, etc.). With some variation, the same may apply to other villages as well, including those where water is supplied by pumping. In the latter case, the water supply system costs increase due to energy costs, which is usually one of the most important reasons for the reduced hours of water supply. For example, in the Bagratashen village due to pumping costs and high water loses due to deteriorated water pipes, water is supplied twice a week for two-three hours. Due to the extreme poverty level of households, the village administration is not able to raise money from villagers on a regular basis to cover the costs and provide better water services.

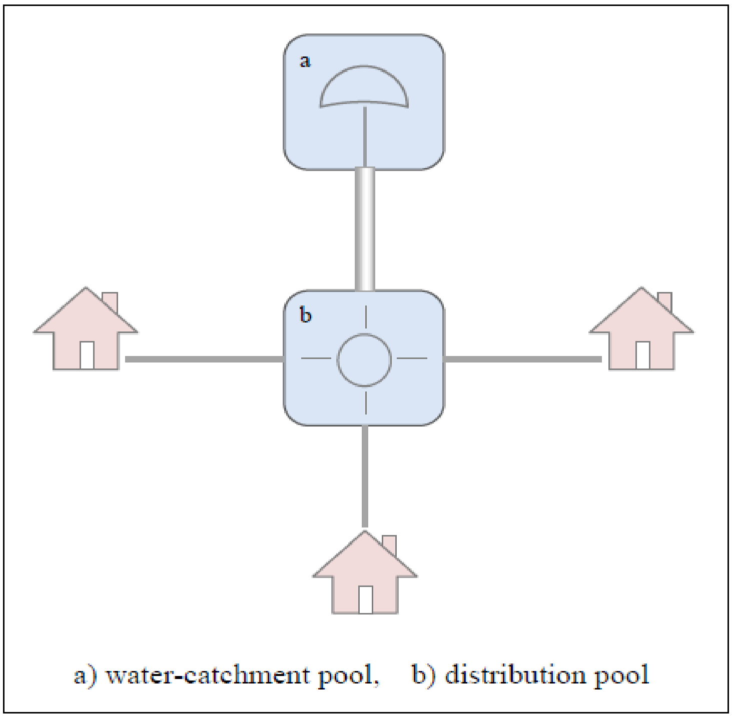


Figure 4.8 Community self-supply water system

According to the village governor of Akunq, a special water catchment pool made of concrete is constructed at the water source in the highest point of the village - up in the mountain (Figure 4.4.6). The water-catchment is covered and well protected, but water is not treated. With regard to water quality, the respondent reported that water does not smell, has no color and no water-related diseases were observed. From the water catchment, a water pipe (50mm) is paved to the distribution pool (Figure 4.4.6b). From the distribution pool lower diameter water pipes (25mm) are spread to supply water to individual houses.

Capital costs for the construction of the water-catchment pool and main pipe to the main distribution pool in Akunq village were financed by the World Vision development program. The distribution pool and the pipes to individual households were self-financed. There is no user fee for maintenance and operation. The system is managed and maintained by the villagers without external support. Money is collected on the ad hoc basis in case repairs are needed. Several times there were some discussions to introduce the water fee, but it did not develop further due to the high resistance. In general, water is available 24 hours. There are seasonal fluctuations of source performance. The water quality deteriorates especially in rainy seasons. There is also the shortage of water in dry or heavy use seasons. The respondents reported that almost all the households (around 85-90%) have piped water supply connection into the house or the yard.

Picture 2. Protected water pool in Verin Aghtanak village: Photo by Naira Harutyunyan

During the fieldwork visits it was revealed that in general the quality of supplied water and water services in the villages with independent community water supply system vary. In some mountain regions the interview respondents reported very good quality water, whereas others that get drinking water from rivers talked about sub-standard quality. The situation is worse especially in border regions. In several villages in the Tavush region, the interview respondents said that they have water for a couple of hours two or three times per week. Water is brown and has sediments. Therefore, for drinking purposes people filter and boil water or buy bottled water. In many cases, village water suppliers do not conduct biological treatment and disinfection of water. If the source of water is mountain springs, the quality is more or less acceptable, but this is not always the case. For example, during the field visits, the cases were revealed when water supply well was drilled two meters aside a polluted river with important industrial urban settlement upstream. Only partial mechanical treatment was applied without further biological or chemical processes.

Currently, the AWSC is in the process of expanding its service area. It is negotiating with neighboring villages not in its service area to connect to its service network with improved service provision quality. Indeed, in all of these villages the priority development project is water supply. However, the finances are the primary barrier. The fieldwork visits revealed an interesting phenomenon with regard to financing sources for rural water systems. It has already become a custom that before election the potential candidates make proposals to villages to sponsor some important measures for the village in return for the electoral votes. The government of the village organizes meetings with village representatives for making decisions on what candidate to support and on what conditions. Usually in villages with lack of effective and safe water supply, the priority for the potential measures is put on water provision or water infrastructure repair projects. There are also a number of international development projects that are targeting rural municipal and irrigation water supply. The most prominent is the USA Millennium Challenge Aid to Armenia, which was unfortunately cut recently due to the worsening democratic practices in the country.

Picture 3. Self-supply water well in Horom village: Photo by Naira Harutyunyan

Another noteworthy circumstance is that at the same time there is another tendency of disconnecting from the central supply systems. There was a case of a village where one part had central water supply with all the necessary fees and practices such as metering, while another part was transferred to the self-supply system fed from the nearby local water source and managed by their own means without a regular fee collected from households. During the fieldwork it was also discovered that some households within a village with central water supply refused to join the system because of having their own wells. However, there is a minimum standard of water services that the households have. Even though water quality may be good, it is still worse than in the case of municipal water due to non-treatment and poor quality of construction materials. There is also lack of safety. The advantage is that this water is free. For village households that use a lot of water for irrigation, animals and agricultural work this is an important factor.

Distinctive is also the case of Garni village. Garni mountains are the main and the highest quality water source feeding the capital city Yerevan and nearby regions. In Yerevan, Garni water is referred to as an indicator for the best water quality. At the same time, there were always problems with water supply in Garni village itself. In addition, there were a lot of debates with village people on the matter of household debts to Yerevan Djur company. Hence, since 2010 the village refused Yerevan Druj company services and transferred to the community self-supply system. The construction of the new water pipeline stretching 22 km for village population cost $3.5 million and was financed by the entrepreneur from abroad, who is from Garni by origin. There is a fee of 1000 AMD (approximately 2.5 USD) for operation and maintenance to be collected by the village administration. However, the field research revealed that some households are paying the fee but a lot of households are not. There are plans to install metering for those who do not pay or to introduce disconnections in order to motivate payment; however, some respondents are skeptical about this.

4.5 Summary of key findings and conclusions

This chapter has examined the transformation processes taken place in the water governance system in Armenia. It has described drastic reforms in the legal, regulatory, and institutional frameworks with simultaneous introduction of decentralization (transfer of roles and responsibilities from the central to local government level) and commercialization with the private sector participation (transfer of roles and responsibilities from the public to private sector). The chapter shows that the emerging need under market conditions to restructure the degrading water networks, financial constrains, structural changes in the whole governance environment and the conditionality of international finance organizations were the main driving forces of privatization. On the whole, the important highlights of the chapter are the following:

Environmental issues were not a priority

The main objectives of the water sector reforms were: to reduce dependence of the sector on state subsidies and donor assistance, to raise revenues from increased water payment collections, to restructure water utility debts, to enhance the management efficiency of water utilities and increase the availability and quality of water service. Environment related goals are not among priorities. They are more of a declarative nature or veiled under the goals of reducing operation costs. This was reflected, among other things, in the exclusion of non-revenue water in the list of performance indicators for any of the public-private partnership contracts. The justification could be the perception of the high level of water availability and the absence of metering, which according to decision makers makes it meaningless to target non-revenue which could not be estimated. However, the drastic increase in metering did not result in the introduction on a non-revenue water indicator in the performance indicators for the next period as well. Taking into account that non-revenue water is still very high in

Armenia, the incorporation of the non-revenue water indicator in the performance indicator list seems viable.

Major role of international financial institutions

Water sector reforms were conducted in the context of border agenda of structural changes which had been taking place in Armenia since 1994. It was conducted under a series of structural adjustment facility programs has been implemented in various sectors. Hence, international financial institutions (Word Bank, Asian Development Bank, KfW, European Bank for Reconstruction and Development, etc.) played an important role in the formation of a new water governance system. Water privatization was among the conditionality of the WB for financing the water sector development programs. Factually, privatization in Armenia was in some way a "no-choice option".

Strong political will for privatization

Tied support of international donors for financial and technical support and accumulated experience with public-private partnerships in other sectors of public services strengthened the political will of the government for introducing private participation into the water sector. But even in view of the earlier success and an accumulated experience with public-private partnerships, the Armenian government was careful in entering into public-private partnership arrangements in the water sector. This was dictated by a critical importance of clean and reliable water supply for human existence and health and dramatic impacts that failures may have. And a *step-by-step approach* was followed to pass through learning and to increase confidence.

Avoidance of sole-sourcing regime

Contrast to privatization in other sectors of public services, where the public-private partnerships were awarded in a sole-sourcing regime, in the water sector the selection of the private operators was done following a competitive bidding with a number of companies that took part in the tender.

Dominance of international private operators though with local partner companies

A peculiarity of public service privatization in Armenia is that the main players are foreign companies that are bidding for infrastructure contracts. In the water sector, three regional water companies operating under the decentralized community partnership models are jointly managed by a foreign and local private company.

Improved accountability and transparency, public information and participation

Innovations introduced into various components of the water governance systems include more effective stakeholder dialogue, better vertical and horizontal sharing of information amongst stakeholders, conflict resolution on a range of different scales and planning procedures. Transparency in performance of utilities is ensured by a number of checks and balances of private operator performance achievements through institutionalized systems of financial and technical reporting against performance indicators.

Plundering practices under tolerance and collusion of donor organizations

Unfortunately, Armenia is not an exemption in facing issues of plundering, including in relation to public-private partnership operation. Even though the quality of public-private partnership regulation significantly improved, there are still a number of issues with accountability and transparency which lead to suspicion of patronage and corruption. Plundering practices (for example, financing of never diminishing electricity debts, manipulation with external auditors, ghost international consultants, etc.) under the tolerance of and collusion with donor organizations were revealed.

Overlapping and duplicating functions

Problems of a conflict of interests due to overlapping and duplicating functions were also revealed. For example, transfer from the SCSW of lessor rights for Yerevan Djur to the municipality introduced a conflict of interests and confusion in the management and monitoring process. A need is emphasized to better specify the roles and responsibilities between the national and municipal level to avoid the overlap of responsibilities. This will ensure more effective project management and enable companies to perform their responsibilities more effectively.

Special provisions for tariff setting and cost recovery

Since the start of privatization there has been no considerable increase of water tariffs. Even more, tariffs were set based on a reduction schedule. According to the Yerevan Djur lease contract, the tariff methodology takes into account the affordability of population and follows the strategy of *burden sharing* between customers and the private operators. However, current tariffs cover only a part of the operation and maintenance costs. This issue is also aggravated in view of the end of grace period of loans and the loan repayment periods that are quickly approaching in the coming years. Provisions will have to be made for repayment. One of the options for meeting the challenges of providing funding to water sector systems to finance infrastructure and service provision improvements can be met by developing a specialized *"revolving fund"*.

Public private partnerships in the water sector are gradually going deeper and wider

There was a buildup of expertise in dealing with economic and legal aspects of privatization contracts in other sectors of public services. Both the positive and negative privatization cases strengthen experience and confidence. The implementation of the first management contract was not without problems, but allowed to learn much and get the experience to go further: deeper privatization with higher grade leasing contracts with the existing contracts and wider to start the new ones in the water sector for which a strong political will was gradually formed.

In fact, in the water sector Armenia that experienced an unprecedentedly rapid and massive privatization: within a decade reaching up to 63 percent of the population. Remarkably, this is the third highest level after the UK (88%) and France (75%) recorded in European countries, where on average 20.5% of the population is served through public-private partnership arrangement. Currently, the continuum of public-private partnership contracts in the Armenian water sector is marked with a centralized lease contract and centralized and decentralized management contract frameworks. The rest of the population gets water services from the community self-supply water systems, which have mixed results of success in terms of reliability and quality of water supply.

Whether rapid and widespread privatization in the water sector was successful and the impacts sustainable are the questions that the following chapters will be devoted to.

CHAPTER 5 PRIVATIZATION IMPACTS ON WATER UTILITIES

5.1 Introduction

This chapter examines the effects of privatization on the performance of all five water utilities currently operating in Armenia under various modes of public-private partnerships. *The top-down approach* is used to scrutinize the privatization issue from the aggregate (utility) level from the supply side, in which the water utility is the unit of analysis. The analysis explores the directional, magnitude and evolution impacts of water privatization in Armenia. The ex-post measurement of the sustainability performance of water utilities is performed along a number of key dimensions guided by basic sustainability principles. In particular, the differences between the public versus private water service provision, differences across various private service provisions, and differences within a single utility across time are explored. Both the relative and absolute measures on the sustainability performance of water utilities are derived and relevant scores for overall sustainability ranking among all studies utilities are developed. Moreover, the performance of Armenian water utilities is assessed on the international level. Apgar score for measuring the general health of utility operation supplements the assessment.

It is important to emphasize that this is a pioneer study since some of the assessments, such as overall sustainability assessment, international comparison, and ranking of water utilities is done for the first time.

5.2 Performance measurement

In many countries performance measurement is considered an important aspect of good governance. It plays an increasingly important role in the management of public utilities (Ndandiko 2010). The measurement of performance can be conducted following the *benchmark analysis* method. Benchmarking (ex-post and post ante) is widely used in the assessment of infrastructure performance which enables to make comparison of input processes and outputs between institutions or within a single institution over time and to motivate appropriate behavior by management (Slapper and Hall 2011, Pisu *et al* 2012, Harvey 2004:1). According to Vlasceanu *et al*. (2004: 26) benchmarking "implies specific steps and structured procedures".

There are different methods for benchmarking the infrastructure performance. Some of the approaches, referred to as the ex-post assessments, are based on actual results or evaluation of the effects of the existing stock on some selected variables, for example, for determining progress towards sustainability. Others are applied to evaluate the performance of new infrastructure projects or for forecasting the results of a particular action or a series of activities taking into account high, medium and low risk scenarios (Pisu *et al* 2012).

Ex-post benchmarking assessment

Taking into account the objectives, the research employs the ex-post benchmarking approach. Based on the aggregation level of data for the analysis, ex-post benchmarking follows two streams with appropriate techniques:

1. **Disaggregate level: performance on the level of each indicator**

   This refers to the procedure of measuring utility performance on the level of each core indicator included in the list of sustainability area indicators (Figure 5.2.1 in the subsequent section). The partial indicators technique is applied to get finer details on pre-privatization and after privatization observations.

2. **Aggregate level: performance on each sustainability area and overall sustainability performance**

   This refers to the procedure of measuring utility performance above the primary indicator level. It includes the process of combining through weighting, summing and averaging related indicators for obtaining a broader picture. The aggregation is done up to the level of each sustainability area (environmental, social and economic) and up to the overall sustainability performance index. Both the relative and absolute measures on sustainability performance of water utilities is measured, and relevant scores for overall sustainability ranking among all studies utilities are developed. The Apgar score for measuring the general health of utility operation supplements the assessment. Indeed, the sustainability performance analysis allowed for the first time to calculate the weighted summary of selected performance indicators for each company. This in its turn enables to rank all water companies and communicate their relative performance, which has never been done before.

For getting more understanding on the logic of analysis and data presentation in various sections of this chapter, more details on each method are presented in the appropriate sections preceding the data analysis part.

Sustainability areas

The sustainability areas and the choice of related indicators in the study is guided by the basic *sustainability* principle that is based on an ecologically efficient use of natural, social and economic resources. Taking into account local circumstances, the purpose and context of the research, as well as the associated need for functions of indicators (Seasons 2005), the selected core indicators are grouped as to fit into the assigned meanings within the three main dimensions, though not directly reflected in the names of indicators:

- *Environmental performance*: non-revenue water, metering level, water consumption and energy efficiency
- *Social performance*: water coverage, affordability of water, and continuity of water supply services
- *Operational and financial performance:* operating costs coverage, water payment collection efficiency, and labor productivity

The graphical representation of these ten core sustainability areas is presented in Figure 5.2.1. The first group of core indicators on environmental performance denotes the relationship between the water utilities and the environment. It includes water consumption, metering, non-revenue water and energy use as measurements of the environmental impacts of the organizational process. The second set can act as the barometer for the social performance of water utilities reflecting customer satisfaction and product quality or the interest of the population. The third group of indicators of operational and financial performance or economic performance presents a proxy demonstration of the financial and economic sustainability of water operators (Harutyunyan 2015).

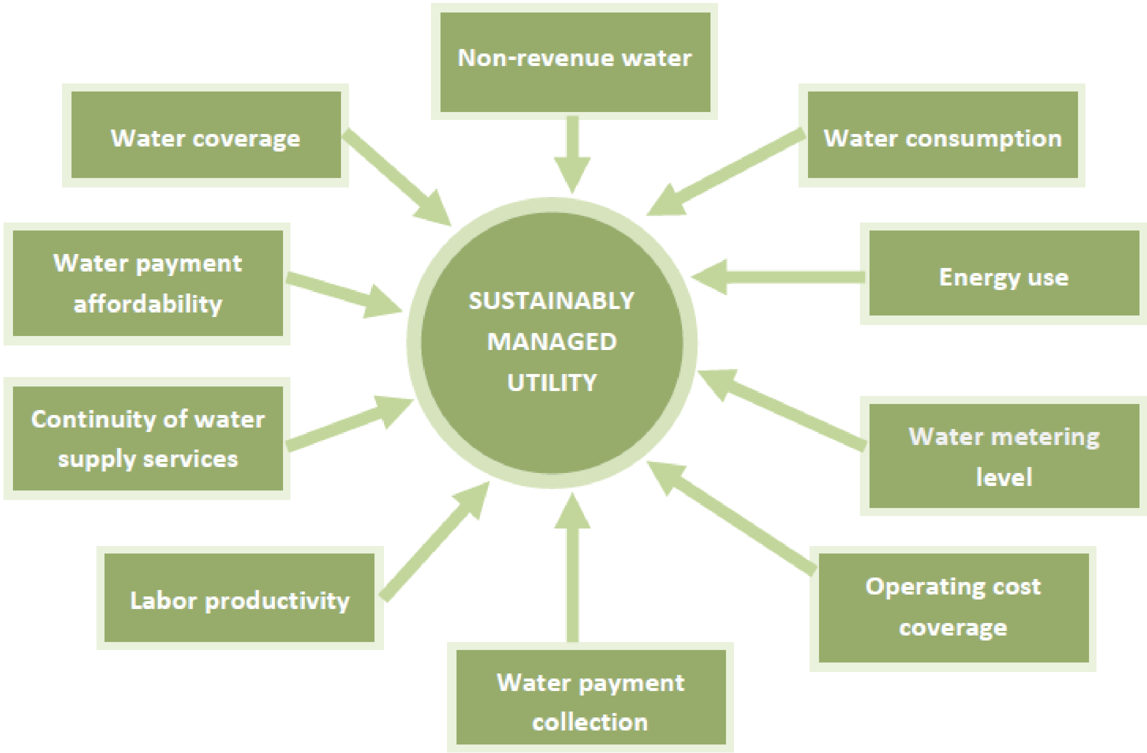


Figure 5.2.1 Ten core sustainability areas

It is important to note that sustainability can have different meanings and different applications in different contexts and there is no universal way or universally accepted standard for measuring sustainability (Slaper and Hall 2011, NCHRP 2011). In assessing sustainability each entity defines sustainability in its own unique way and develops an appropriate measurement framework from a variety for assessing sustainability performance (NCHRP 2011). At the same time, this can be regarded as strength since it enables to tailor the common framework to the need of a particular entity (governmental, private or academic), specific projects or policies (infrastructure or education), or various locations (urban, rural, or country) (Slaper and Hall 2011).

5.3 Data considerations

The ex-post benchmarking analysis is based on data collected through desk research supplemented by the analysis of interviews conducted during the fieldwork. Availability of publicly accessible and reliable data is the major constraint in many countries of the region. Fortunately, this situation is gradually changing and hopefully in the coming years more data could be publicly available. In Armenia, while water utilities are gradually providing more information, in some cases it is far from being satisfactory. There is still rather limited availability of good data on core variables, especially for earlier periods against which to measure performance of water utilities after privatization. This suggests that earlier data may not be as comprehensive as later data.

The data for the analysis is obtained from the International Benchmarking Network for Water and Sanitation Utilities (IBNET) - the World Bank's data library for water utilities. IBNET provides comprehensive, disaggregated and consistent data on many important variables over time across a set of water utilities. The dataset is based on a common set of data definitions, which is critical for making performance comparisons. Whenever possible, IBNET data is validated against data provided by water operators and the state regulatory agency. In case of significant variations, IBNET data is replaced.

The data analysis based on the benchmarking method (top-down method) is, however, limited to the source of variation at the municipal (utility) level and not to micro household data. Therefore, the research proceeds with the estimation of the privatization impacts in the water sector using micro-level data collected through the household survey, to be discussed in the next section.

The study is based on the analysis of five water utilities currently operating in Armenia under various contractual forms of public-private partnership (Table 5.1). The analysis does not cover the operation of 560 village associations and agricultural water service companies. The study examines the drinking water supply focusing on the residential water use sector. This aspect needs some more explanation taking into account the transitional processes relevant to Armenia. Since the late 1980s with the collapse of the Soviet Union, industrial and agricultural water demand has experienced a major decline due to drastic a reduction of activities in these sectors and the closing down of many enterprises. According to data of the National Statistical Service of Armenia, industrial water use constitutes on average 8% of total water use in Armenia within the last 20 years. This strengthens the importance of residential water users in the total demand for water and for revenue generation of municipal water utilities. However, with the recent economic revival the share of industry, in contrast to agriculture, in the Gross Domestic Product of the country is gradually increasing, which is likely to stimulate the subsequent rising demand for water and the need for further studies for this sector.

Table 5.1 Water utilities, privatization contracts, operators and assessment periods

Utility name	Contractual forms	Operator	Service Area	Period studied*
Yerevan Djur	1) Management Contract	A.Utility (Italian consortium)	Yerevan city and 32 rural settlements	2000-2004
	2) Lease Contract	General des Eaux, Veolia Water (France)	Yerevan city and 32 rural settlements	2005-2010
Armenian Water and Sewerage Company	Management Contract	Saur (France)	37 urban and 280 rural settlements	2004-2010
Nor Akunq	Management Contract	MVV (Germany) & AEG Service (Armenia)	12 urban and rural settlements	2003-2010
Shirak Water and Sewerage Company	Management Contract	MVV (Germany) & AEG Service (Armenia)	Gyumri city, 38 urban and rural settlements	2005-2010

Utility name	Contractual forms	Operator	Service Area	Period studied*
Lori Water and Sewerage Company	Management Contract	MVV (Germany) & AEG Service (Armenia)	17 urban and rural settlements	2005-2010

* The first year is the year “before” privatization, the second year is the last year (“after”) for which data was analyzed

To assess whether and how newly formed public-private arrangements in the water sector in Armenia have helped to improve water utility performance as compared to public utility performance, the paper compares the performance of water utilities for two periods: the year “before” the private operator started operation, which differs for each company, and the year 2010 for all companies denoting the situation “after” the privatization. It is worth noting that within the study period, the Yerevan Djur water utility experienced public-private sector involvement under short-term management contract and a long-term lease contract. For Yerevan Djur the year 2000 is taken as the year before privatization contract took place and the year 2010 is taken as the last year of operation for which data was assessed.

Where needed, the discussion is supplemented by deeper analysis of specific issues, such as the tariff policy or the water metering process, which played an important role in analyzing the performance of water utilities. In some cases, regional or international studies and comparisons are also highlighted.

5.4 Results and discussion

The analysis starts with methodological considerations. Then it proceeds with presentation of ex-post benchmarking performance results on the level of each core indicator that are appropriately grouped into sustainability areas. Special attention is given to the non-revenue water issue and to the investigation of the process and impacts of water metering.

Methodological considerations

Specific analytical benchmarking techniques for estimating the impact of utility management models on water utilities include partial indicators methods, total factor productivity, data envelopment analysis, and statistical techniques, such as ordinary lease squares and stochastic frontier analysis (IBNET 2005). Application of various benchmarking techniques in various countries in water utility management is exemplified in Peru, Canada, France, Italy, etc. (Lin 2005; CWWA 2009, Kirkpatrick *et al* 2004, Woodbury and Dollery 2003). The choice of methodological approaches with varying degrees of sophistication depends on the research objectives, data availability and practical circumstances. More complex statistical techniques require large data sets for controlling many factors that can impact utility performance and for obtaining reliable results. At the same time, less complicated techniques usually are less data intensive and make assessment more traceable and the resulting analysis less complex.

Selection of methods and indicators is based on objectives, practical circumstances and availability, accuracy and comparability of data. Availability of consistent and reliable data can be a limiting factor for sustainability performance measurement (Slapper and Hall 2011).

The analysis rests on the *counterfactual-based approach* following a conceptual comparison of water utility performance "before" (the counterfactual) and "after" privatization. The counterfactual analysis is a widely used analytical technique in environmental policy analysis (Lankoski and Ollikainen 2011, Foster *el al* 2005). It allows integration of different impacts of the reform into a single methodological framework (Foster *et al* 2005). Comparison of the counterfactual with the current case highlights the significant factors explaining the impacts of policy. The elaborate approaches extrapolate historic trends in the years "before" the privatization and compare them with the trends "after" the privatization. In this case the impact is derived as a change in the long-run trend of various performance factors. The major methodological challenge with the counterfactual analysis, like with many other methodological techniques, is the availability of data for pre-reform periods limiting the possibility to establish historic trends (Lankoski and Ollikainen 2011, Slapper and Hall 2011, Foster *et al* 2005). Indeed, data limitation is the key reason why the studies in the context of privatization are ambiguous and few (Gassner *et al* 2007). Hence, in the context of the present research setting, the choice of methodological approach in this research is constrained by the lack of comprehensive historical data for earlier periods and the small number of utilities that does not allow application of more complex econometric tools. Meanwhile, ACCC (2010) asserts that no one approach to counterfactual analysis is more valid than another. The applied approaches are case-specific and should reflect the specific circumstances of individual evaluations (Lankoski and Ollikainen 2011).

Hence, dictated by the circumstances, the counterfactual (the "before" case) in this study was constructed on data for the year before the private companies launched their operation, whereas, the "after" case is based on data for the year 2010 (the latest year for comprehensive data is available). The *partial indicators* technique is applied to estimate summary statistics for the specific core indicators for the "before" and "after" cases. The specific core indicators consist of ratios representing key aspects of water utility activity. The difference between the "before" and "after" cases represents the effect of privatization in the water sector.

In general, the contention related to the performance indicators technique is that it is restricted in the possibilities for making profound analysis of associations among different factors (IBNET 2005). Nonetheless, the advantages are availability of data from different sources, and the possibility of presenting information in trends and patterns over time (Seasons 2005). Moreover, these are apparent techniques for conducting manageable performance analysis and comparisons. These methods are currently widely used especially as a starting point for assessing utility performance (Clarke *et al* 2009, IBNET 2005, Marin 2009, Corton 2003), which is exactly the case for Armenia, where water utility performance evaluation is currently in its formative stages and there is still lack of research in this area.

5.4.1 Economic performance

Performance indicators clustered under the dimension of the operational and financial performance combine collection efficiency, operating cost coverage, and labor productivity. For the purpose of the present research, this set of indicators provides a proxy demonstration of financial and economic sustainability of water operators. In the business context, operational performance is usually measured by assessing the operational efficiency, which shows the capability of a company to provide services to its customers in the most cost-effective manner yet ensuring the high quality of its service. Measuring efficiency of utility operations helps to identify excess and wastage of resources (workforce, technology and management processes), and opportunities to achieve higher profits and increase financial health by implementing targeted improvement actions.

Collection efficiency

Collection efficiency is measured by the total amount collected as a percentage of the billed amount. Nonpayment for water services was one of the main issues for water utilities. In the late 1990s, collection rates were less than 20%. Payment enforcement was hampered by the lack of water consumption metering and by water system characteristics that complicate the disconnection of water supply (Lampietti et al 2001). Moreover, due to the collapse of the industrial base, the importance of household water users increased for revenue generation of water utilities. Therefore, the water sector reform that featured with transition to the public-private governance structure defined the increase of payment collection rates as one of the primary indicators in the performance based contracts for all utilities. As shown in Figure 5.4.1, under private management all water companies managed to achieve a significant increase in the water payment collection rates. On all utility level, water payment collections ascend 80% in 2010. As in the case of some other indicators, the leader is the smallest company, Nor Akunq, which reached a collection rate of 98 percent, and outranged by 16% Yerevan Djur company that operates at municipal level. This in on the background that in Yerevan, generally, wealthier people are concentrated than in other regions, which enhances the importance of the small Nor Akunq company's progress. Indeed, revenue collection in Armenia is exceptionally high when comparing weighing against international and regional experiences, manifesting a good performance (WB 2011).

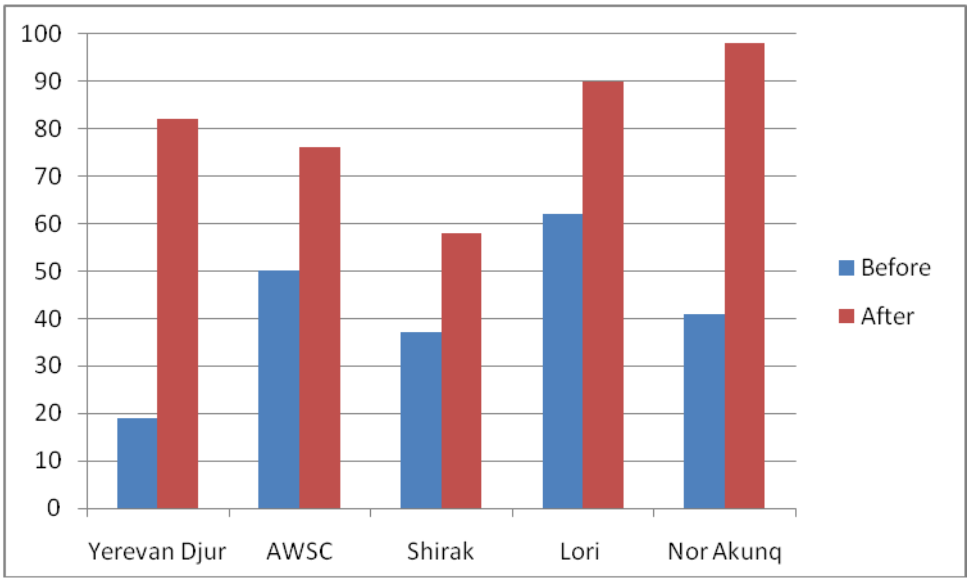


Figure 5.4.1 Collection efficiency (%)

[Hereinafter, the "before" indicates the "before privatization" case and the "after" indicates the "after privatization" case.]

It is worth mentioning that the reverse of the chronic loss-making pattern and the improvement of payments for water services was supported by implementation of a number of measures, including massive installation of meters, transition to metered based water pricing, debt restructuring and partial cancellation stipulated by the Law (2000) on Restructuring Indebtedness (in more detail described in metering section), the introduction of the balanced system of sanctions for non-payments up to disconnections.

Labor productivity

Efficiency in the use of labor was estimated by labor productivity measured as number of employees to number of water connections and labor costs to total costs. Generally, staff costs comprise a key part of operational costs, which makes them an important aspect to consider. Understanding the situation with staffing level supports in picturing any over- or under-staffing in a water company. As seen in Figure 5.4.2, except for one case with the smallest Nor Akunq company, under private management and operation, water utilities improved labor productivity. In general, after privatization, big water utilities have fewer employees per connection than small companies with fewer connections. The increase of the number of staff may be explained by the different housing stock and approach to service connection.

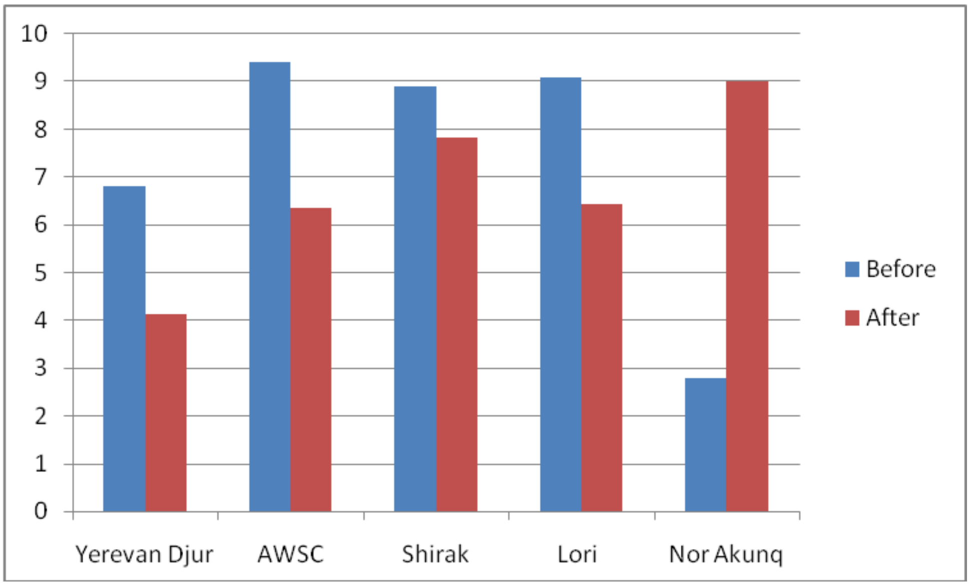


Figure 5.4.2 Number of staff per 1000 connection

Despite the decrease of number of staff per 1000 connections, the indicator for staff costs expressed as a percentage of total operational costs increased for all the companies (Figure 5.4.3). Labor costs are becoming gradually a major component of operating costs. Nor Akunq experienced the highest increase in labor costs compared to "before" case, reaching as high as 39 percent. Nor Akunq has also the highest rates of sourcing-out some of its services to subcontractors, meaning that the level of this indicator would be even higher if outsourced employees had been included in the these figures.

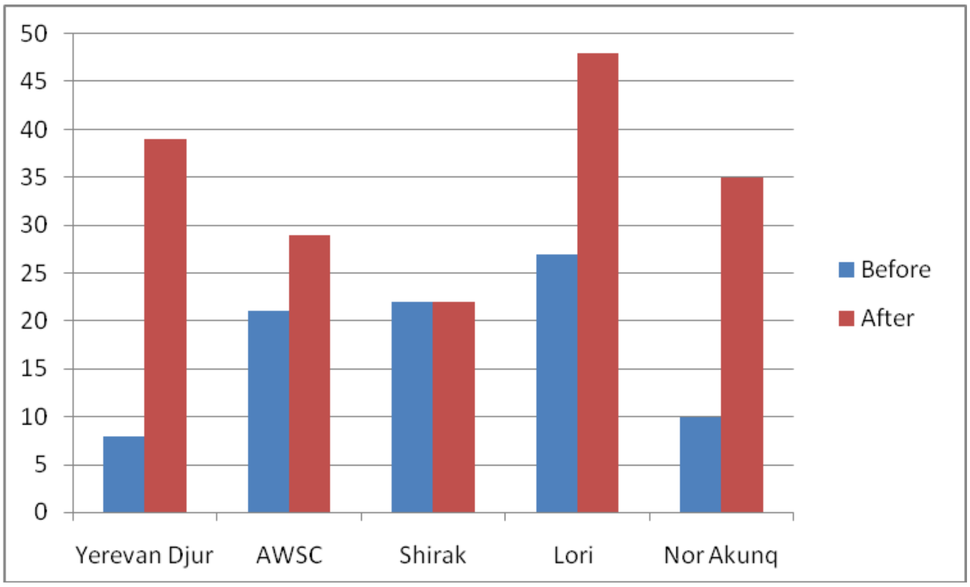


Figure 5.4.3 Labor costs as percentage of operational costs (%)

In some cases staff management is affected by the conditions of privatization contracts. For example, the salaries of the Yerevan Djur employees rose by 35% in the period between the tender and the starting date of the contract. Under the contract, the local staff salaries are to be kept unchanged for at least the first year of the contract (OECD 2008). Under the management contract of AWSC, the hiring and firing of the staff was the private contractor's responsibility from the beginning.

Operating cost coverage

Operating cost coverage presents the ratio of total annual operational revenues to total annual operating costs. Operation costs exclude depreciation, interest and debt service. This indicator is used to measure the ability of water companies to generate revenues that can recover operating costs and answer an important question: “Do revenues exceed operating costs?”

Figure 5.4.4 shows a mixed picture on the performance of Armenian utilities on this indicator. Two companies, Nor Akunq and Lori, have improvements on this indicator as compared to the "before" situation. Lori managed to increase the cost coverage ratio even while experiencing a tariff rate reduction in constant terms. Despite the improvement, Nor Akunq is still unable to recover the operating costs, which is the case also with AWSC and Shirak. AWSC that operates in a large area encounters high fixed costs, and higher network investment requirements. Yet, Yerevan Djur reduced its capacity to generate revenues exceeding the operating costs. From the highest position in the "before" case, Shirak experienced a drastic worsening of its capacity to cover its operational costs. Decline in operation cost coverage signals the reduced capacity of water operators to make further investments and increased pressure for public money.

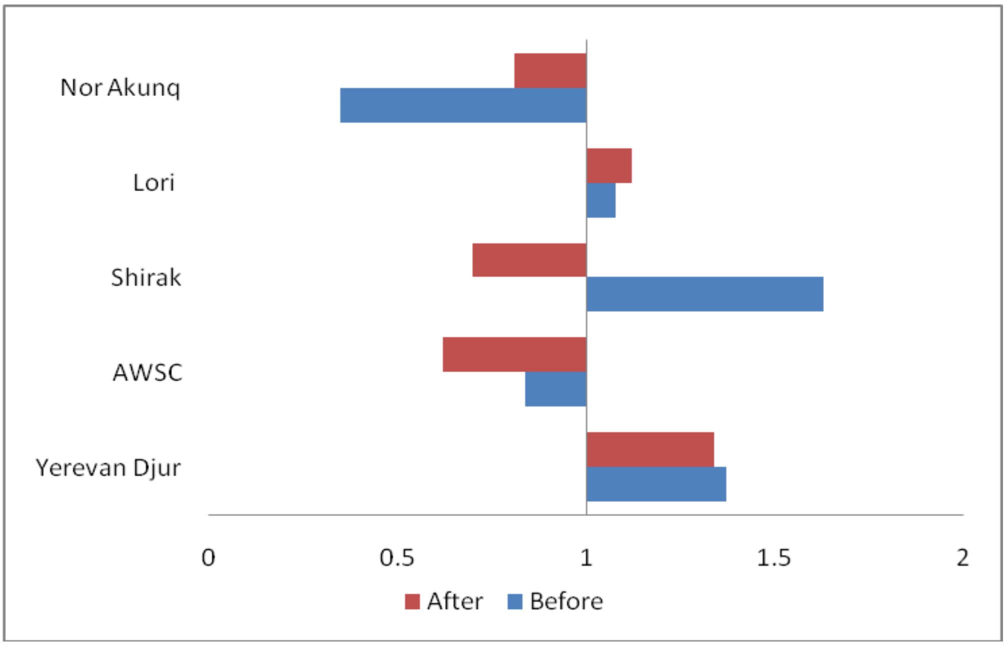


Figure 5.4.4 Ratio of operational revenues and operational costs

[If revenues exceed costs the ratio gets a value over one, and vice versa.]

A number of factors such as tariff rates in place, collection rates, costs of inputs, population density influence the capacity of companies for recouping operation and maintenance costs. While some factors are under the control of the water operators, others are not, for example, tariffs. In Armenia, tariffs are set by an independent governmental body - the Public Service Regulatory Commission, which is responsible for public utility regulation in the country. Within the study period, tariff rates in constant 2000 prices decreased for two utilities and increased for the smallest utility and two big ones (Figure 5.4.5).

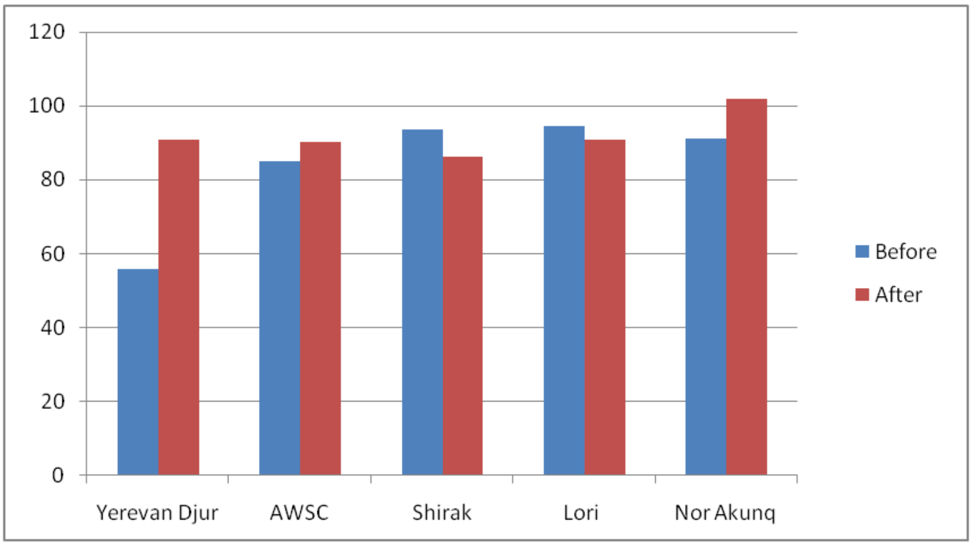


Figure 5.4.5 Tariffs (Armenian dram per cubic meter) in constant 2000 prices

Even experiencing reduced water tariffs in constant terms (Figure 5.4.5 above) Lori increased efficiency gains thanks to implementation of cost reduction actions through higher productivity (Figure 5.4.6). Together with Nor Akunq, it managed to improve its operating cost coverage (Figure 5.4.4 above). Interestingly, this is not the case with Yerevan Djur (Figure 5.4.6), which did not succeed in getting efficiency gains despite having the highest level of operating cost coverage compared to other operators. Shirak and AWSC companies also operate with efficiency losses.

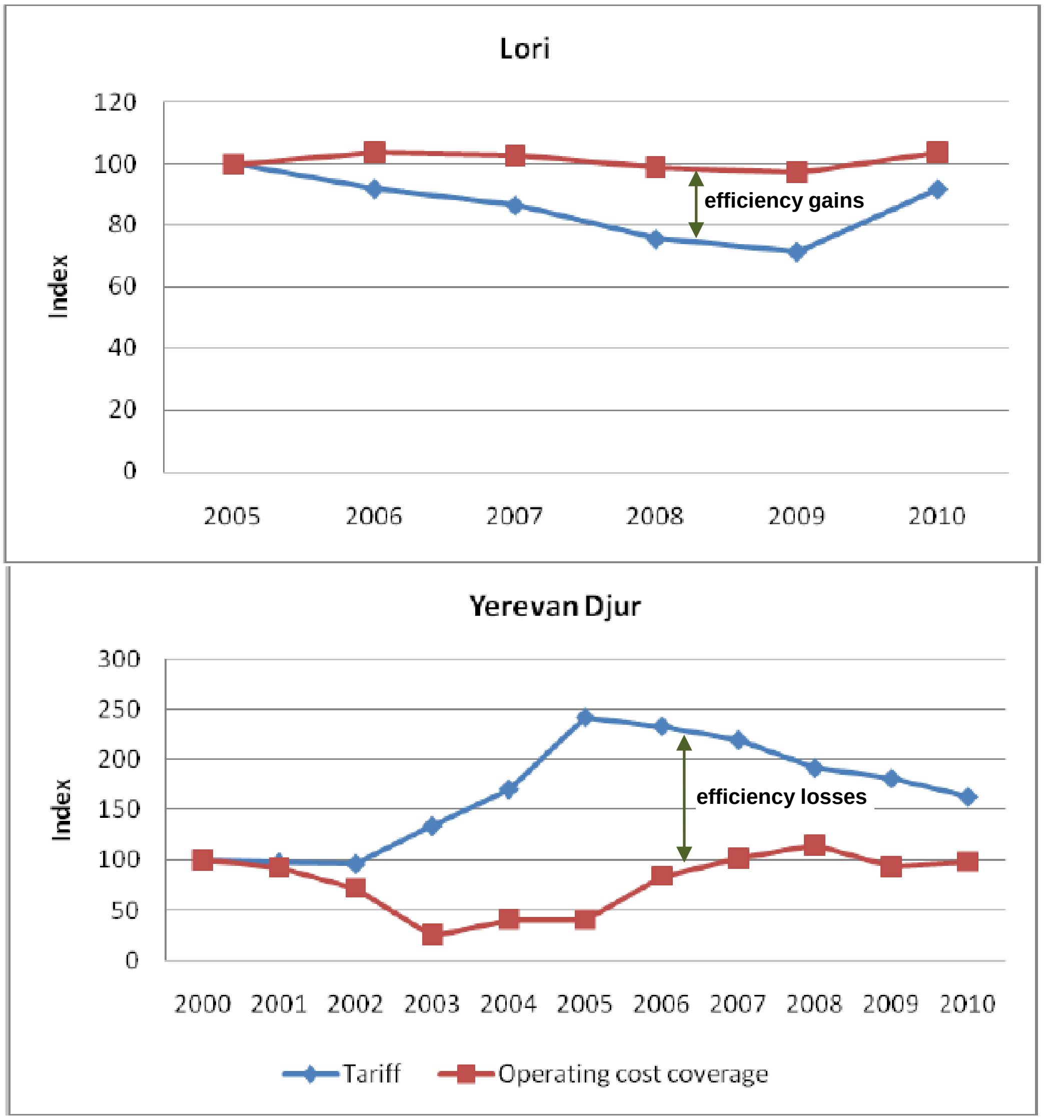


Figure 5.4.6 Efficiency gains/losses

An important factor to add here is that every water utility has a different tariff structure based on costs, provision of water supply only or water supply and wastewater treatment provision, etc. for example, tariffs for Yerevan Djur are supposed to be the lowest because it serves the largest concentration of urban population. However, its tariffs are higher than those of AWSC because it incorporates wastewater treatment costs as well, which is not the case for all other utilities. Taking into account the importance of tariffs within the context of cost recovery, operational efficiency and the financial health of companies, the next section is devoted to a more detailed analysis of tariff policy issues in Armenia.

Tariffs and cost recovery

Prior to the reforms and the introduction of water metering a uniform monthly charge system was used in Armenia for municipal water that included residential, institutional, and commercial water. The charges set in 1998 were at a level that did not allow covering operational costs of water utilities. Various studies showed that the full cost recovery of operation would require a three-fold tariff increase (OECD 2004). Because of political resistance and the potential heavy impacts on the living standards of the poor, water sector reforms could not rest much on increasing water tariffs and enforcing a rigid bill payment discipline for improving revenue generation and reduction of state subsidies. Hence, the initial stage of the water reform was planned to proceed with improved water services, a significant rise of payment collection rates and modest tariff increase.

Initially, it was suggested to introduce an increasing block tariff system with lower tariff for all customers for securing minimal affordable usage and for encouraging water conservation. However, the government proceeded with the introduction of a volumetric uniform tariff at a fixed rate per unit of consumed water. Massive metering enabled rapid transition to the new volumetric pricing system. Retail prices varied depending on the region and availability of meters. Metered tariffs were the same for all users. If water was not metered, customers were charged based on records of building block meters (to be installed at the expense of water utilities) and costs shared by building inhabitants or a standard consumption – on average 200-250 liters per person per day for centralized water supply and 50 liters per person per day for street standpipes. All the utilities had different tariff rates based on different cost calculations.

A critical factor revealed by the 1999-2000 household survey was that households were not willing to pay for water because they believed that they were charged for much more than they consumed. Only 13% of surveyed households regularly paid the water bills. With less than 1% of households having water meters, self-reported water consumption was considerably underestimated, with the average household thinking that they consumed 23 liters per capita per day instead of the normative of 250 liters per person per day (Lampietti e*t al* 2001). Lack of metering hindered the understanding of water consumed, which in turn impeded the water payment collection process.

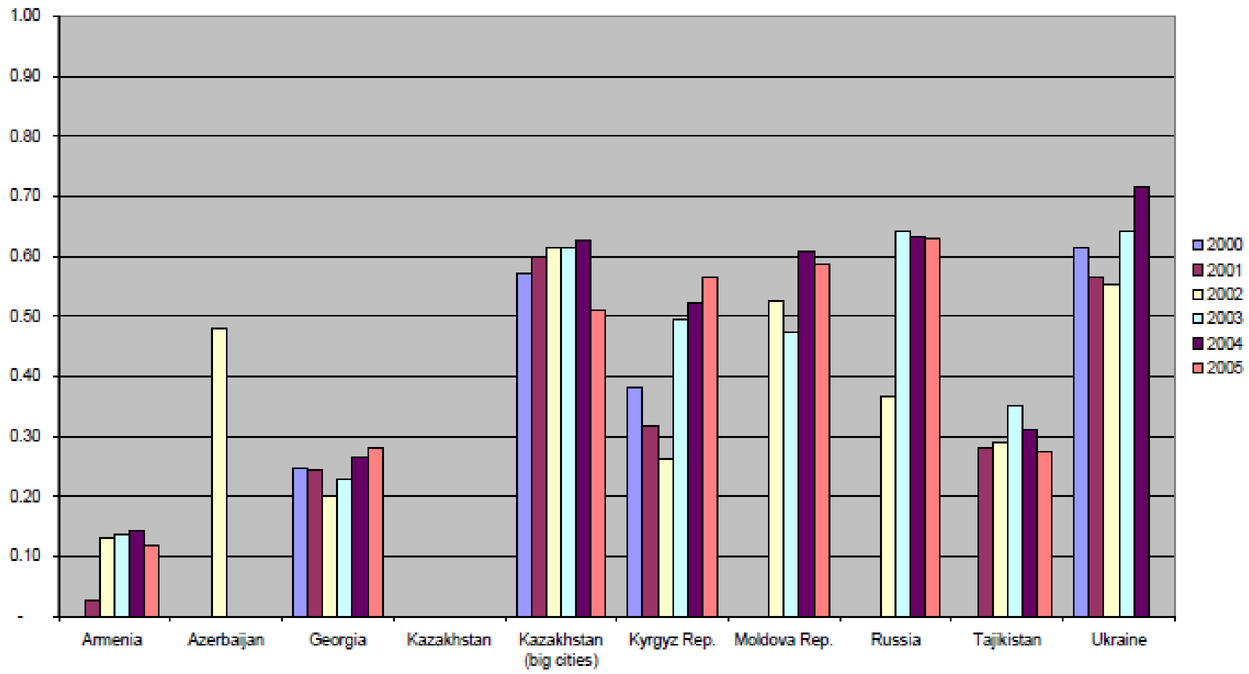
Hence, one of the main policy strategies was the modernization of the water sector with metering systems and transition to volumetric pricing that would enable the reduction of inefficient water consumption, improvement of water payment compliance, and promotion of increased duration of water supply for users, especially in urban areas where satisfaction with water delivery services was lowest, income was higher, and infrastructure investments were related to significant economies of scale.

Soon after introduction of the new water tariff structure, the levels of tariffs also increased – by 27% in 2005, and by 10% in 2006. In 2005, it was AMD 140 per m^3 (equivalent of USD 0.4), where AMD 115.65 is for potable water supplied to customers and AMD 24.35 for waste water services against each m^3 of supplied potable water. Tariff structure includes three types of costs: fixed costs (regardless water amount supplied), variable costs depending on the amount supplied, and consumer service costs (mainly water meter data reading, billing, and collection) (OECD 2008).

It is worth noting that the increase of water tariffs was backed by studies on affordability of water tariffs. Thus, according to ADB (2008), the tariff increase of 2005 accounted for 2.4 %

of increase in household expenditures. This is lower than the WHO[7] accepted maximum 4% of household expenditures above which the household passes the water poverty level.

At the same time, the current tariff level does not allow for full cost recovery. Indeed, real cost recovery amount and trends in Armenia are the lowest for the NIS region (Figure 5.4.7). Therefore, the tariffs are the main pressure for making investment into full maintenance of infrastructure. For example, the AWSC tariffs cover only operations, emergency maintenance and partly routine maintenance costs. With the financial support of international donors, the AWSC is able to cover the other part of routine maintenance costs and preventive maintenance cost. There is a financial gap for replacement, rehabilitation and system expansion costs, which are supposed to be covered by the government or increased tariffs (WB 2011).



Source: OECD 2007

Figure 54.7 Real cost recovery in NIS countries

[7] World Health Organization

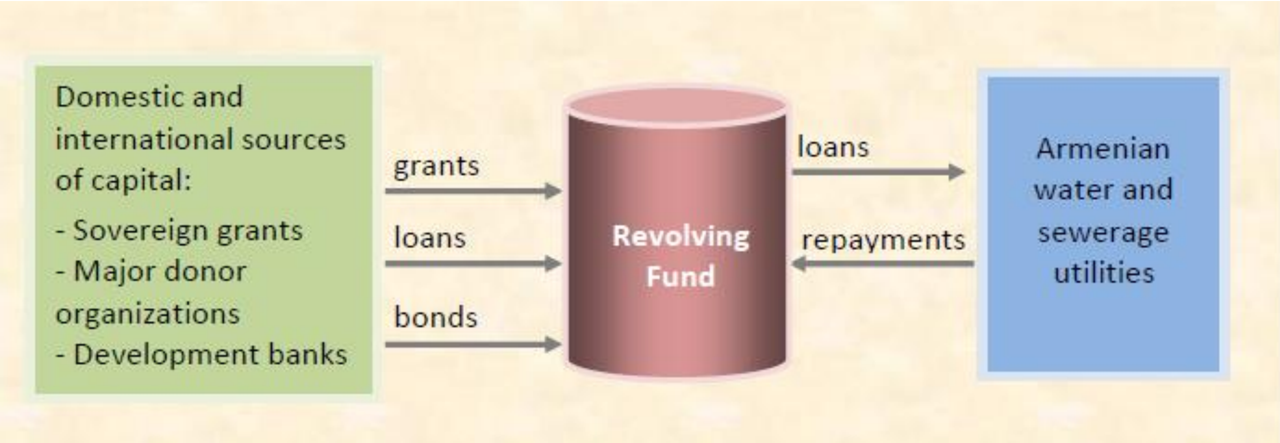
Moreover, financial performance and cost recovery issues are especially highlighted in the context of the termination of the *grace period* for some of the water sector loans and the fast approaching need for repayment arrangements (Table 5.2). This will entail significant tariff implications and a strong need for a careful tariff policy for mitigation of tariff shock impacts (WB 2011).

Table 5.2 Current committed capital investment program for the water sector

IFIs:	WB	WB	WB	ADB	KfW	KfW	EBRD
Start year	2004	1998	2005	2008	2001	2005	2008
Amount (mln)	23+20 $	30$	20$	36$	12.8 €	15 € + 7.8 €	7 € +7€
Principal repayment due	2015-2044	2008-2032	2015-2044	2016-2039	2010-2041	2015-2044	2010-2022
Project	Municipal Water and Wastewater	Municipal Develop-ment	Yerevan Water and Wastewater	Water Supply and Sanitation	Communal Infrastructure (Armavir)	Communal Infrastructure (Shirak and Lori)	Lake Sevan Environmen-tal Project
Water utility:	**AWSC**	**Yerevan**	**Yerevan**	**AWSC**	**3 towns**	**3 towns**	**AWSC**

Source: WB 2011

One of the options for meeting the challenges of providing funding to water sector systems to finance infrastructure and service provision improvements can be met by developing a specialized "revolving fund" (Cardinalli and Albani 2010). The revolving fund will be supported by the government and enable to finance various measures on reasonable conditions. Schematically, the fund is presented in Figure 5.4.8.



Source: based on Cardinalli and Albani 2010

Figure 5.4.8 Capital flows within the revolving fund system

The concept of the revolving fund is based on raising capital with the specific aim to finance the needs of users more than once. *Revolving* means the financial resources are moving between the fund and the users. Hence, the fund's resources revolve through the water sector over time, financing the next water sector measures after the loan is repaid by the previous water measure. Currently, work is in progress for establishing the National Water Sector Revolving Fund in Armenia.

5.4.2 Social performance

Social and environmental aspects of utility performance are becoming increasingly important aspect of business operation of utilities. As a result, along with economic measures, researchers often aggregate the environmental and social indicators for assessing the overall sustainability performance of companies.

Continuity of water supply services

Increased water metering and improved water payment collection enabled water operators to provide better services. Thus, there was a gradual increase in the average duration of water supply depending on the region and the company. As seen in Figure 5.4.9, water supply services significantly improved in cases of all water operators. The average daily hours of drinking water service reached the highest 22 hours with the smallest Nor Akunq company. There was also a significant increase of water supply duration from 4 to 21 hours in the large urban centre serviced by Yerevan Djur. Shirak and AWSC are struggling with high levels of breakdowns and water losses which did not allow them to considerably increase water supply hours. The duration of water supply is one of the main performance indicators of water utilities conditioned in the contracts of water operators. All the companies have targets to reach the 24 hour supply based on different target dates.

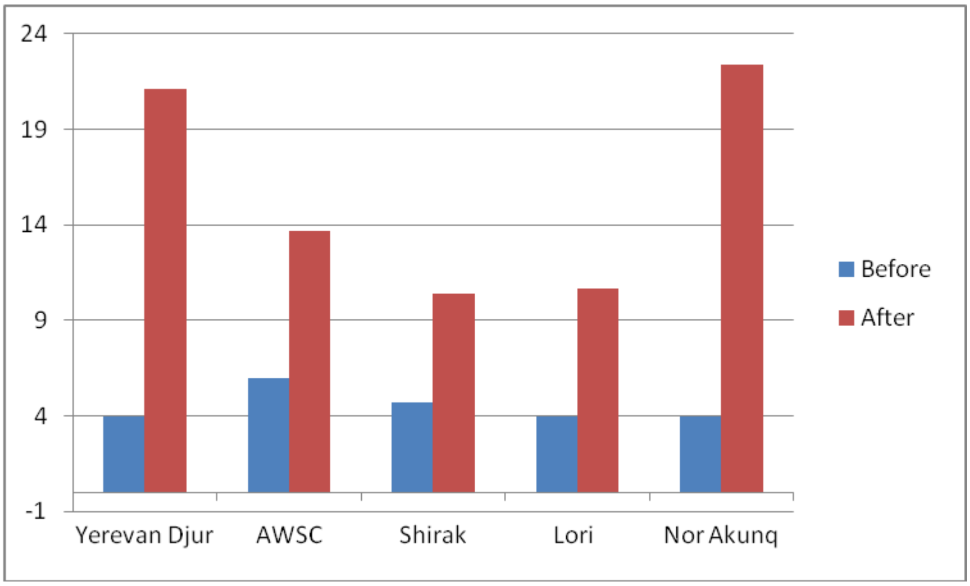
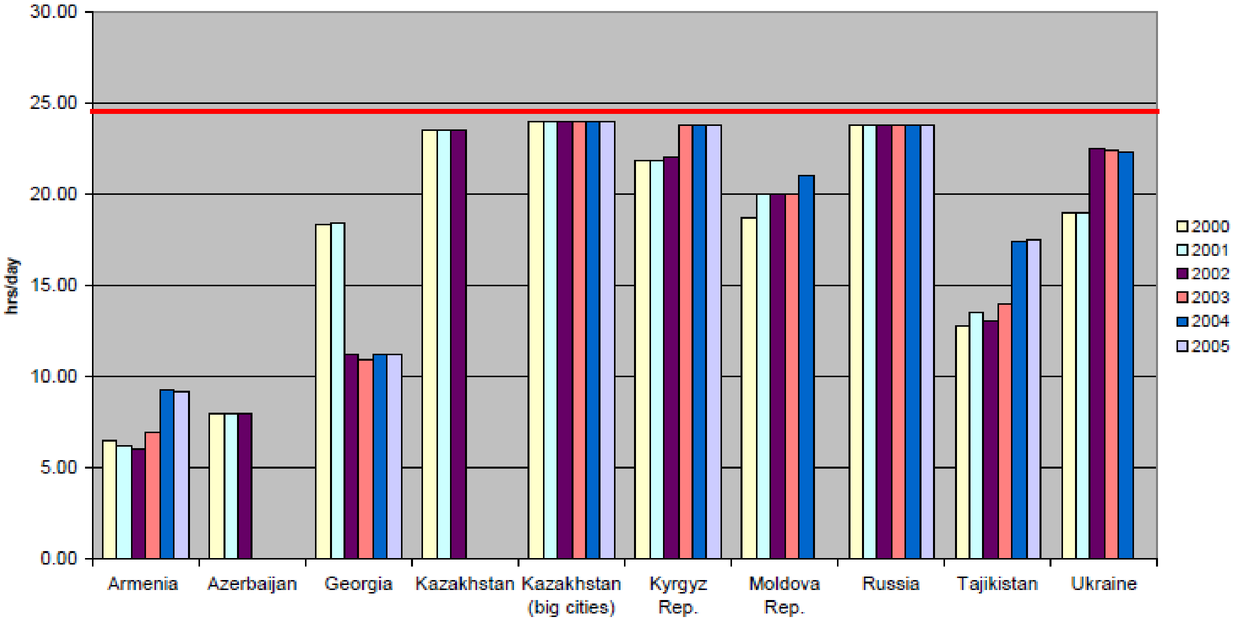


Figure 5.4.9 Continuity of water supply service (hours/day)

Water supply duration can only be improved if there is an increased investment in the rehabilitation of the existing infrastructure. Meanwhile, the insufficient duration and schedule of water supply are currently frequently raising issues. A survey conducted in one of the towns revealed that 57% of respondents were unsatisfied with the schedule of water supply, especially in households where water is provided during working hours when family members are not at home to collect water (Mkhitaryan 2009). Though with some improvement, overall Armenia ranks very low in terms of the continuity of water services compared to other countries in the NIS region (Figure 5.4.10).



Source: OECD 2007

Figure 5.4.10 Continuity of water supply in NIS countries

The analysis of household survey data conducted within the frameworks of the present PhD research will bring interesting insights about the depth of this issue and coping strategies of the population to deal with it.

Affordability of water

It is important that the analysis of water services and water tariffs is put in the perspective of affordability. There are different ways of assessing service affordability. More accurate assessment is based on the share of household water expenditure in the total of the household income or consumption expenditures. However, this type of data is usually hard to acquire. Hence, one of the more appropriate and consistent measure available is through the GNI[8] (Atlas method based), which can be separately complemented by other references. Hence in this research, affordability of services is expressed in the total annual operating revenues per

[8] Gross National Income

population served divided by national GNI (2002) per capita. The GNI is for the whole country without consideration of local variations.

Before proceeding, a remark should be made for the threshold percentage of affordability. Since there is no universal benchmark for measuring affordability for utility bills, some governments and international financial institutions have developed indicative benchmarks. In general, indicative benchmarks for water bills are 2-5% (Fankhauser and Tepic 2005). In particular, the WHO's acceptable threshold is 4% indicating that affordability becomes problematic if water bills account for more than 4%, of household consumption expenditure.

As Figure 5.4.11 shows, water companies' revenue per population share in GNI per capita in the before case did not exceed 2%. Within the study period, except for AWSC, the affordability for all the companies improved, not exceeding 1%. The analysis by this method does not show practically any significant changes over the considered time period. It is important to mention that these figures do not take into account capital expenditures, such as connection or metering installation costs (for more details see metering section below), which could be a significant financial burden, especially for the poorest.

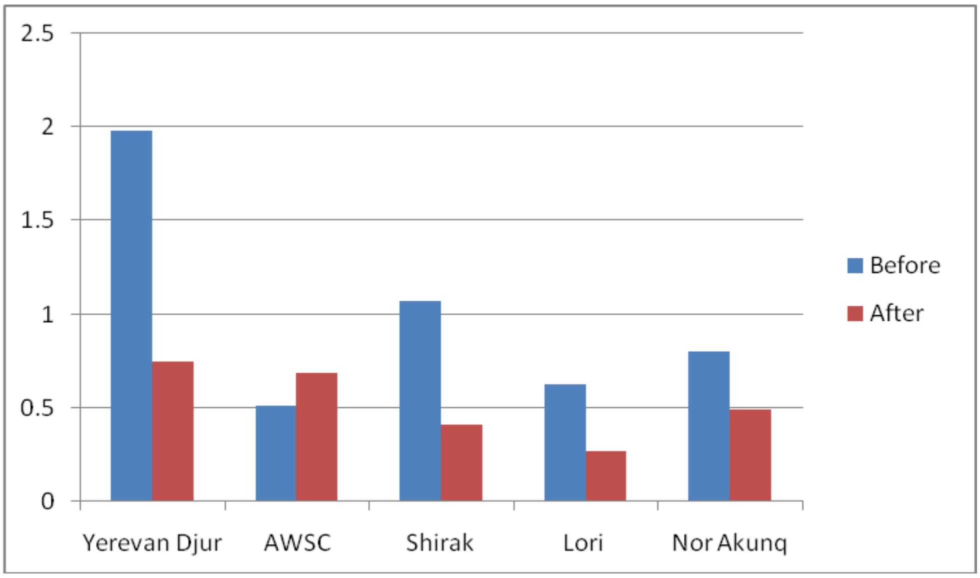


Figure 5.4.11 Affordability (%)

Macro-affordability assessments at household level, conducted as a part of ex-ante evaluations of water sector policy actions, showed that in Armenia households spent 3.1% of their budgets on water and wastewater services in 2001 (OECD 2004). This is lower than the WHO's accepted maximum 4% of household expenditures above which the household passes the water poverty level.

According to the Yerevan Djur lease contract, the tariff methodology takes into account the affordability of the population and follows the strategy of *burden sharing* between customers and the private operators. As a result, the tariff was set at 144 AMD/m^3, which will further go down to 89 AMD in constant terms within the period of 10 years. However, there are also counter arguments that the PSRS does not take into account aspects of quality of services and consumer affordability in their tariff setting procedures. Therefore, more research is needed to clarify it (OECD 2008).

Water coverage

Water coverage is one of the most important development indicators. In this analysis water coverage presents the ration of population with access to water services (either with direct connection or within a reach of a public point) to the total population in the water utility service area. Overall, the connection to water supply is rather high in Armenia. On all utility level, the water coverage increased from 65.8% in 2004 to 91% in 2010. The analysis of water coverage for individual utilities gives mixed results (Figure 5.4.12). Water coverage in utility areas that are serving the medium and small urban areas with surrounding settlements increased: AWSC (to almost 80%), Shirak, Lori and Nor Akunq (all to 100%). At the same time, coverage in the utility areas that serve the capital city Yerevan with surrounding rural settlements decreased. Normally, connections in urban areas are not a problem. Utilities in these areas face the issue of overcapacity of infrastructure connections. Coupled with high levels of “closed door” households due to high level of migration within a long period of time gave a significant change. The opposite situation is with rural areas that traditionally lacked a proper water infrastructure. Therefore, the major activities in these areas were directed on increasing the connection level of the population. From the development point of view rural areas are important targets, therefore, a more detailed explanation is presented in the next section.

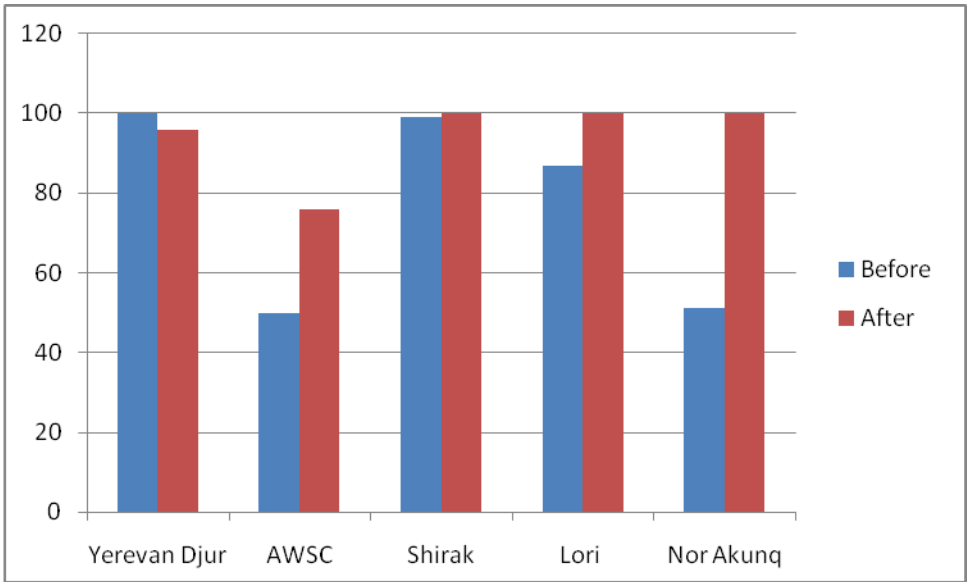
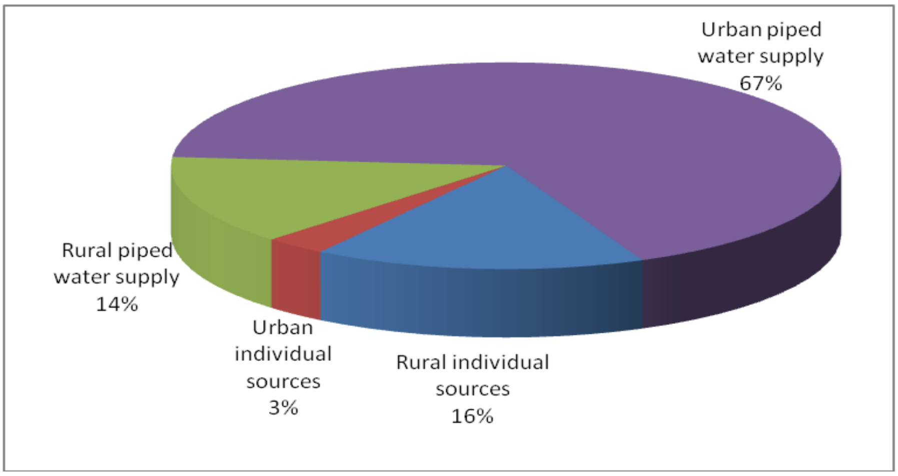


Figure 5.4.12 Water coverage of population (%)

Rural water supply connection

Based on the World Resource Institute database, in 2004 about 92% of the population in Armenia had access to improved water sources: 99% of population in urban and 80% in rural areas. Groundwater is the major source of water supply for household purposes. The World Bank (2001) reported that only 5% of drinking water supply is abstracted from surface sources. The issue is the accessibility of rural population to indoor water supply. As of 2001, about 81% of the population (67% in urban and 14% in rural areas) has access to pipe water supply. Accordingly, 16% of rural and 3% of urban populations have individual sources of water supply such as private or public wells, springs and open sources (Figure 5.4.13). At the same time, 87% of urban and 45% of rural populations have indoor water taps. The Poverty Reduction Strategy Paper (PRSP) targets the improvement of the rural indoor water supply from the 45 to 70% by 2015 (Jantzen 2008). Lower connectivity of rural areas is explained by such factors as remote location, low-income communities and low population density, which makes these areas commercially unattractive for water infrastructure to expand. According to the IFAD study, in 2006 only 2% of rural communities had water systems in acceptable conditions and almost 50% of the water system requires fundamental repair (Mkhitaryan

2009). The analysis of the household survey will enable to trace the progress in these figures for revealing the trends. For now, for a general trend for over time changes in the general state of rural water coverage can be seen through the above indicator of water coverage. Taking into account the high level of piped coverage of urban areas, any changes in these indicators can indirectly display the situation in rural areas. As it can be seen above, coverage of water utilities operating mainly in rural areas increased, giving a reason to suppose progress in piped water supply.



Source: built by the author based on WB 2001

Figure 5.4.13 Piped versus individual water supply, 1999

5.4.3 Environmental Performance

Environmental performance is a way of measuring and numerically benchmarking the environmental performance of public or private companies. The three indicators are used for quantifying environmental performance of water utilities in Armenia are water consumption, non-revenue water and water metering. The analysis of this performance is amplified by more profound analysis of specific important aspects and regional or international comparisons.

Water consumption

The indicator on total water consumption expressed in litres per person per day shows an interesting trend (Figure 5.4.14). Compared to the "before" period, water consumption of only one company (AWSC) increased, while for all the other companies it dropped. Interpretation of these figures requires important considerations to take into account. As it is mentioned in the section on metering, in 2002-2003 the whole country passed through a rapid process of massive metering. The uniqueness of water metering in Armenia is that the target was to promote universal metering, that is metering at individual apartment level rather than building level, which will be discussed in more detail in the metering section below. Water metering brought its immediate effects on water consumption. Sample studies on residential water consumption immediately after meter installation revealed that on average water use decreased almost fourfold compared to water consumption based on the normative of 200-250 litres per person per day (Harutyunyan 2014b). This is reflected by the drastic difference in the total and residential water consumption in "before" situation of Yerevan Djur company (Figures 5.4.14 and 5.4.15) in comparison with other companies, since they entered into public-private arrangements later.

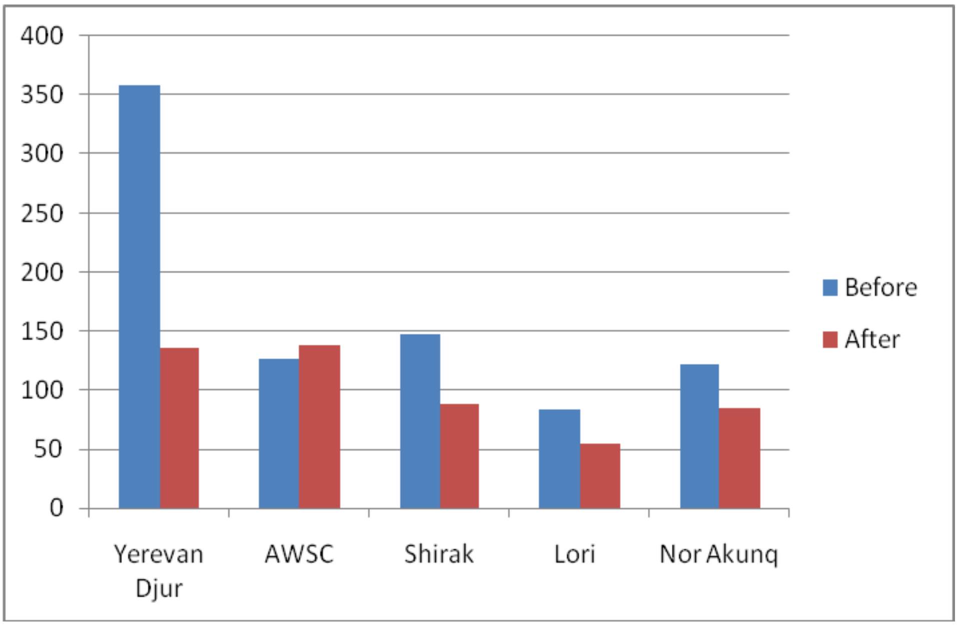


Figure 5.4.14 Total water consumption (litres/person/day)

In the analysis, the reference to residential water consumption is necessitated by the fact that in contrast to Soviet period when industry was the major water consumer, in the period of this study residential consumption is the major consumer and revenue base for water companies (Harutyunyan 2014b). The share of residential consumption in total consumption for all the companies ranges from 72 to 91 percent in the "before" situation and from 61 to 86 percent in "after" cases. As seen in Figure 5.4.15, under private contracts residential water consumption decreased for all companies. This is a result of a combination of measures implemented, including metering and enhancement of payment discipline. This observation is even more significant taking into account the increased duration of water supply that normally pushes water consumption up. Within the study period, tariffs increased on average for all companies by 10 percent in real terms (constant 2000 prices) and 85 percent in nominal terms, accounting for about 5.6% of average household expenditures in 2010.

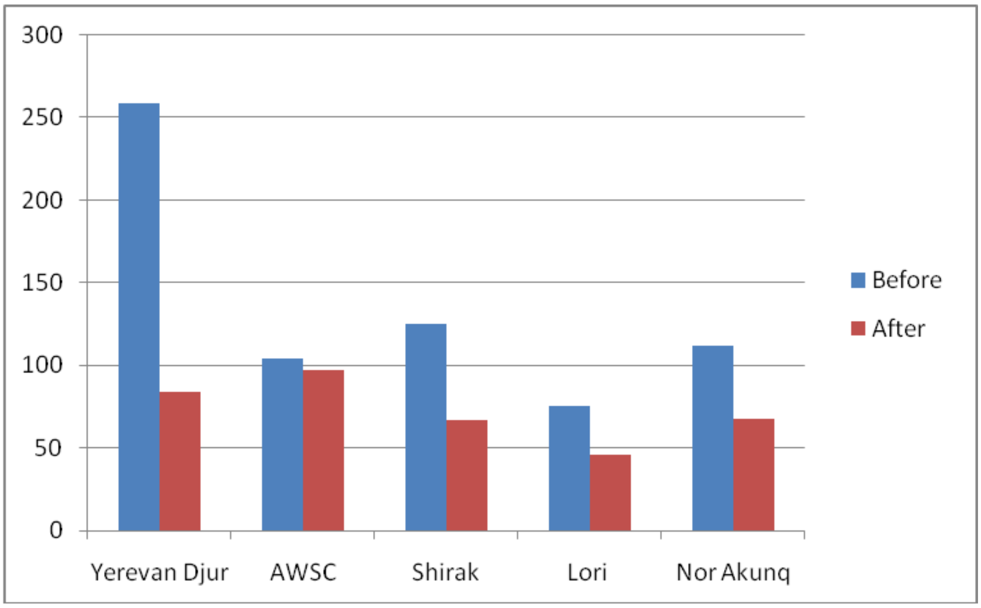


Figure 5.4.15 Residential water consumption (litres/person/day)

Water metering

The water metering level represents the ratio of total number of metered connections to total number of connections expressed as a percentage. As Figure 5.4.16 shows, water metering levels increased under public-private partnership contracts for all companies. The highest results in metering among all operators are achieved by the biggest Yerevan Djur and the smallest Nor Akunq companies that succeeded in increasing metering levels up to 99 and 98 percent, respectively. In the early 2000, water metering level amounted to less than 1 percent throughout the country. This is reflected in the “before” situation of the Yerevan Djur. The difference in “before” metering levels for other water operator is explained by the later start of public-private partnership contracting with these operators - after the Law on Restructuring Indebtedness, which promoted the massive installation of metering in 2002-2003 throughout Armenia. Another important trend worth noting here is that an overall increase of water metering is accompanied by a growing trend of water sold that is metered indicating that Armenian water companies are succeeding in incorporating large water users into the metering and billing system. Indeed, sectorization and meter installation significantly increased operation and financial performance. At the same time, the meter stock has already exceeded its working life, which among other things means increasing revenue losses due to incorrect meter records (Harutyunyan 2014b). However, the interpretation of these changes requires more background information on the water metering process in general and in Armenia, in particular. A deeper analysis is also important for highlighting the relationship between water metering and consumption trends.

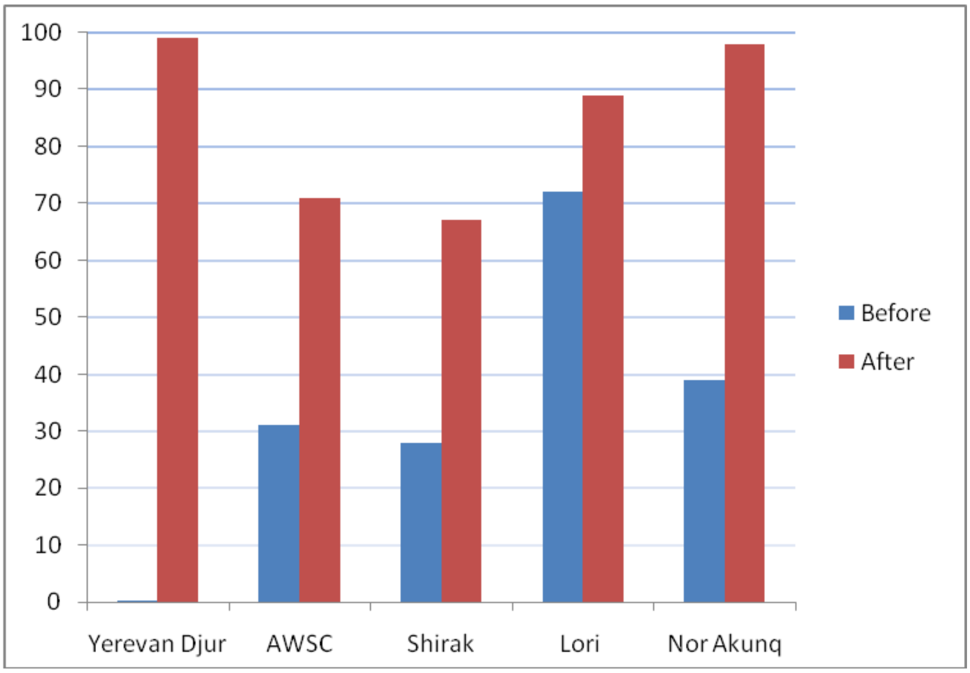


Figure 5.4.16 Water metering level (%)

International experience with water metering

Worldwide, with heightened concerns over water conservation and regulatory pressure for efficiency in the water sector, water metering and volumetric pricing are increasingly recognized as essential economic policy instruments for ensuring effective planning, allocation and management of water resources. Although not being a water efficiency and conservation technology per se, water metering has a potentially large impact on water demand. Various studies on the conservation effects of water metering show on average a 20-40% cut in household water use due to metering (Inman and Jeffrey 2006; Mayer et al 2004). In some countries water metering and metered pricing are required by legislation, in others mandatory metering is not being introduced due to concerns about the potential adverse impacts on low-income households.

Currently, in most countries belonging to the Organization for Economic Co-operation and Development (OECD), water metering exists in most single-family houses, but most multi-apartment buildings that house the majority of the OECD population are equipped with building level meters (at the lower floor of the building) rather than individual apartment meters, and universal metering is still a controversial issue in a number of countries (Staddon 2008) with impacts of metering depending upon the context of implementation (Walker 2007). According to the study of the Environment Agency (2008), in many European countries, households are almost universally metered. For example, in the Netherlands, 75% of apartments are individually metered. In most cases, domestic metering is on the building level, which creates a lower incentive for individual users to control their water consumption than in the case of individual apartment meters (Mayer et al 2004). In Eastern Europe, water metering is also more common at the building level, which creates a low incentive for individual users to control their water consumption. The studies on the experience of water metering in the region of Newly Independent States (NIS) are scarce. In Ukraine, only 9% of multi-apartment buildings have water meters. In Kyrgyzstan, household metering hardly exceeds 1% (EEA 2007). In this context, the case of water metering in Armenia is rather unique with the water metering level currently ranging from 67 to 99 percent, depending on the water service provider.

Enabling laws to water metering in Armenia

Introduction of water metering was one of the imperative measures in water sector reforms in Armenia (the early 2000s), with the primary aim of increasing water utility revenues and reducing state subsidies through improved collection of water payments based on metered billing, increasing water use efficiency and improving water delivery services. The water metering process in Armenia was directly backed by laws that stipulated a transfer to a new charging system based on metered water consumption. A number of decrees set the rules for water system management with the introduction of water meters and transition to international accounting standards. They provided that households with individual water meters were to be charged based on metered consumption. In the absence of water meters, an alternative water recording procedure established by the Government was employed. For non-metered institutions, the payment was based on the pipe diameter. Non-metered private house payment was also based on the pipe diameter (starting from July 01, 2005 no more than 100 m2 per month). For non-metered apartments, if there was no building block meter, the payment was made according to the normative of 200 liters per person per day (250 liters in Yerevan) based on the number of persons registered in the apartment or the number of factually residing persons certified by appropriate authorities. If there was a building block meter, the payment was calculated by deducting the sum of all metered household consumption from the building block meter records and dividing the rest among the non-metered households based on the number of people registered in the household but no more than 400 liters per person per day (GOA Decree N130-N).

While these amendments provided some economic stimulus for metering, the metering and expected improvements in water bill payments from household customers did not proceed as planned. Then, as now water metering is voluntary (even though water utilities pushed for making it mandatory) and there are still households that do not have meters. It is usually large families with not all the residents registered at the given apartment that prefer to pay based on building block meter or pipe diameter. Another major reason that largely hinders the meter installation process is the absence of people from the country due to migration.

To foster voluntary household metering, various incentive measures were introduced. The turning point became the adoption of the Law on Establishing Privileges in Repayment of Debt for Water, Wastewater Services, Sewerage Treatment and Irrigation (hereinafter – the Law on Restructuring Indebtedness) by the National Assembly on November 6, 2002. The law stipulated partial amnesty for accumulated household debts for water payment on condition of 30-50% debt repayment and installation of water meters at the expense of households within a six month period (by October 9, 2003). Otherwise debts were subject to collection in full through court. Governmental Decree N130 N (2004) envisages a right for water companies, in case it is technically possible, to disconnect customers that do not pay for the services until they repay the debts. The customers were required to sign a contract with the water company within a period of three months (from January to mid April 2003). The contracts stipulated debt restructuring conditions and compelled the household to make regular water payments based on their metered consumption. Later, in October 2003, a decree was passed to prolong the period for meter installation to July 1, 2004 (OECD 2004).

The purchase and installation of meters was supposed to be done either by customers themselves at their expense or by the water companies if the customer signed a contract for the meter purchase and installation works to be financed at the expense of the customer. Households could themselves install the meters provided they met the technical requirements certified by the water companies. The meters should be checked and sealed by the relevant standardization, measurement and certification body (GOA Decree N130-N).

Protection of poor consumers

Water meter purchase and installation may be costly and become a heavy burden, especially for low income families. For promoting water reforms and mitigating negative social impacts, various expert groups and studies recommended proceeding with massive installation of individual meters with stipulation of financial assistance for meter installation for the poor. At the initial stage of reforms a number of studies recommended that the costs of meter installation should be covered by utilities and amortised within five years through water payment as in the case of energy metering. This could mitigate negative public attitudes, and create favorable psychological influence on acceptance of the reforms (Roe et al 2003). Expert estimations put the cost of household water metering installation at about USD 22.5

million, including water meter equipment and installation cost. However, due to the lack of budgetary funds and the unwillingness of water operators to make up front expenditures, water metering was implemented at the expense of the households. The full cost of meter installation was estimated at USD 30 per meter, which exceeded the value of minimal consumer and food baskets by 1.5 and 2.4 times, respectively. Taking into account that in some cases there is a need to install more than one meter, costs of meter installation were a heavy burden not only for poor, but even for average income households (Melikyan 2003). To mitigate the high burden on low income families, a special subsidy scheme was stipulated by the Law (2002) on privileges granted for water service payments. The approach was to provide meter installation free of charge for those in the Poverty Family Benefit (PFBP) system. For those in the list of vulnerable provided by the Ministry for Social Security (not eligible for PFBP) there was an opportunity to pay 50% of the cost with gradual repayment of the rest amount within two years (Roe et al 2003). The PFBP scheme was also used for giving vulnerable families special write-offs for accumulated water payment debts.

Water metering implementation

The massive water metering process required serious preparatory work, particularly related to organizational capacity building. In early 2003, water utilities set up numerous local branches for servicing customers. An extensive information dissemination campaign was launched. Since then the water utilities have been committed to regularly notify customers about relevant changes and requirements (for example, service hour changes, amendments in contractual requirements, etc.) through the mass media, their websites, telephone calls and branches, as well as through water utility check-men taking the records of the meters.

At the start, the most rapid process of re-registration and water metering was observed in the capital city Yerevan. In the period of January-November 2003, the number of metered customers of the Yerevan Djur increased more than ten-fold (from 18,427 to 226,840), reaching 76% of all registered customers. Implementation of water metering was slower with the other utility – AWSC, amounting to 40% in 2004 (OECD 2004). The issues faced were the higher prices for meter installation and the lack of funds among customers to acquire meters because of a higher poverty level in the regions outside the capital. This was especially the case with low-income households, which were supposed to get reimbursement of metering costs within five years. In reality, water companies failed to provide all the conditions for extending interest-free loans, hence, meter installation for this population segment lagged behind. AWSC also experienced higher rates of "closed door" customers (dwellings with customers not regularly residing in the country) and an inability of getting payments for the fixed costs associated with the operation and maintenance of water infrastructure. The problem could have been solved by introducing increasing block tariffs with a fixed fee for operation cost to be paid regardless of consumption, plus metered consumption payment.

Picture 4. Water meter: Photo by Naira Harutyunyan

Testing, repair and replacement

The uniqueness of water metering installation in Armenia is that the target was to introduce universal metering at the individual apartment level rather than the building block level. This seems rather ambitious taking into account that block meters at the lower floor of the building is common practice in most countries. This is an important difference because it is highly recognized that building block meters create low incentive for individual users to reduce water consumption (Mayer et al 2004). At the same time, with individual apartment metering it is more likely that the meters are tampered with or not read. Conversely, with building block metering it is more difficult to manipulate the meter and less demanding to take the readings and identify the malfunctions.

Currently, household metering in Armenia is at the individual apartment (or private housing unit) level and all the metered customers are charged based on individual apartment meters. Due to a number of legal issues related to the ownership of intra-building pipelines and the practical viability of mass introduction of individual water meters, contrary to expectations, building block meters were not widely introduced. Practically, the building block meters were not used for charging non-metered customers based on the difference of the block meter and the sum of individual meter readings. Then, as now the building block meters are used primarily for checks, identification and reduction of real water losses due to leakages up to block meters in transmission and distribution mains and storage tanks. They also facilitate determining commercial losses related to unauthorized consumption and metering inaccuracies, data handling and billing errors for taking further improvement measures. The purchase and installation of building block meters is done at the expense of water utilities that obtain the ownership for the building block meters and piping systems up to the building block meters and carry responsibility for the operation and maintenance of these facilities (MY-YD 2013).

Indeed, the issues of inaccuracies of water meters and unauthorized consumption are quite important to highlight. Over time, a large number of water meters become unreliable in recording a growing amount of water passing through them (EPA 2009). This leads to the increased non-revenue water, reduced water bills and increased profits of water companies. In

Armenia, even with the increase of water metering and payment collection and reduction of water consumption during the reported period, the total volume of losses from water distribution systems remains quite high with all utilities. Water losses include real losses due to leakages in storage tanks, transmission and distribution mains and commercial losses due to poor plumbing, illegal connections, by-pass of water meters, under-registration of flows by meters, and meter inaccuracies. The utility reports indicate that the majority of registered violations are related to meters, including seal violations (YD 2013). In light of this, testing and replacing water meters and triggering water tampering policies are of great importance for reducing commercial water losses.

According to the Government of Armenia Decree N1030-N (2012), water utilities are entitled to test water meters and, in case of malfunctioning, demand meter repair or replacement. Water meter testing or new meter installation can be implemented by the water utility workers if it is stipulated in the contract signed between the customer and the water utility. If the water utility purchases and installs a new meter, it receives ownership for the meter (MY-YD 2013). In the case of intentional damage to the meter with the purpose of tampering with water consumption records, the water utility worker registers the violation and signs with the customer a protocol on meter usage rule violation, which makes the customer legally responsible and becomes a base for water consumption recalculation (GOA Decree N130-N). To diminish cases of water connection before the meter and reduce tampering, water utilities, among other things, relocate water meters outside the territory of private houses (MY-YD 2013).

If the household owner himself suspects any troubles with the operation of the meter, based on household owner application or water company demand, the meter is subject to official check. All the related costs are to be covered by the water company unless the results of the check prove that the meter meets the requirements. In case the check shows a discrepancy, the water company should recalculate the water consumption based on the average of the previous three months (in case the damage was not intentionally caused by the household owner) (GOA Decree N130-N).

Normally, no single type of water meter can precisely measure water flow for all applications. The selection of the meter type is based on the location peculiarity and the conditions of the place of installation (EPA 2009). No less important are the costs of installation to customers and/or water companies. Depending on a number of factors (for example, type and size of the meter stock, period of service, water quality, available staff, etc.), the recommended replacement period for residential water service meters on a rotating schedule may vary from 5 to 20 years (EPA 2009). In Armenia a great part of water meters were installed by household customers themselves in the years 2003-2005. The meters were low-cost (dictated by local circumstances), hence, water meter inaccuracy and consumption data errors are frequent (MY-YD 2013). According to the pilot studies of water utilities, the major part of the commercial losses is due to non-tested, low quality and already obsolete water meters (YD 2013).

Initially the legislation stipulated water meter testing once in 5 years. Taking into account economic and technical feasibility issues, testing frequency was gradually extended: in 2008 to 7 years, in 2011 to 10 years and currently to 12 years (MY-YD 2013). At the same time, the stock of meters in operation for more than 12 years is increasing. Even though the water utilities possess appropriate laboratories and report their progress in water meter tests, repair, and replacement activities, prompt actions are needed to solve a number of related issues. According to water expert opinion, the procedure of water testing is complicated and unrealistic. It is also time- and money-consuming activity for customers. There is a need for more simplification and clarification of water meter testing and replacement procedure, meter ownership and responsible agency for the service along with necessary investments (YD 2013).

Nowadays, a number of water supply and sanitation system investment projects envisage water meter replacement and installation measures to improve accuracy in consumption-based billing and to reduce commercial losses. For example, the World Bank loan for municipal water project envisages procurement of water meter chambers, sets of residential water meters class C and sets of electronic ultrasonic water meters with wireless reading, as well as procurement and installation of automatization systems. As an advancement, the new investment projects envisage gradual transition from manually read meters towards Automatic Meter Reading (AMR) systems that reduce reading errors yet cost more to establish and operate (WB 2012).

Short-term effects of water metering

The introduction of water metering was of particular importance in terms of obtaining, for the first time, information about actual water use and making a more realistic analysis of water demand trends. Sample studies immediately after metering revealed that, on average, water use decreased three to four times compared with the normative water use of 200-250 liters per person per day (OECD 2004). However, in short-term, the sharp first phase decrease of water consumption is followed by a gradual increase of water metering and a rise in water demand, though not to the level of normative use. For example, within six months from March to October 2003, water consumption per person per day in Yerevan increased from 70 liters to 120 liters (see Figure 5.4.17). This *rebound effect* has the following explanation. The pioneers of meter installation were the households that tried to reduce their water bills and/or those that had low water service access and did not wish to pay for undelivered services. As water metering was increasing, water utilities were gradually improving water supply services, such as better water quality and increased hours of daily supply. With tariffs remaining unchanged in 2003, water consumption rebounded after metered households made considerable savings on water bills as compared with the previous normative-based payments that weakened their motivation to use less. Partly, the rebound effect is due to the psychological effect of user awareness of being metered and the fear that the bill would increase after introduction of metering. As soon as reduced water charges are observed, water savings due to metering gradually reduce, and if not accompanied by tariff change, water demand rebounds almost to its original level (Harris et al 2002). Therefore, metering alone may not be effective in influencing the water demand profile and should be accompanied by other conservation measures.

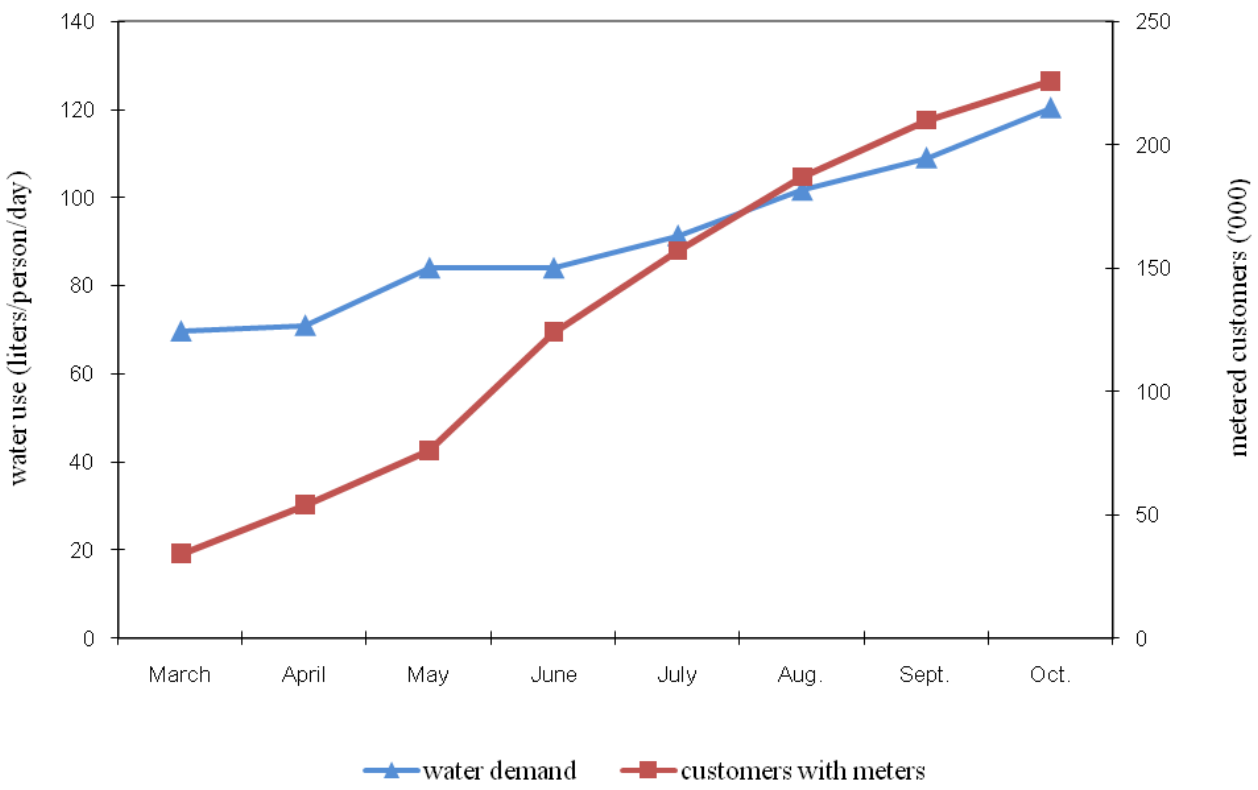


Figure 5.4.17 Water metering and consumption in the short-term perspective, 2003

Since water tariffs did not change, the increase of water metering and water payment collection rates was accompanied by a drastic decrease in revenues of water companies (Table 5.3) (OECD 2004). Thus, within the six month period of metering installation, AWSC water utility revenues decreased by 14%. This experience was also observed in other NIS countries where water bills depend only on consumption without fixed component as in block tariff rate systems. In eastern European countries such as Hungary, Poland, and the Czech Republic, public water pricing is exclusively volumetric based without any fixed charge element. In countries where fixed tariffs still persist, significant free allowances are gradually decreasing (Jones 2003). At the same time, high tariffs may result in much lower water consumption, which is potentially detrimental to health.

Table 5.3 Impact of Individual Water Metering on Revenues of AWSC

	January 2003	June 2003
Customers Receiving Services	258,807	241,346
Meters Installed	12,000	35,703
Total Revenues (AMD million)	208.6	179.2

Source: OECD 2004

Long-term effects of water metering

The analysis of long-term trends of water metering process of all water utilities throughout Armenia has revealed a different picture. Figure 5.4.18 shows that during the period of 2002-2010, water metering levels increased from 6% to 86%. Yerevan Djur, experienced the highest rate of individual meter installation reaching up to 99% (near-universal metering) in 2010, followed by the smallest utility Nor Akunq that succeeded in reaching 98% metering. Within the same period of 2002-2010, average total per capita water demand fell by 61 percent: from 205 to 126 liters per capita per day. Within the same period, residential water consumption reduced by 48 percent: from 172 to 83 liters per capita per day. As the figure shows, the residential sector is an important water use sector. Since the 1990s, the industrial sector has experienced a drastic decline in activities and a reduced water demand. This trend is, however, reversing with gradual industrial development and rising demand for water (Harutyunyan 2014b).

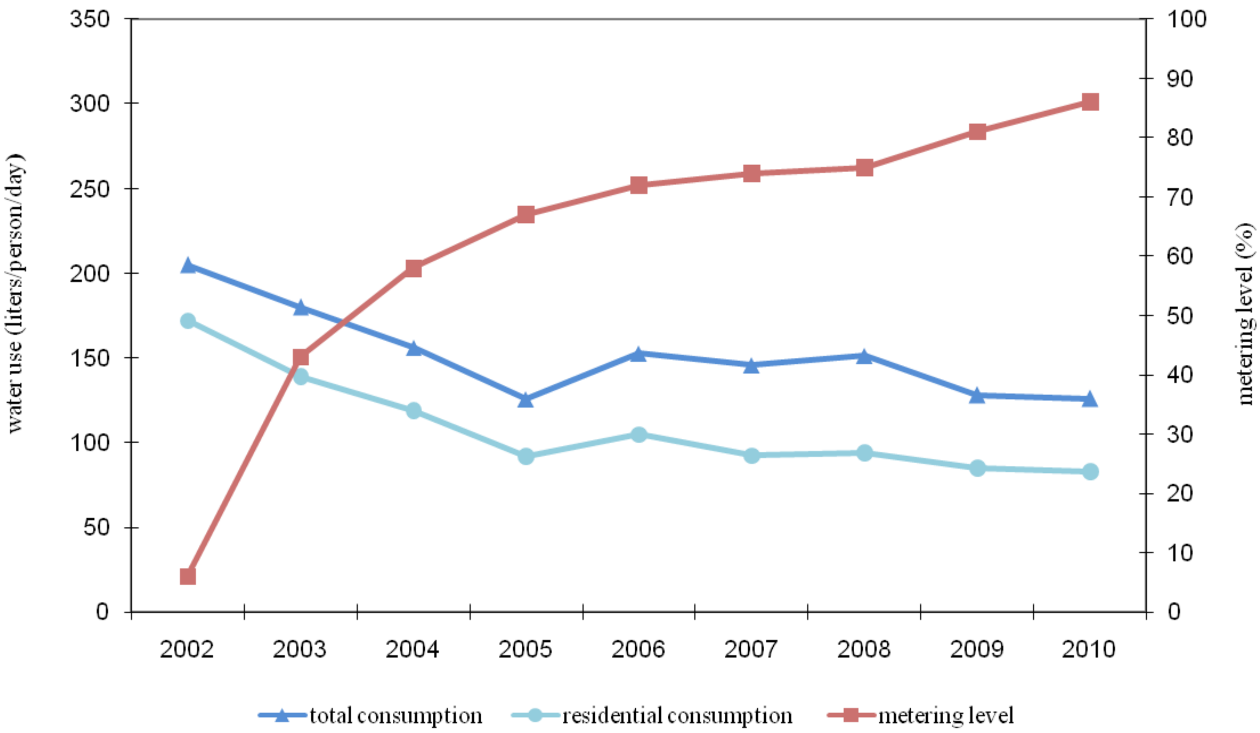


Figure 5.4.18 Long-term trends in water metering and water consumption

Even though Figure 5.4.18 gives a clear picture of metering and water consumption, there are some other important factors to be taken into account. First, during the initial stage of water reforms and implementation of metering in 2003, water tariffs did not unchange. On average, residential water tariffs increased by 20-40% and 10% in 2005 and 2006, respectively. There was no tariff change up until 2009. The average tariffs for all utilities amounted to AMD 120-140 (equivalent of USD 0.34-0.4) per m3. However, as Figure 5.4.18 shows, increase of tariffs in 2005 did not result in water demand reduction. On the contrary, there was a trend of increased consumption. In 2009-2010, there was the next tariff increase (in some cases up to 70% in nominal prices, which amounts to 23% in constant 2003 prices). The impact of this is reflected in a reduced water use trend during these years. Compared to 2008, residential water demand dropped by 12% in 2010.

Another important aspect is that increased water metering was accompanied by increased water payment collection rates. Due to the Law on Restructuring Indebtedness and the opportunities of water payment debt forgiveness under the condition of partial debt repayment and installation of meters, collection rates reached 119% (including arrears) in 2003 as compared with the average of 20% in 2000. An increase in collection rates, in turn, enabled water utilities to provide better water services. Thus, there was a gradual increase in the average duration of water supply, which normally leads to an increase in water consumption. For example, in Yerevan the duration of water supply increased from 3 hours per day in 2002 to 21 hours in 2010. In other regions on average water supply duration in 2005 was 4-7 hours reaching 10-14 hours in 2010.

Finally, an overall increase of water metering is accompanied by a growing trend of metered water sold, indicating that Armenian water companies are succeeding in incorporating large water users into the metering and billing system. This is an important factor, taking into account the high level of water theft and corruption practices of colluding with big and powerful water users (Harutyunyan 2012). At the same time, simplification and clarification of meter testing and replacement procedures can facilitate commercial water loss prevention (Harutyunyan 2014b).

Energy efficiency

Efficiency in the use of energy was measured as annual electrical energy costs expressed as a percentage of total annual operational costs. As seen in Figure 5.4.19, under private management and operation, water utilities improved energy efficiency. There is a general trend of reduced energy costs for four water companies. Only the Lori company did not register improvement, which could be partially explained by the geography that creates poor possibility to use gravity pressurization and distribution. A large amount of energy is required for servicing the high lift areas of the water system.

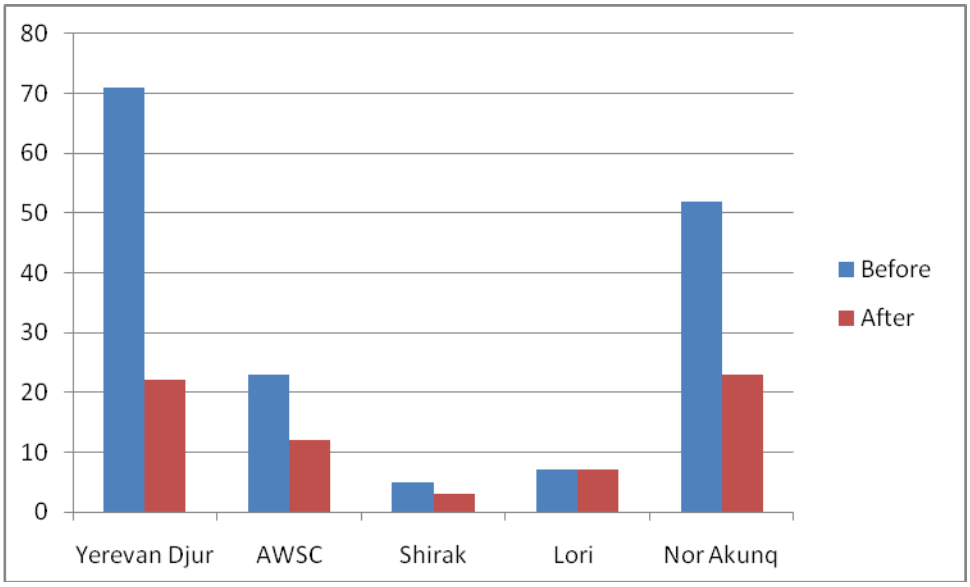


Figure 5.4.19 Energy efficiency (%)

The cost of energy was lowered through water utility energy efficiency measures, e.g. pumping station rehabilitation, sectorization, leak detention and repair, and diversion from pumping to increased gravity use. For example, Yerevan Djur conducted extensive energy efficiency investments, which proved to be highly cost effective with short payback periods (Table 5.4). In some regions, the company increased gravity use by laying pipes from the river up to transmission mains, straitening the pump wheel to adjust the charge for the demand, and improve the pumps. In other regions, more energy efficient pumps were installed and/or rehabilitation and leak detection works resulted in considerable water savings, making pump operation needless. Within the period of 2005-2010, measures implemented by Yerevan Djur for improving the gravity and pumped water source management resulted in a reduction of the share of mechanical water supply in favor of increased gravity water supply – from 43.4/56.6 to 31/69 (YD 2011). Needless to say, energy efficiency savings lead not only to economic and environmental benefits but also enhance energy security that is today of primary importance in Armenia.

Table 5.4 Cost-effectiveness of energy efficiency measures

Benefits:	Average annual electricity savings	4.83 mln USD/year
Costs:	Energy efficiency measures: - Sectorization (14.68 mln USD) - Pumping upgrade, leak detection, gravity use (2.1 million USD)	16.78 mln USD
Simple Payback:		3.5 years

Source: based on ESMAP 2011

Non-revenue water

Non-revenue water represents the difference between water supplied and water billed expressed as a percentage of total water production. Despite the drastic increase of collection efficiency and mass introduction of consumer water meters, private water companies face difficulties in operating more efficiently and reducing non-revenue water volumes. On all utility level, non-revenue water went up from 81.3% in 2005 to 83% in 2010 (Figure 5.4.20). Along with that, there is a gradual positive trend of non-revenue water reduction observed since 2007. After solving urgent issues (supply hours, metering, collection, etc), the companies started tackling down to the obviation of both real losses due to deficiencies in transmission and distribution systems and commercial losses due to unauthorized consumption and meter inaccuracies (see section on metering above).

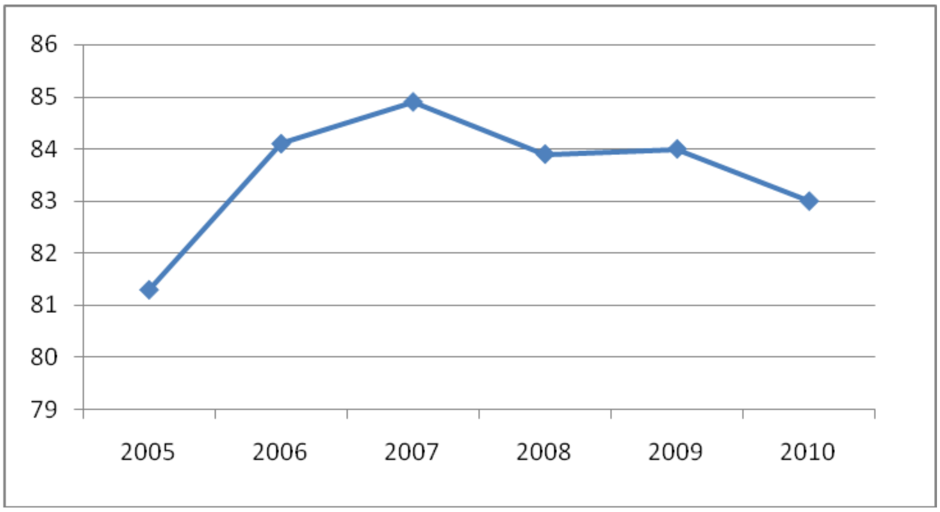


Figure 5.4.20 Non-revenue water trend for all utilities (%)

The analysis of non-revenue water for utilities individually is presented in Figure 5.4.21. Under private management and operation, three medium and small size companies succeeded in reducing non-revenue water, whereas the two biggest utilities are unable to reverse non-revenue increasing trend.

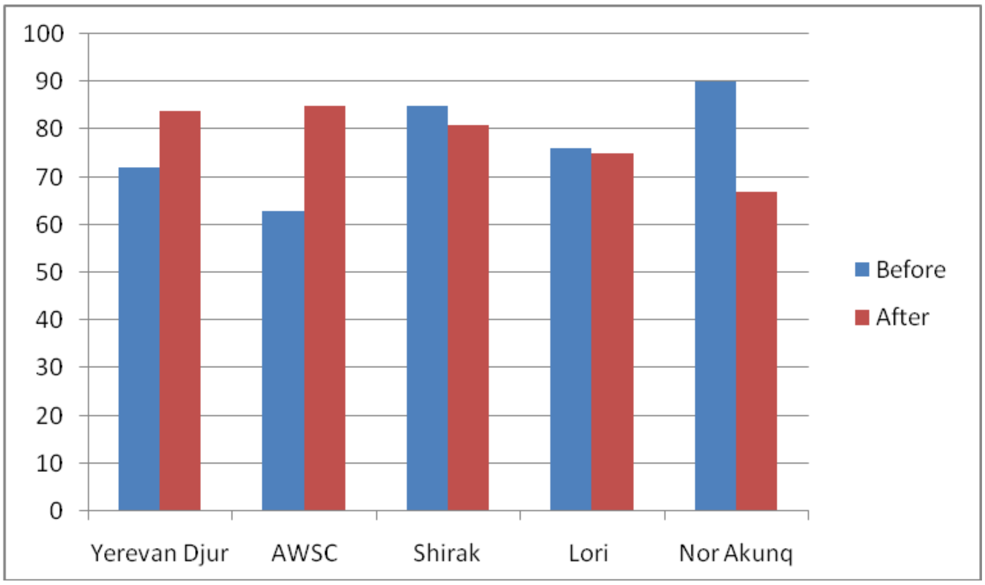


Figure 5.4.21 Non-revenue water (%)

In general, the high level of non-revenue water normally is the result of poor cost containment, and insufficient technical and managerial practices. On the background of the increased duration of water supply, companies fail to properly implement regular and preventive procedures for reducing water losses through old pipes.

The state of the pipe network can be measured through the number of pipe breaks for which there is most readily available data. The analysis of pipe breaks indicator (total number of pipe breaks per year expressed per km of the water distribution network) represents a surrogate indicator for the state of the network and for operational and maintenance practices. Figure 5.4.22 demonstrates that Lori and Nor Akunq that had very high number of pipe breaks in the "before" situation, drastically reduced it in the "after" case, which was reflected in the improved non-revenue water indicator. The reverse is the case with Shirak and Yerevan Djur that are experiencing a gradual worsening of the ability of their piping network to provide services to customers. However, the poor condition of water pipes is not always the main reason of non-revenue water. For example, in Armavir (Nor Akunq service area), about 70% of pipes were restored, and water supply duration was increased to 22 hours. However, NRW decreased from 87 to 70% only (WB 2011). This is partly due to lack of pressure regulation and the high level of commercial losses. Another factor responsible for high non-revenue water is the wide spread problem of inaccurate water metering readings because of outdated meters and tampering practices (for example, the use of magnets). Finally, the high level of non-revenue water indicator is also explained by the possibility of water theft and corruption practices of colluding with big and powerful water users.

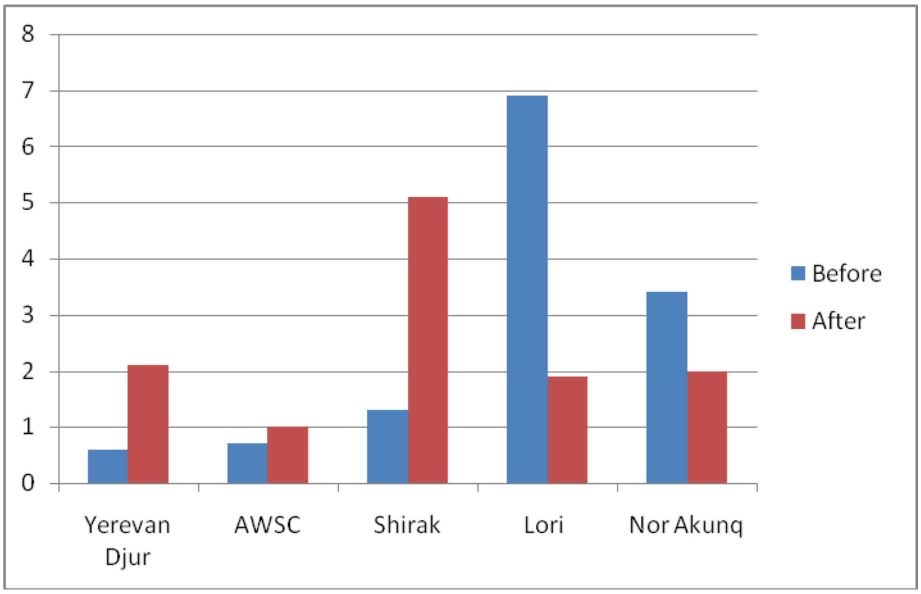


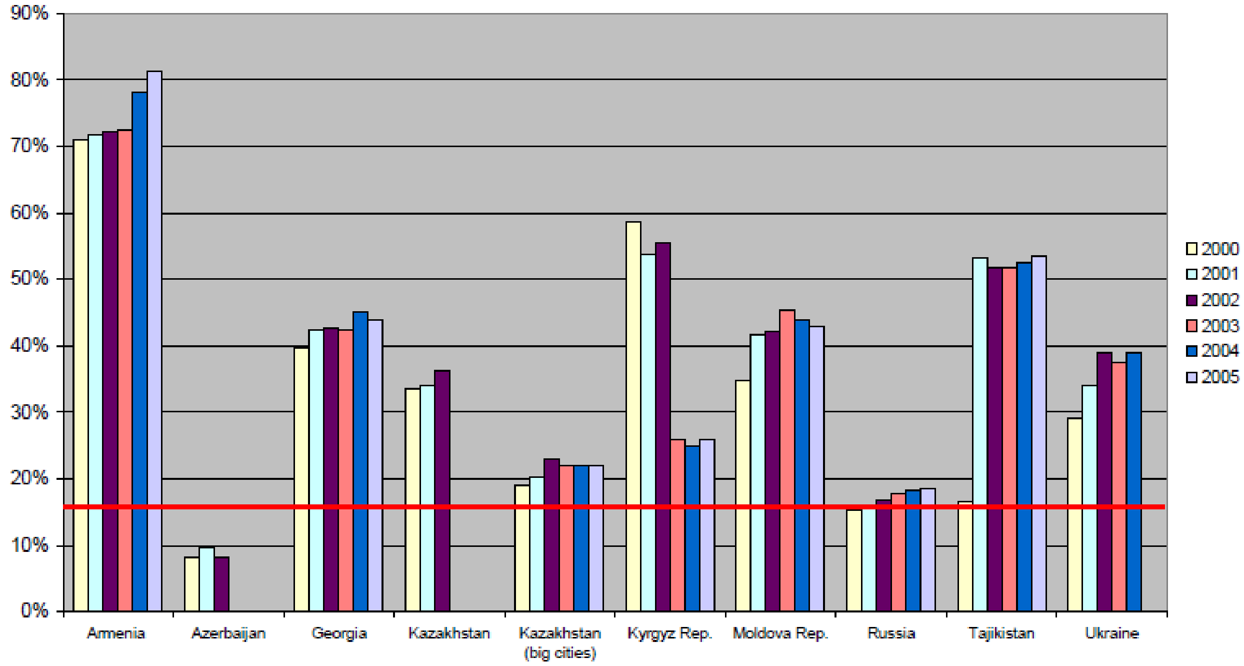
Figure 5.4.22 Number of breaks per year per km

Picture 5. Water pipe changed during repair: Photo by Naira Harutyunyan

It is important that the non-revenue indicator was not selected as a performance indicator for any of the public-private partnership contracts. The justification is the perception of the high level of water availability and the absence of metering, which according to decision makers makes it meaningless to target non-revenue which could not be estimated. Indeed, this sounds awkward, especially taking into account that there was a goal to introduce metering within a short period of time on mass level throughout the country, which was actually done.

Picture 6. Water pipes water pipes from Erebuni fortress (modern Yerevan, Armenia), constructed in 1st century BC and used over 2000 years: Photp by Naira Harutyunyan

However, the drastic increase in metering did not result in introducing the non-revenue indicator among the performance indicators. Taking into account that non-revenue is still very high in Armenia, incorporation of a non-revenue indicator in the performance indicator list seems viable. This is on the background that non-revenue water in Armenia is the highest among the NIS countries (Figure 5.4.23). However, these figures should be taken with caution. Since many of these countries lack metering (none of them have universal metering), their reporting figures could not be as reliable as the figures available for Armenia.



Source: OECD 2007

Figure 5.4.23 Non-revenue water in NIS countries

The break-down of the non-revenue for AWSC is estimated as 45% in technical losses (leaks and ineffective management), 55% in commercial losses (theft, illegal connections or inaccurate billing). About 50-65% of losses are due to arrangements of metering and supply within the property boundaries of buildings and houses, which the utilities are unable to control. Better management transfer of responsibility and operation of these systems within the property boundaries to the AWSC operator may improve the situation. However, this may require additional investments (WB 2011). *Zoning and sectorization* for identifying the priority rehabilitation needs and regulation of water pressure may considerably reduce water losses and increase water supply duration. Also, the transfer of meter ownership and management to utilities, relocating them outside the dwellings, rationalizing meter operation in buildings, and locating meters in safe boxes will reduce commercial losses (WB 2011).

5.4.4 Sustainability performance

The previous section presented the analysis of the core performance indicators clustered in three dimensions: economic, social, and environmental. It is also important to refer to these connected areas simultaneously. This can be done by developing a sustainability performance measure which will be used to track the overall sustainability development performance of water utilities. Studies on utility performance point out that in case of having a large number of separate but related indicators, performance indexing can be used as a practical management tool for aggregating various data sets into an overall sustainability measure.

The performance indicator is the outcome of a comparative analysis of a performance measurement in relation to the corresponding performance target. Instead of the target, a past performance can be used for comparison. The aim of the index is to provide a fast, overall picture of performance. The advantage of using indexes certainly rests in their ability to condense the information reflected in a great amount of variables into one number and demonstrate what is happening overall (TRADE 1995).

In general, there is no set procedure for producing indexes. At the same time, there are a number of concepts that need to be followed. The fundamental one is that all the indexes are architected for a certain objective and that proper and related indicators are selected and conjoined in a way that contributes to the purpose of the index (TRADE 1995).

This section extends the analysis and provides two approaches of estimating the ex-post performance that combines the core indicators into summary indexes for presenting both relative and absolute measures on sustainability performance of water utilities and developing scores for overall rankings among all studied utilities. The Apgar score for measuring the general health of utility operation is also developed.

5.4.4.1 Relative sustainability performance

Among the most popular methods of estimating overall performance is the one based on a linear combination of weighted parameters. Employed in the research is the *performance relatives method* proposed in the Handbook of Techniques and Tools developed for the US Department of Energy (TRADE 1995). The method is based on incremental changes in a number of indicators, relative to a baseline period in time, and then averaging these changes or ratios. These incremental changes are referred to as "performance relatives" meaning that performance during a given period is relative to the performance during a set baseline period. It is not an absolute value. It is valid only when traced over time and compared with baseline performance. For the purposes of the present research the baseline is the "before" case.

In the analysis, the relative sustainability performance index (SPI_{rel}) is based on incremental changes (performance relatives) used to show the relative weight or progress in the performance of each water utility compared to its baseline (the "before" case). The performance relative is a number that compares the value for an indicator in the given period to the value of the same indicator at some point in the period. It is a relative value. Absolute value of this index is meaningless, only getting its meaning when compared to the baseline.

The average of performance relatives or the performance index is calculated by using a geometric mean, which is claimed to be the most balanced method. Below is the formula for the relative sustainability performance index based on the geometric mean of performance relatives used in the research:

$$\mathbf{SPI_{rel}} = \frac{\textbf{antilog} \left(\sum \textbf{log } \mathbf{I_a/I_b}\right)}{\mathbf{n}}$$

I_a – performance indicator value for "after" period
I_b – performance indicator value for "before" (baseline) period
n – number of performance indicators in the series.

According to the formula, the performance relatives for each indicator are multiplied and then the n^{th} root is taken. In the analysis consideration is taken on how the increase and decrease in each indicator relate to performance and the baseline. The baseline here is the “before” case.

The relative SPI is designed based on ten indicators in three main dimensions: economic, social and environmental. The results of the analysis of relative SPI show that the maximum record of performance was reached by Yerevan Djur company with 597 points (Figure 5.4.24**)**. The second best performer is Nor Akunq with recorded 281 points of relative SPI. The other three companies have almost equal improvements in performance. Such significant difference of the performance of Yerevan Djur, however, needs some clarification. In sections above, the analysis referred to the exceptional case of the metering with Yerevan Djur. First, it was the first company to enter into privatization contract. Second, there was a big impact of the Law on Indebtedness that stimulated a large scale of metering at that period all over the country regardless of private or public water provision (Harutyunyan 2014 b). Hence, in the analysis, a correction factor for metering was introduced to present more pragmatic effects. As a result, Yerevan Djur performance declined to the 244 point level, ceding the leading position to Nor Akunq (Harutyunyan 2015).

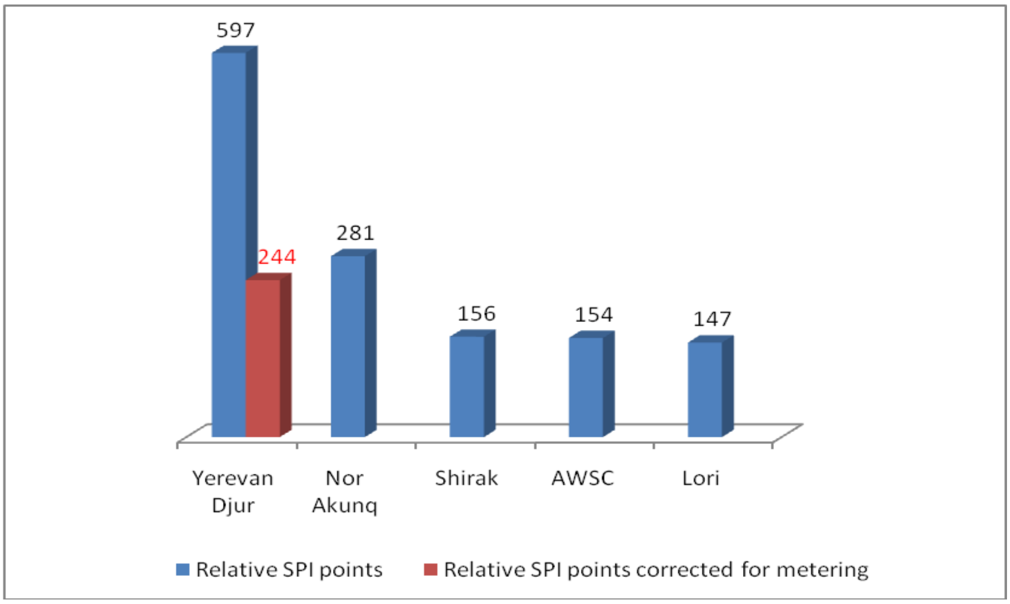


Figure 5.4.24 Relative sustainability performance

Figure 5.4.25 presents a more detailed view on the relative performance of companies portioned by each performance dimension: economic, social and environmental. Considerable achievements of companies are made in relation to social performance. Next by size of progress is the environmental performance, which is led by Yerevan Djur with a score of 180 points, followed by Shirak (170 points), Nor Akunq (169 points) and Lori (109 points).

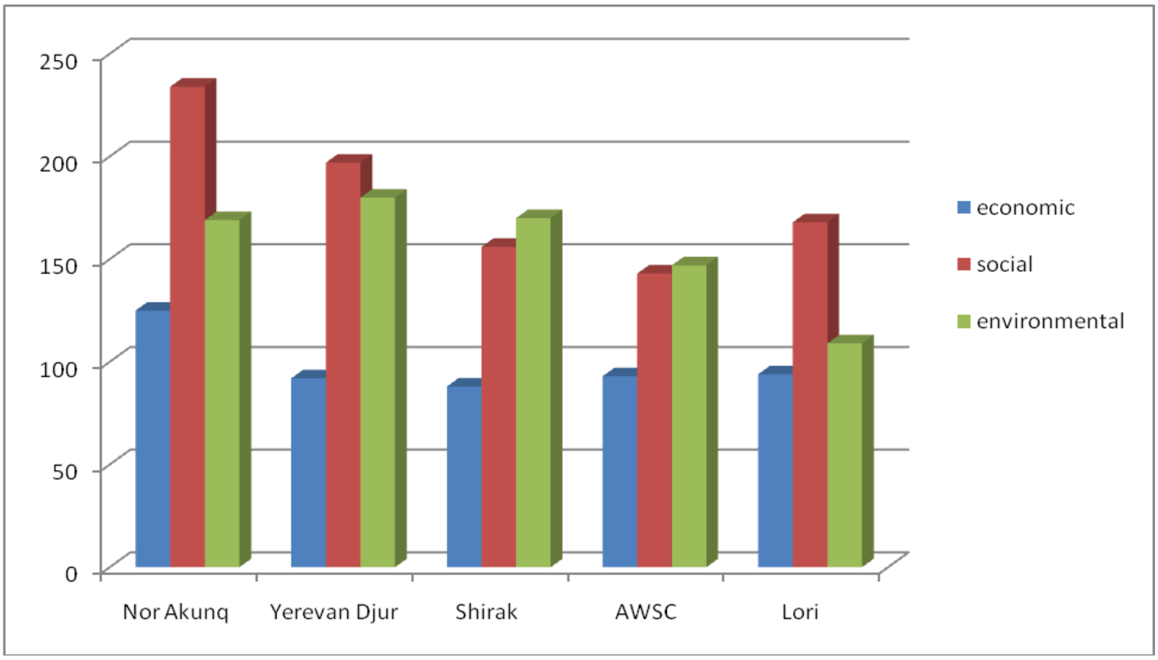


Figure 5.4.25 Split of relative SPI into economic, social and environmental performance

The split of relative environmental performance demonstrates the highest progression achieved by all water utilities with metering (Figure 5.4.26). Relatively significant improvement was also recorded in energy use performance with the highest 330 and lowest 120 scores traced with Yerevan Djur and Lori, respectively. Figure 5.4.26 also shows there is room to make significant improvements in non-revenue water. In comparison with the "before" performance the two biggest water utilities reversed progress with non-revenue water.

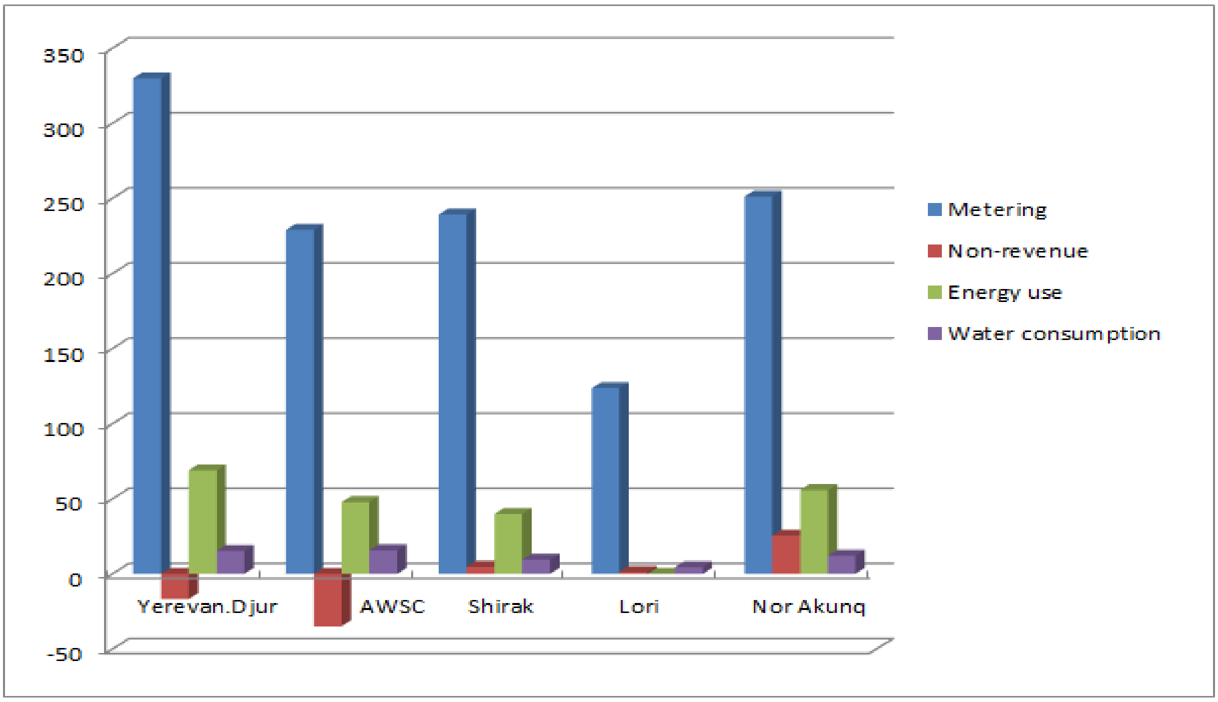


Figure 5.4.26 Split of the relative environmental performance

From the analysis of individual indicators it is seen that currently the level of metering is very high. This means that in further assessments the impact of metering on progress will be quite low. Hence, for recording environmental progress more efforts, especially for improving non-revenue, are needed. There is still significant room for better management practices to reduce commercial losses. However, the situation is more complex with physical leakages that require more significant amounts of investment and better management practices.

5.4.4.2 Relative performance ranking

Relative ranking compares the same indicators only to each other, in contrast to fixed, absolute thresholds or targets. Table 4.2.1 presents the relative performance ranking for each water utility. The ranking in the first column is based on the points attained on the sustainability performance measure. Nor Akunq with 281 points is the leader among all water utilities in sustainability performance. The next is Yerevan Djur with 244 points corrected for metering. Table 5.5 also presents the split of sustainability performance into economic, social and environmental performances with related rankings. The best in environmental performance is still Yerevan Djur even if deflated with metering and having a negative improvement trend in non-revenue (Harutyunyan 2015). Three companies (Yerevan Djur, Shirak and Nor Akunq) are clustered in the upper level of the environmental performance with significant progress in performance, whereas two companies (AWSC and Lori) are in the lower level without much difference in performance. AWSC that provides water services in a large area is burdened with higher water leaks, higher costs and investment requirements, which negatively impacted the overall efficiency of its performance.

Table 5.5 Utility ranking on relative sustainability performance

	Sustainability performance		Economic performance		Social performance		Environmental performance	
	rank	SPI_{rel}	rank	SPI_{rel}	rank	SPI_{rel}	rank	SPI_{rel}
Yerevan Djur	2	244*	4	92	2	197	1	180*
AWSC	4	154	3	93	5	143	4	117
Shirak	3	156	5	88	4	156	2	170
Lori	5	147	2	94	3	168	5	109
Nor Akunq	1	281	1	125	1	234	3	169

* *corrected for metering*

5.4.4.3 Absolute sustainability performance

The absolute sustainability performance index (SPI_{abs}) is an absolute value derived by combining the specific core indicators into a weighted summary index. Indicators included in the sustainability performance index analysis are expressed in scores that could be compared to the baseline and goals values and the changes overtime such as a comparison with the "before" case.

The absolute sustainability performance index is built upon the method that derives a fixed scale for the range of performance for a set of selected core indicators. Then a multiplier is used for the values from the derived scale and the results are summed up. This method is based on the Kodak Safety Performance Index developing process (TRADE 1995). A ten-level performance matrix is developed for all ten performance indicators for each utility. The matrix incorporates the baseline, attainable stretch and superb goals which are built with due consideration of various studies, best practices, country priorities, utility targets and international benchmarks (for example, WHO, IBNET, Pacific Water and Water Association, etc.). In a way, this allows to ensure international comparisons as well.

For each performance indicator a relative importance (weight) and impact on the index is identified. The weights add up to 100%. The weights are selected based on logical and common sense reasoning of the research based on local knowledge of needs and priorities.

The performance matrix is designed with due consideration of how increase and decrease in each indicator relate to the performance. The baseline and goals values are devised accordingly. It is important to note that an increase in the value of the absolute SPI represents a decrease in performance. The approach to construct the baseline follows the logic of building to some extent an average minimum international performance. The same way, the stretch and superb goals are built to reflect an average high and superb international performance (Harutyunyan 2015).

Figure 5.4.27 depicts the results on the absolute sustainability performance of water companies. This pentagram diagram helps to visualize how the absolute SPI scores of water utilities can be compared with the baseline value of 700, the stretch goal of 300 and superb (best international performance) goal of 100 scores.

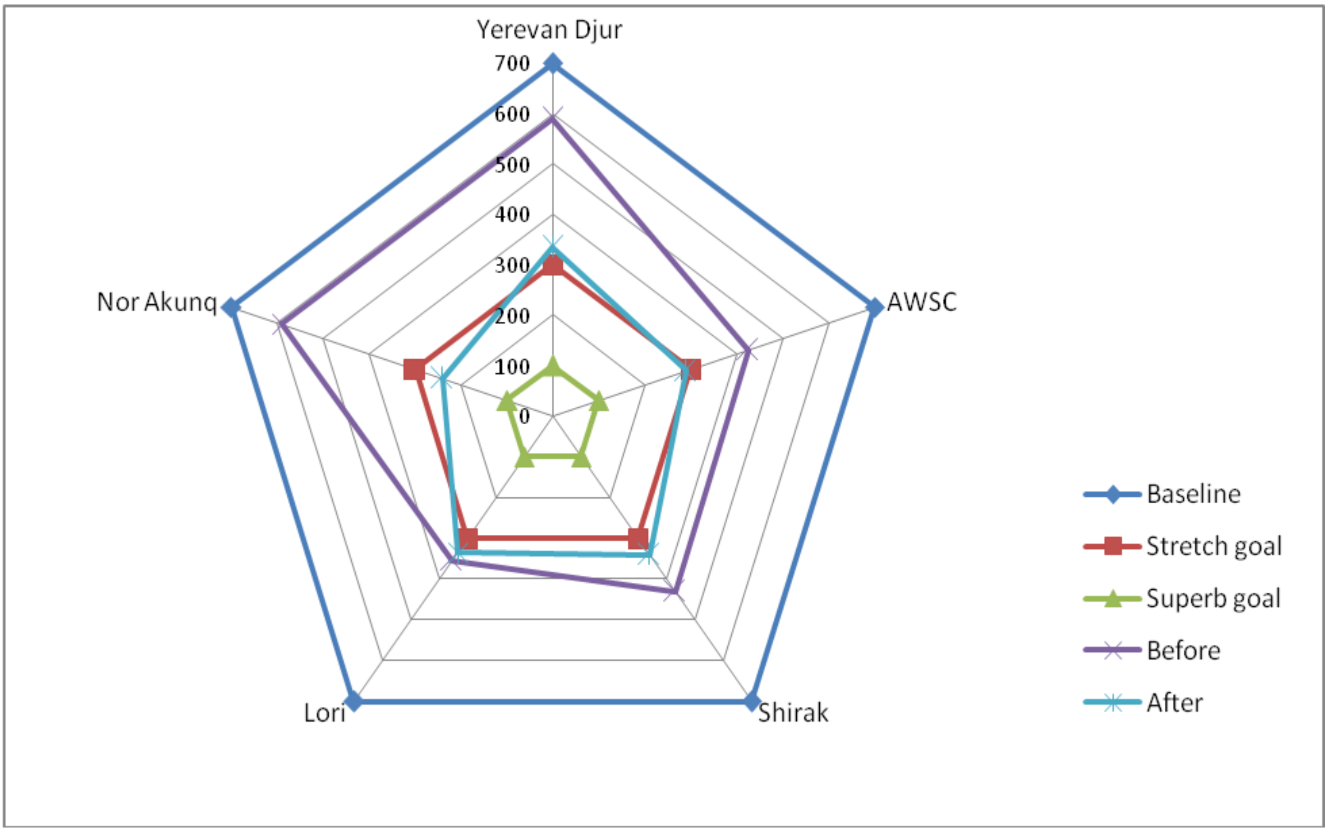


Figure 5.4.27 Water companies absolute sustainability performance

First, the current ("after" privatization) performance is compared with the "before" privatization performance. Figure 5.4.27 shows that compared to the "before" scores all water utilities have improved their sustainability performance in the "after" case. As it is seen, under public-private partnership arrangements all water companies have improved their absolute sustainability performance. Moreover, compared to the baseline (a surrogate of average minimum international performance) in both the "before" and the "after" cases all the companies score superior performance. Furthermore, Nor Akunq from the initial the lowest "before" score (590) recorded the greatest achievement in the "after" case (240). Together with AWSC scored 290, it managed to step beyond the stretch goal 300 (a surrogate of average international performance). The rest of the companies are operating close to the stretch goal: Lori and Yerevan Djur with the score of 335 and Shirak with score of 240. Overall, in addition to improvement relative to pre-privatization performance, Armenian utilities succeed in performing quite well internationally. Finally, being on a good track, all the companies still have a lot of room for improvement to reach the superb goal of 100 (a proxy of best international performance).

5.4.4.4 Absolute performance ranking

The absolute performance rankings presented in Table 5.6 for each water company are based on the points attained on the absolute sustainability performance measure. The ranking compares the absolute sustainability performance of all utilities to predefined thresholds: the baseline (700) and the stretch goal (300). It is important to note that absolute ranking is different from relative ranking (Table 5.5), which is based on the comparison with the "before" case only. In the meantime, absolute ranking reflects international comparisons.

Table 5.6 Utility ranking on absolute sustainability performance

Before	SPI	Rank	SPI	After
Baseline	*700*		*700*	
Lori	**355**	**1**	**240**	Nor Akunq
AWSC	**425**	**2**	**290**	AWSC
Shirak	**430**	**3**	**335**	Lori
Nor Akunq	**590**	**4**	**335**	Yerevan Djur
Yerevan Djur	**590**	**5**	**340**	Shirak

Water utilities that achieved and outperformance the stretch goal of 300 are highlighted in green. These are the smallest and the biggest companies: Nor Akunq and AWSC, respectively. Interestingly, two bottom companies, Yerevan Djur (the biggest company) and Nor Akunq (the smallest company), in the "before" case appeared in the top position in the "after" case. Steeper improvement of Yerevan Djur reflects its operation at the municipal level with a higher density of connections and poorer initial conditions on some indicators, such as metering and collection rates.

5.4.5 Water utility Apgar score

Calculating the Apgar score is a method developed by Dr. Viriginia Apgar for estimating the health of newborn babies on five criteria on a scale from zero to two, followed by totaling up the five values for obtaining the overall score which ranges from zero to ten. Berg and Danilenko (2010) used the Apgar score for measuring the general health of utility operation. Depending on the availability of information on sewage performance they use either five or six indicators.

In the present research, five indicators (operating cost coverage, water payment collection efficiency, affordability of water, water coverage, and non-revenue water) are used and the score is normalized to ten (the maximum score). Each criterion is assessed on a scale from 0 to 2, and the results are summed up (Harutyunyan 2015). The benchmark values are built with consideration of various studies, utility targets and international benchmarks. This enables international comparisons. The Apgar score focuses on the sustainability aspects of utility performance: economic, social and environmental. Utilities are ranked according to the following scale of overall performance:

- **Critically low** for utility score 3.6 or less (referred to as the grey zone)

- **Fairly low** for utility score between 3.6 and 7.2 (referred to as the blue zone)
- **Normal** for utility score over 7.2 (referred to as the green zone)

Figure 5.4.28 presents the overall results of the Apgar score for all water utilities. As can be seen, between 2000 and 2010 there was progress in the average Apgar score. Compared with the “before” case, all the companies, except for Shirak, moved one step up. Shirak still encounters operational cost coverage issues even on the background of significant improvement in collection.

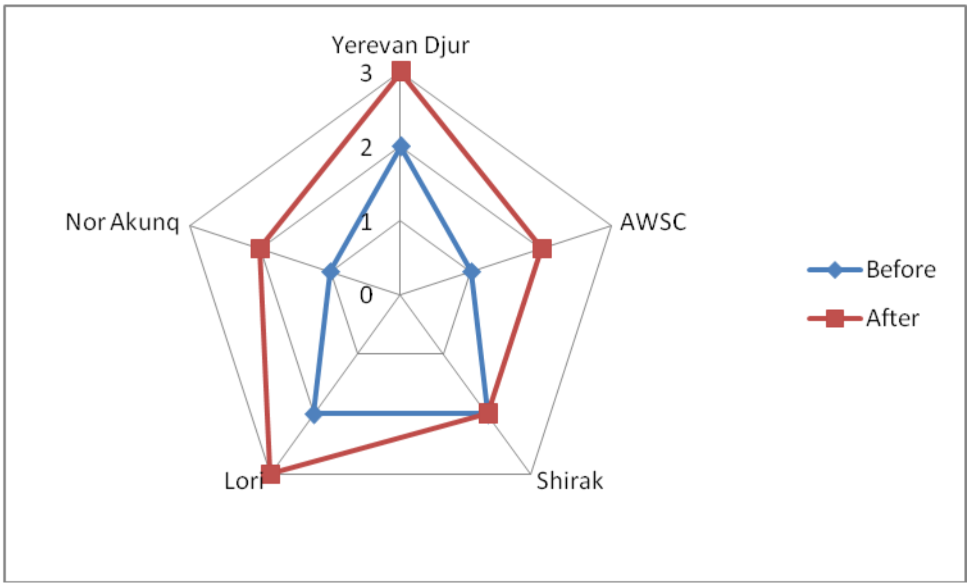


Figure 5.4.28 Water utility progress on Apgar score

More detailed results on Apgar score calculation are also presented in Table 5.6. There was no utility operating in the green (normal) zone in the “before” case. Two companies (Yerevan Djur and Lori) moved from fairly low towards performance classified as normal (marked green). At the same time, there is no more utility operating in the critically low zone as it was in the “before” case. The scale does not matter and the smaller utilities do not over- or under-perform large utilities.

Table 5.6 Water utility Apgar score

	Apgar Score	before	Apgar Score	after
Yerevan Djur	**5**	**Fairly low**	**8**	**Normal**
AWSC	**3**	**Critically low**	**4**	**Fairly low**
Shirak	**5**	**Fairly low**	**5**	**Fairly low**
Lori	**5**	**Fairly low**	**8**	**Normal**
Nor Akunq	**2**	**Critically low**	**7**	**Fairly low**

Assessing a utility performance with the Apgar score not only gives an indication of its current state. It is also an important tool for signaling water utilities about the problems to be faced in the near future and giving a good time for preventive measures.

5.5 Summary of key findings and conclusions

This chapter examined the impacts of transition to public-private partnership modes of governance in the water sector in Armenia based on the performance of all five water utilities. *Top-down approach* is used to scrutinize the privatization issue from the aggregate (utility) level from supply side, in which the water utility is the unit of analysis. The ex-post benchmarking technique was applied to assess the sustainability impacts of the privatization of water utilities currently operating under various forms of the public-private partnerships. The chapter explored impacts of water privatization along three sustainability dimensions: economic, social and environmental performance. It employed both the relative and absolute measures on sustainability performance of water utilities. Relevant scores for overall sustainability ranking among all studies utilities are derived. The performance of Armenian water utilities was also assessed on the international level. The Apgar score for measuring the general health of utility operation amplifies the research. Finally, the sustainability performance analysis allowed for the first time to calculate the weighted summary of selected performance indicators for each company. This in its turn enabled to rank all water companies and communicate their relative performance, which had never been done before, making it a pioneering study. In particular, the most important findings of this chapter are as follows:

Environmental and economic savings of energy efficiency measures can be highly cost effective

During the reported period major energy savings were gained through water utility energy efficiency measures, e.g. pumping station rehabilitation, sectorization, leak detention and repair, and diversion from pumping to increased gravity use. Extensive energy efficiency investments proved to be highly cost effective with short payback periods. In addition to the environmental and economic benefits that these results have, there are energy security issues that are today of primary importance in the country.

Unique experience of water metering: universal apartment level metering

The findings show that 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 worldwide and unique in that it is individual apartment level metering in contrast to building block level metering. Indeed, the massive metering process moved the practical implementation of water reforms from the idle point and became a trigger for a chain of water sector improvements – all backed by an enabling legal and institutional environment. It became a key measure in introducing a consumption-based tariff system, enforcing water payments. It improved reliability of water supplies and increased water use efficiency. Moreover, water metering was a prerequisite for transferring to a new public-private governance system with performance-based service contracting, obtaining more accurate data and making more pragmatic analyses of changes in the water sector.

Conservation effects of water metering: short- and long-term effects

The water conservation effects of metering were higher during the initial period after installation of meters and the last period of 2009-2010 when the tariff increased. In the short-run, immediately after meter installation, residential water consumption declined nearly four times. However, without price increase acting as a signal and substantial cuts in water bills observed by households, the result was a rebound of water consumption by up to 70%. In the long-run, however, large-scale water metering was accompanied by an almost 48% reduction of water demand, even in view of improved water supply services, such as increased water supply duration. Moreover, metering helped start the process of tackling water theft and corruption practices, especially related to substantial water uses. At the same time, simplification and clarification of meter testing and replacement procedures can facilitate commercial water loss prevention measures.

Poor environmental performance: high level of non-revenue water

Despite the drastic increase of collection efficiency and mass introduction of consumer water meters, private water companies face difficulties in operating more efficiently and reducing non-revenue water volumes. Under private management and operation, three companies of medium and small size succeeded in coping with the issue of reducing non-revenue water, whereas the two biggest utilities are not able to reverse the non-revenue increasing trend. In general, high level of non-revenue water normally is the result of the poor cost containment, and insufficient technical and managerial practices. On the background of increased duration of water supply, companies fail to properly implement regular and preventive procedures for reducing water losses through old pipes. However, the poor condition of water pipes is not always the main reason of non-revenue water, and significant pipe restoration works may not always result in significant reduction of water losses. This is partly due to the lack of pressure regulation and the high level of commercial losses necessitating more efficient regulation and monitoring practices.

Difficulties in recovering operational costs

The next finding of the chapter is that even in view of the drastic increase of payment collection rates and labor productivity, under private management and operation, water utilities had significant difficulties in recovering operating costs. If this situation does not improve, companies would have to refrain from making further investments and fall into higher dependence on public funding. These difficulties may also partly explain why some private operators did not have a positive effect on performance in reducing non-revenue water volumes.

Differences in regional and capital areas: a small company can outperform

Private sector participants are usually more willing and successful in more dynamic areas of the country where there are more opportunities to gain profits, leaving the most vulnerable regions without private investment in infrastructure, thus aggregating poverty devastation in those areas (Polischuk 2008). In water supply services, one of the small water utilities, Nor Akunq, was identified as a special case. In particular, the company was capable of outperforming all others in almost all the specific core indicators and in achieving the best improvements with sustainability performance. It was the only company that succeeded in reversing efficiency losses into efficiency gains while experiencing reduced water tariffs in constant terms. The contrast case is the AWSC with an area of service largely spread in urban and rural areas with various infrastructure conditions. Therefore, the level of services varies. This could be recommendation is to set different targets for individual towns and regions to develop more targeted investment and action plans.

Relative to pre-privatization performance and ranking

The results of the analysis of relative sustainability performance compared with the "before" case as a baseline show that the maximum record of performance was reached by Yerevan Djur with 597 points. The second best performer is Nor Akunq with recorded 281 points of relative sustainability performance. The other three companies have almost equal improvements in performance.

The results of assessment of relative ranking on the points attained on *sustainability performance* show that Nor Akunq is the leader among all water utilities in sustainability performance followed by Yerevan Djur.

The split of sustainability performance into economic, social and environmental performances with related rankings shows the best results in *environmental performance* with Yerevan Djur, even deflated with metering and having negative improvement in non-revenue. Three companies (Yerevan Djur, Shirak and Nor Akunq) are clustered in the upper environmental performance level, whereas two companies (AWSC and Lori) are in the lower level without much difference in performance. AWSC that provides water services in a large area is burdened with higher water leaks, higher costs and investment requirements, which negatively impacted the overall efficiency of its performance.

Absolute performance and ranking: successful performance compared to the "before" and international performance levels

Under public-private partnership arrangements all water companies have improved their absolute sustainability performance. Moreover, compared to the baseline (average minimum international performance) in the both "before" and "after" cases all companies record much better performance. Furthermore, Nor Akunq from the initial lowest "before" score recorded the greatest achievement in the “after” case. Together with AWSC, it managed to step beyond the stretch goal (average international performance).

The results of the absolute rankings that reflect international comparisons demonstrate that two water utilities (the smallest Nor Akunq and the biggest AWSC) achieved and outperform the stretch goal (average international performance).

Improvement in average Apgar score

The results of the Apgar score for measuring the general health of utility operation show that between 2000 and 2010 there was an improvement in the average Apgar score. Compared with the before case, four out of five companies moved one step up. There was no utility operating in the green (normal) zone in the before case. Two companies (Yerevan Djur and Lori) moved from fairly low towards performance classified as green (normal). At the same time, there is no more utility operating in the critically low zone as it was in the “before” case.

Overall sustainability performance improved under public-private partnership arrangements

The results on the comparison of performance indicators for five water utilities “before” and “after” privatization demonstrate that the participation of the private sector in the water industry proved to have a positive impact on the operation of water utilities. Under public-private partnership arrangements all water companies improved their overall absolute sustainability performance. The most significant were the gains in operational efficiency with increased levels of water metering and water payment collection rates that enabled improving water supply services through longer continuity of supply. Revenue collection is exceptionally high when weighing against international and regional experiences. It is inspiring that within the studied period there was a progress in piped water supply in rural areas.

One of the small water utilities, Nor Akunq, was identified as a special case. In particular, the company was capable of outperforming all the others in almost all the specific core indicators. It was the only company that succeeded in reversing efficiency losses into efficiency gains while experiencing reduced water tariffs in constant terms.

The final concluding point is that under public-private partnership models both small and large scale companies can operate equally successful. Moreover, though privatization of water utilities may generally lead to the sustainability of water utility performance, the scale of impact may depend on the initial state of the enterprise and the local context. Furthermore, after the low-hanging fruits are reached at the first stage, more efforts will be required for enhancing long-term sustainability and effectiveness, consistent with social and environmental needs.

CHAPTER 6 PRIVATIZATION IMPACTS ON HOUSEHOLDS

6.1 Introduction

This chapter is devoted to the examination of the effects of the privatization of water services on households. *The bottom-up approach* is based on the household survey conducted in all regions (marzes) of Armenia for examining water privatization issues on demand side. The household is the unit of analysis. A set of various statistical analysis tools (descriptive and inferential) are employed to depict household water consumption profile and identify the main factors effecting household water consumption differentiated by rural and urban areas and by utility suppliers. The estimation and ranking the quality of water services delivered by water utilities in urban and rural areas is performed. The analysis also identifies the level of satisfaction with the water payment rate and with water supply service quality. It also describes the water service improvement needs and willingness to pay for the improvements. The water conservation actions are presented that households would be ready to undertake in case of potential increase of water prices. Special attention is given to estimation of costs that households bear of water supply and sanitation services and to identification of the coping strategies (using other water sources or private equipment) that households undertake for mitigating the deficiency of water supply services with assessments of related expenses and total costs that household bear for water services. Finally, two models based on multivariate techniques are developed: multiple linear regression model and multiple logistic regression model.

6.2 Household survey research approach

Household survey research instrument is designed to answer *research question 2* and to solicit data on water services from the households - the beneficiaries of water policy reforms or sacrifice of governance failures. Contrast to data from utilities, this measure, which "*does not* *include business connections in estimates"*, enables to get a more distilled view of the impacts of water sector reforms on households (Clarke *et al* 2009). It is quite important to put "the finger on the pulse" on water end-users for identifying the privatization issues of critical importance that deserve to be taken up by the proposed research and to be heard by decision makers and policy makers to make informed and evidence based decisions. The household survey as one of the main participatory – bottom-up tool obviates the limitations of the top-down approach. Another advantage of the survey method is in its presentation of empirical results based on primary data that may be gathered from a large number of people who may be widely spread geographically (Herbert 1990).

6.2.1 Survey research design and sampling strategies

The proposed research is explanatory research what follows the *cross-sectional design* that describes the things at a single point in time. According to this design the data is collected at one point in time – as a snapshot, and then the analysis done to describe the current status of things and to make comparisons. Among the advantages of *cross-sectional design* approach is that it portraits the things as they are for the purpose of making further plans. Hence, if the results of the survey demonstrate disappointing picture then necessary changes can be further done. The cross-sectional surveys design act also as pioneer surveys where no previous research and survey has been done before. The shortcoming of this approach is that the things are changing quickly and survey data may possibly become obsolete (Fink and Kosecoff 1985). Since there are several utilities under the study, the survey design also includes the elements of the comparison design (Fink and Kosecoff 1985).

The unit of analysis in the proposed survey research is the household water consumers (or households) in urban and rural areas in Armenia. The research does not cover industrial, commercial and institutional users. Irrigation water usage is analyzed separately.

Since the complete lists of households for sampling was unavailable, 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*.

Important aspect to note is that *de facto* residence rule (Groves *et al* 2009) was used in the survey in order to reflect the issue of high migration. Another important aspect is that to a lesser extent indoor and much greater extent outdoor water consumption is influenced by the season when data is collected (Cordell et al 2003). Therefore, the survey was conducted in spring time to control the seasonal variations. The main fieldwork periods with pretests were March - May 2013, 2014.

The research aims at statistical generalization which requires that the sample be randomly drawn and representative that is ensuring that all people in the population have an equal chance of being selected. Unbiased sampling frame and probability sampling approaches are more likely to generate representative samples and accurate sample estimates (De Vaus 2002). 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 based on 95% of confidence level and the confidence interval of 10, for which a sample of 96 households is already sufficient. The survey research data was collected from all eleven marzes (regions) of Armenia making it a national survey: pan-Armenian survey (Figure 6.2.1 and Annex VI-1). The survey used the face-to-face interview as the survey procedure (more details are in the section of Fieldwork Administration of Chapter 2).

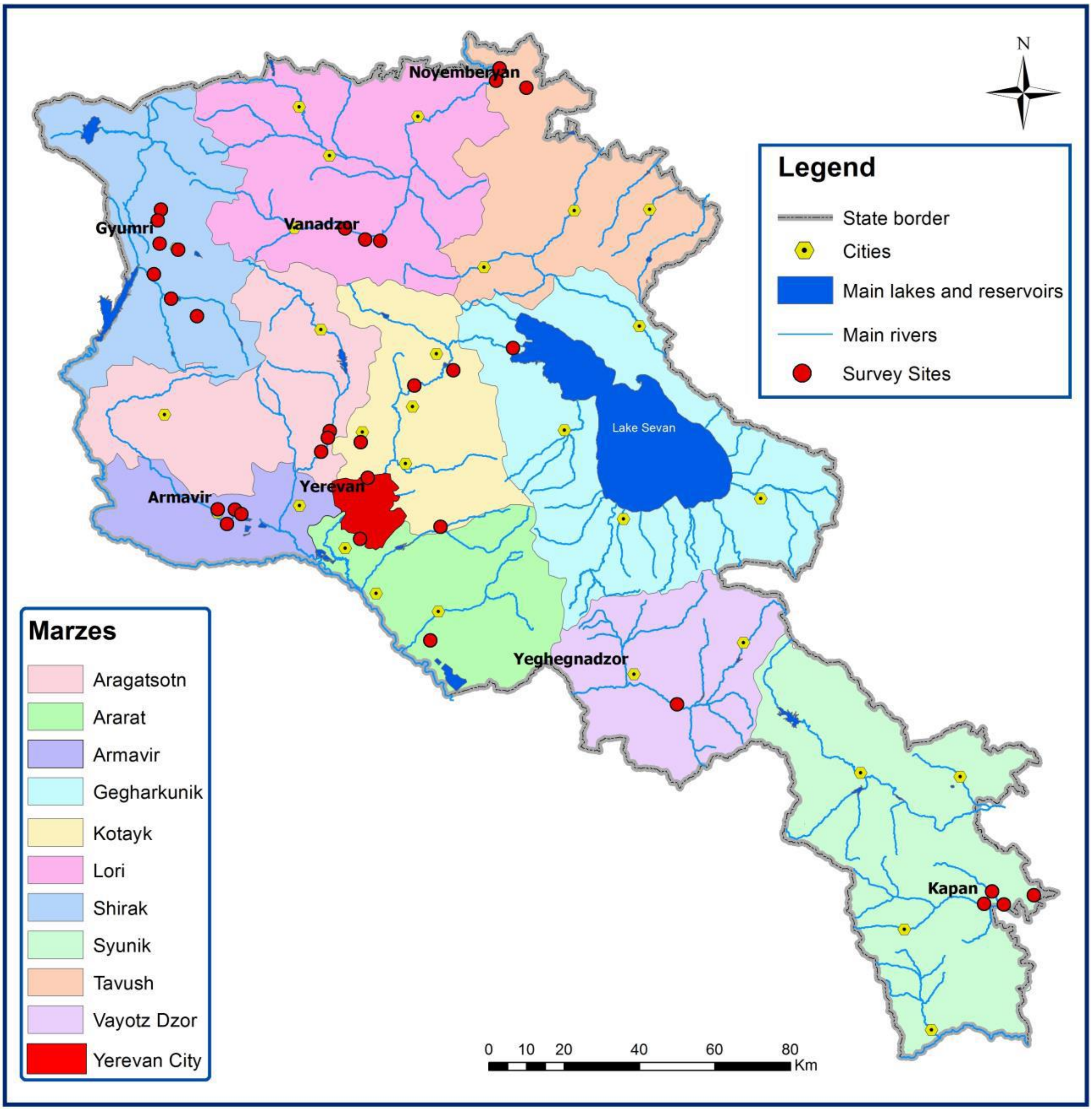


Figure 6.2.1 Regions (marzes) and survey sites

Normally, national survey samples follow multi-level (multistage) selection processes that combine random, systematic or stratified probability sampling at different levels: stratified selection of sampling units, systematic selection of households by random walk, random selection of one person per household (Hoffmeyer-Zlotnik 2003). The present research *sampling method* followed the multistage cluster sampling with preliminary stratification by geographical (water utility service area, administrative regions and urban/rural areas) and demographical characteristics. Due to time and financial resource restrictions, the probabilistic cluster sampling was combined with random route and quota sampling within the selected clusters in order to define the ultimate survey units. According to Radal and Martin (2012), by using this type of combination it is possible to achieve the same degree of representativeness as in the case of household sampling based on state authority registers.

The main sampling principles applied in the multistage selection process were the following:

- The first step was the selection on the spatial level. Hence, the clustering was done based on water utilities providing municipal water services. Average number of households (800000) based on census data, based confidence interval of 10 and confidence level of 95% comprised the base for calculating the sample size (205 with minimum requirement of 96 households). The sample size was calculated based on weighted by population. Within each cluster the selection of survey sites was done to ensure both rural and urban areas. All the utility area urban centers were covered, including capital city Yerevan where all twelve districts were selected.

- The selection of urban or rural sites and the household sampling units within the sites was performed by random route or walk sampling.

- In towns both private house and apartment buildings were selected. The first step within the apartment building was the upper floor followed by the lower floor.

According to National Statistical Service records, in 2013 urban-rural division of the population in Armenia was 63% in urban and 37% in rural areas. About 30% of population inhabits in capital city Yerevan. Figure 6.2.2 shows how this division (weights) is reflected in the sample area by settlement type of the survey research (see Annex VI-1 for more details).

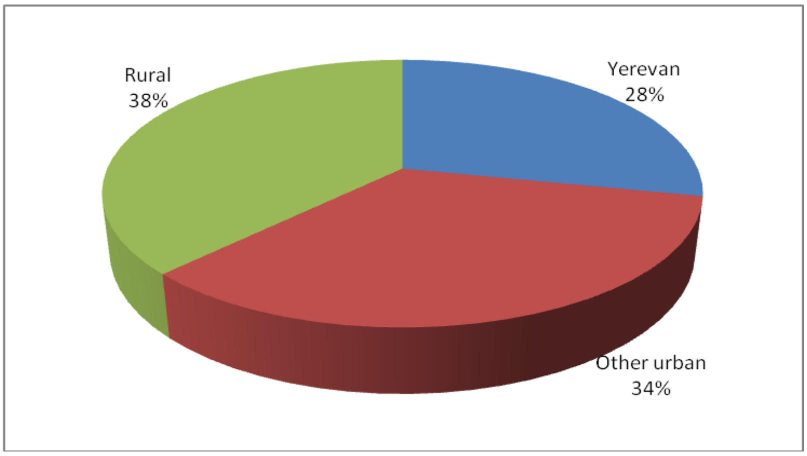


Figure 6.2.2 Sample area by settlement type

6.2.2 Survey questionnaire

Data collection was done through the standardized questionnaire that contained a limited number of open questions. A comprehensive questionnaire was designed to capture people's experience with and opinion on a variety of issues on water supply and sanitation services. Useful insights for the survey questionnaire, especially for the component on sanitation service issues, are taken from Zerah (2002) household survey.

The survey questionnaire covers the following domains: 1) background information; 2) household property characteristics; 3) household characteristics; 4) water amenities; 5) access to water and water sources; 6) water consumption; 7) water billing and payment; 8) perception on the level of services and willingness to pay for improved water service quality; 9) strategies for coping with water service deficiency and related costs; 10) comments or recommendations; 11) respondent information.

The questionnaire was translated into Armenian. Themes in the questionnaire include background information, property characteristics, water amenities, water source and consumption, equipment and other costs, water billing and payment, perception of the level of services and willingness to pay, evaluation, respondent information. In the "evaluation" section, the respondents were given the opportunity to express their opinion on the performance and efficiency of the supply and distribution systems, on communication and any conflicts between the users and supply organizations, any problem of water supply and desirable or proposed plans for improvement.

6.2.3 Data analysis

The present survey research employed various univarite, bivariate and multivariate methods of data analysis, such as frequency distributions, totals, means, percentages, range, standard deviation, crosstabulations, correlation, comparisons and regression. Correlation statistics was used to show the relationships between variables and to determine whether there are any significant correlations between certain variables (Herbert 1990). The testes for significance used Pearson, Spearman, eta and Kendall's tau correlation coefficients depending on the level of measurement of analyzed data. For example, the Person coefficient was used for looking association between interval variables, for categorical variables - the Spearman-rank order correlation (Ruane 2005, Fink and Kosecoff 1985). Comparison of means was based on chi-square for categorical data, t-test, one way analysis of variance (ANOVA), etc.

Two models based on multivariate techniques were developed: multiple linear regression model and logistic regression model. The models enable to derive the associations between the dependent variable and a group of a number of different factors.

Data analysis was done with the help of the SPSS software application. The analysis is presented in tabular, graphical and statistical ways, depending on appropriateness of each method. For some measures that require much information annexes are used. Both descriptive (for example, mode, means, and correlation) and inferential statistic (test of significance and interval estimates) methods are used.

Regarding the analysis the following points are important to mention:

- Special consideration is given to the determination of the level of measurement of variables. In general, the higher the level of measurement, the more informative the variable is. Accordingly, data measured at the interval level provides opportunity to apply wider range of more powerful data analysis techniques (De Vaus 2002). Since both categorical and continuous variables were used in the proposed survey, different analytical techniques were applied for specific levels of measurement or the variables were converted (categorized differently) from one level into another level for certain purposes (Babbie 1990).

- Though representative, the sample size in the present research is still small, therefore, it is difficult to achieve statistical significance and the likelihood of sampling errors with small samples can be much higher (De Vaus 2003).

- A number of actions have been conducted to clean data. For example, descriptive statistics was computed to compare the sample size with the number of responses to each question. In case the errors were found, checks were done with the questionnaire for finding and fixing the omitted responses or eliminating the questions entirely.

- The analysis is based on the *valid per cent values* that measures the percentage of those respondents how gave a valid response to the question, which is commonly applied approach when reporting results (De Vaus 2002:212). The cases when the number of respondents is rather limited are specifically mentioned during the analysis.

- During the fieldwork unexpected results were identified. For example, the respondents raised some important issues which were not designed in the questionnaire and their count started from the first reference after a number of other questionnaires have already been done. For example, this was the case with water payment debt which was not in the questionnaire but since people raised it themselves a need occurred to reflect it in analysis. In such cases a special note was given to that kind data analysis.

- In general, the major strategies for minimizing the effects of missing values (such as “don’t know”, “refuse to answer” or system omissions) included presenting data with mentioning about the response rate, leaving the data as it is, with missing values in place, imputing data under the sample or group mean approach or deleting the cases with missing values. Using SPSS software package helped to deal with missing values. For example, by default, SPSS logistic regression does a listwise deletion of missing data by entirely excluding the cases with missing values from the analysis.

- In case of comparing and combining the measures on variables with different distributions or comparing the variables with incomparable units of measurements, the conversion of measures on variables to standardized z-scores was implemented. The z-score enables to compare the relative position of the variables (de Vaus 2002: 171).

6.3 Results and discussion

This part of the chapter is devoted to the household survey data analysis. The analysis is grouped into seven major sections. It starts by the examination of housing and household characteristics and households’ water facilities. It then proceeds to the assessment of water sources, consumption and payment. Water debt and water quality and service issues are also referred to along with coping strategy costs that households bear for mitigating water service deficiencies. The estimations are done to examine the variations according to the urban or rural split and water supply companies. Ranking is provided for water utilities based on household perception of water service quality. Finally, the needs for water service improvement are identified and household willingness to pay more for improved water services is assessed. The discussion extends to water sanitation issues as well.

6.3.1 Housing and household characteristics and water amenities

This section aims to describe the general characteristics of the surveyed households and their housing conditions. It also portrays water equipment, bathing facilities and water discharge modes that households practice.

The surveyed households by settlement type are distributed as 62% urban and 38% rural areas (Table 6.1) covering all 11 marzes (regions) of Armenia. The distribution by marzes is presented in Annex VI-1 and Figure 6.2.1.

Table 6.1 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 6.3.1 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.

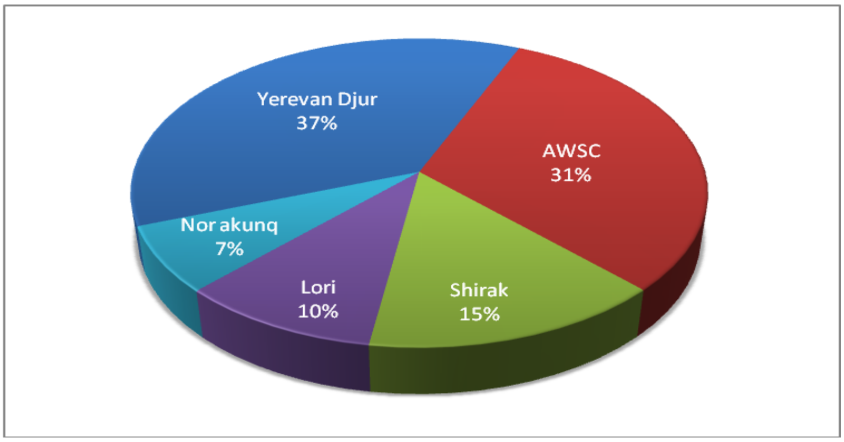


Figure 6.3.1 Distribution of households by water supply utilities (%)

6.3.1.1 Characteristics of housing

In the survey research the vast majority (94%) of households are owners and 4% of households rent their dwellings. As Figure 6.3.1.1 shows, the remaining marginal share of around 2% of the accommodation belongs to the state, reflecting the massive privatisation of all state apartments in the late 1990's.

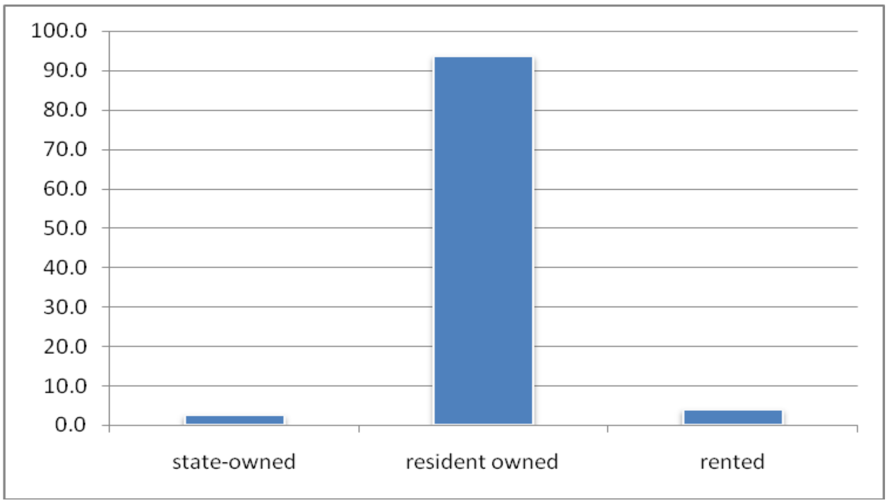


Figure 6.3.1.1 Distribution of housing according to ownership (%)

More than half of the surveyed households (52%) reside in a private house rather than in an apartment (Figure 6.3.1.2). The share of those living in apartments with 2-6 stories and 7-14 stories is 31% and 17%, respectively.

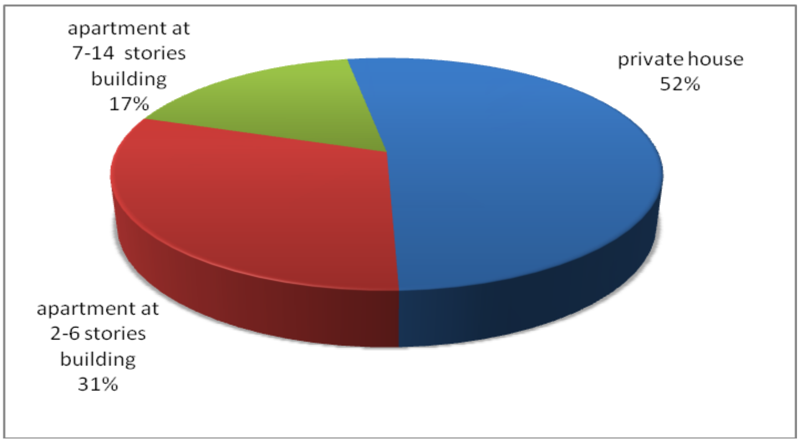


Figure 6.3.1.2 Share of housing according to dwelling type (%)

Around 60% of the surveyed households reside on the first[9] or ground floor (53% of private house and 7% of apartment residents). The average floor of surveyed apartment houses is four. The bigger concentration of apartments below the 6th floor depicts the division of dwelling units by type described above (Figure 6.3.1.3).

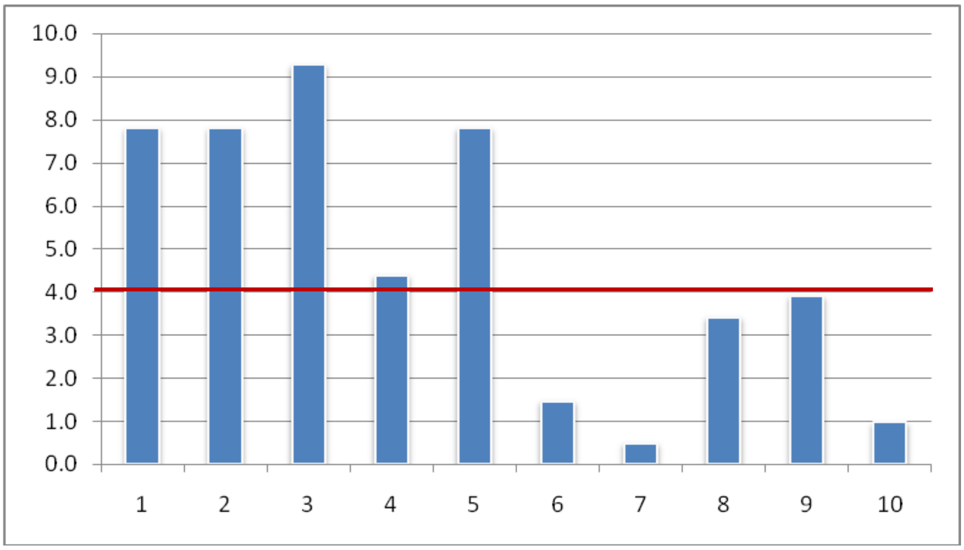


Figure 6.3.1.3 Distribution of apartment residents according to floor occupation (%)

[9] In the NIS region the counting of the floors starts from the first floor contrast to other regions where it starts from the ground floor.

6.3.1.2 Characteristics of households

In the survey sample the minimum number of currently residing household members is 1 and the maximum is 12. The average household size is 4 persons (Annex VI-2), which is significant at the level of 0.000 ($p < 0.001$) meaning that it is likely to reflect the real mean in the population. Household members not at home for more than 6 months are excluded from this account. It is important to note, that in the present study the test for normality is based on a rule of thumb of skewness (-2:2) and kurtosis (-4:4).

The monthly income level of households is presented in Figure 6.3.1.4. Overall, 86% of households have an income of less than 150000 AMD (equivalent of 360 USD). The average household income for the capital city, other urban and rural areas fall within the same range of 37000-92000 AMD (equivalent of 90-220 USD). About a third of all surveyed households could give more precise figure of their monthly income with derived mean of 93500 AMD per month per household (Annex VI-3). Even though it is significant at the level of 0.000, the reference to population could hardly be done due to the low number of households.

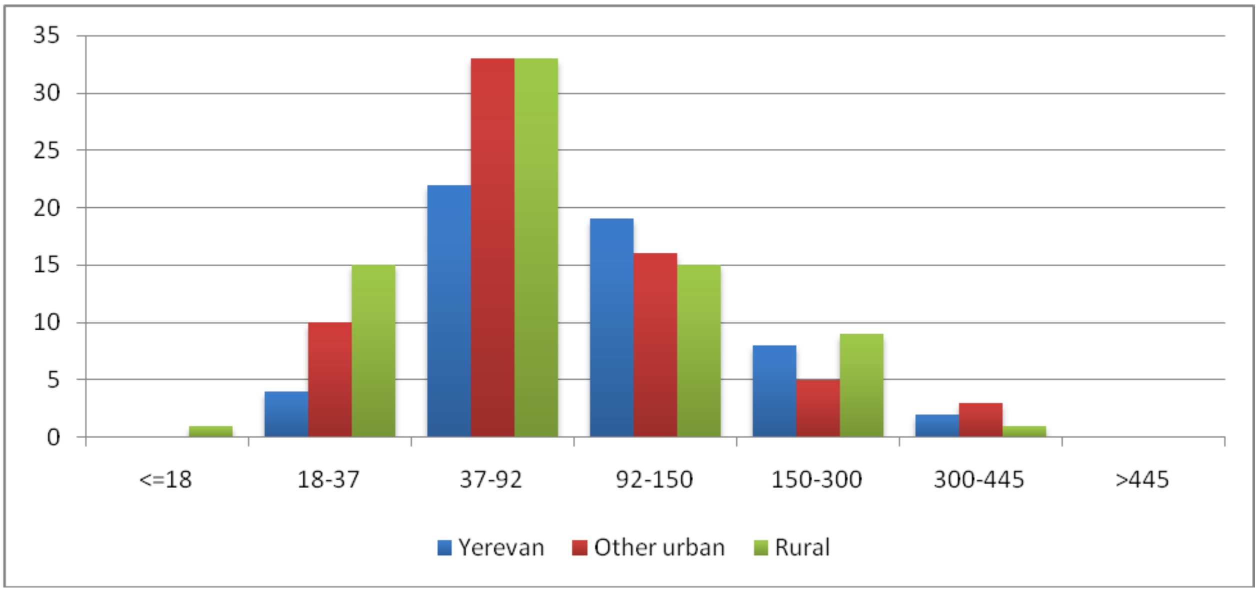


Figure 6.3.1.4 Distribution of households according to income level ('000 AMD)

For getting a better sense of these figure they can be compared to the official minimum 45000 AMD (equivalent of 110 USD) and average monthly salary of 140000 AMD (equivalent of 340 USD) in 2013. 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.

6.3.1.3 Water amenities

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 6.3.1.5). 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.

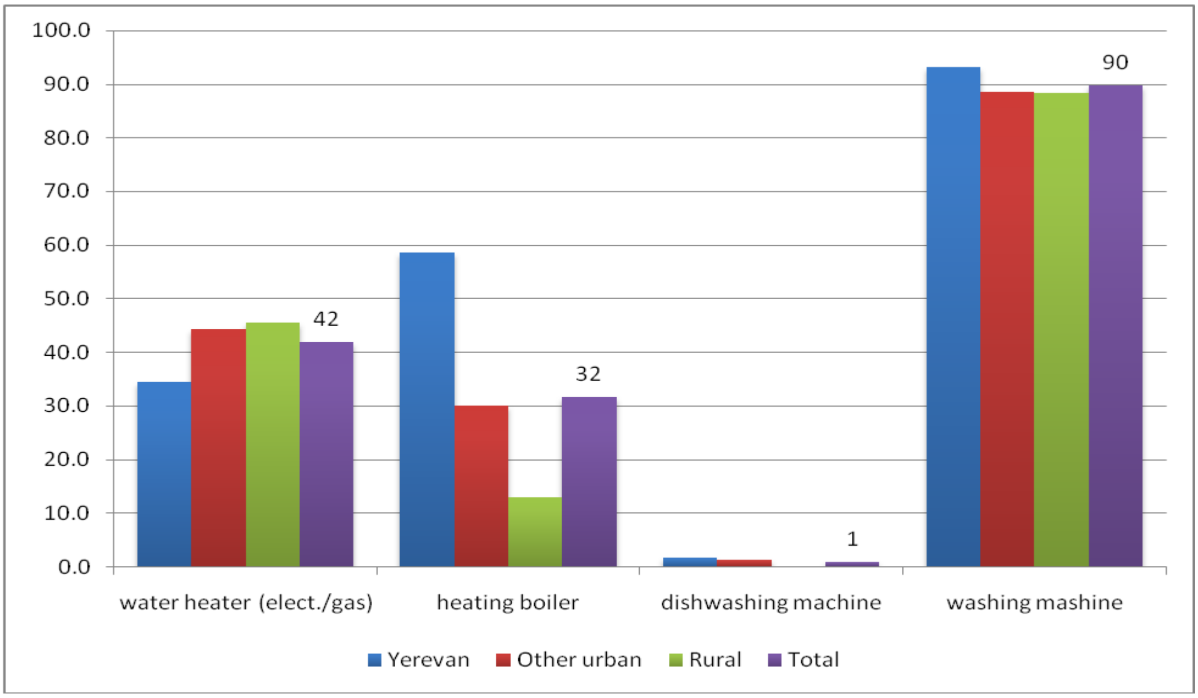


Figure 6.3.1.5 Distribution of water equipment owned by households (%)

Among the surveyed households, 73% have access to a shower. In rural areas, having a shower was reported by 54% of households (Figure 6.3.1.6). In rural areas the percentage of households using buckets is the highest (46%) compared to Yerevan (7%) and other urban areas (21%). It is important to mention that despite quite high availability of bathtubs totalling 59% with 85% in capital city Yerevan, the practice of filling a bath for bathing purposes is practically not existent. The average time for showering is about 20 minutes, with the frequency of 3.5 times per person per week (Annex VI-4).

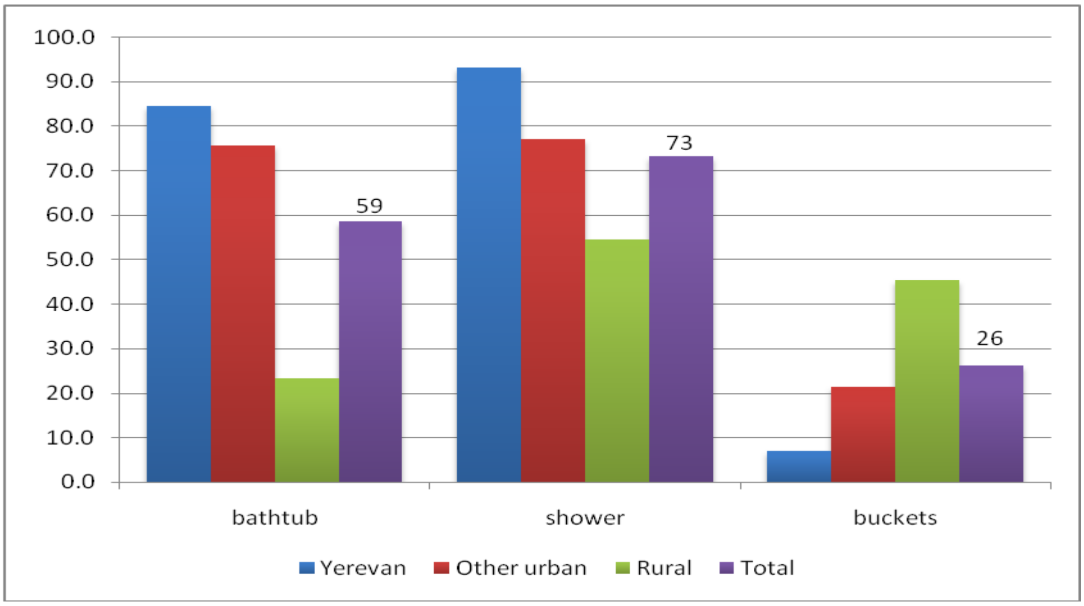


Figure 6.3.1.6 Distribution of bathing facilities owned by households (%)

The analysis of access to wastewater discharge modes reveals that 67% of surveyed households have access to the central canalization system (Annex VI-4). For the remaining households (33%) mainly in rural areas, wastewater or toilet water is discharged to roadside drains, soak pits or septic tanks. There are some villages (e.g. Zovuni or Eghvard) where half of houses are connected to the central canalisation system, whereas another part is not.

6.3.2 Access to water and water sources

This section provides the analysis of the supply modes both for municipal and irrigation water with the description of the source used, modes and characteristics of supply.

6.3.2.1 Water sources for indoor water use

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 (Annex VI-5). More precisely, the distribution of secondary sources is presented in Figure 6.3.2.1. 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.

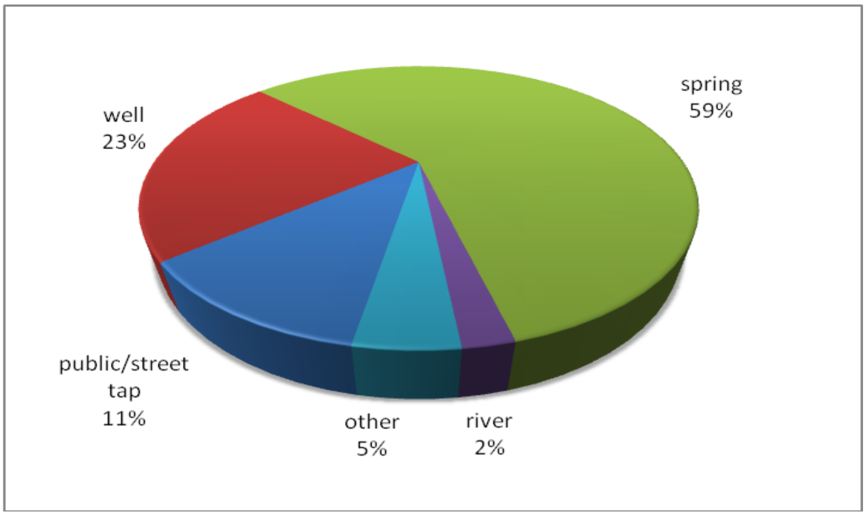


Figure 6.3.2.1 Distribution of other water sources for indoor water use (%)

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 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 (80000 AMD) 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.

Interestingly, the analysis of grey water usage shows that only 7% of respondents indicated that they reuse grey water mainly for the car washing, cleaning sidewalks and the toilet flushing.

6.3.2.2 Water sources for outdoor water use

Regarding water sources for outdoor or irrigation purposes, more than half of households that practice irrigation get water via irrigation canals (32%) or irrigation pipes (26%) (Table 6.2). Those who use municipal water (16%) do not have irrigation water supply but they want one and irrigate only in extreme cases, since it is quite expensive. Some respondents used to have irrigation previously.

Table 6.2 Distribution of water source for outdoor water use

Water sources	No of households	Percentage
Municipal connection	10	16%
Well	7	11%
River	5	8%
Irrigation pipe	16	26%
Irrigation ditch or canal	20	32%
Rainwater	4	6%
Total	62	100%

The costs that households bear for irrigation water supply services range from zero to 60000 AMD with an average of 8000 AMD per year. For avoiding the distorting effect of extreme cases on measuring central tendency value, during the analysis both the bottom and the top quartiles were cut off for getting the middle 50% of the sample. Thus, the interquartile range is 3000 - 7000 AMD per year. Of course this depends on a number of factors such as the frequency and duration of irrigation, type and area of irrigated plants, etc. Some pay a lump sum for the total irrigation season which normally starts in May and ends in September. They get water supply once in several days or a few times (5-10) within a season. Others pay a fixed amount based on irrigation area for the season or a fixed fee for each irrigation session. Some also pay a fixed amount for each hour of water supply. Finally, some village administrations provide water to villages free of charge (2%).

6.3.3 Water consumption and billing

This section provides the analysis on water consumption, billing and payment practices of Armenian households. The level of metering as a main prerequisite for transferring from fixed to volumetric water payment is also estimated along with the perception of household satisfaction with water charges. It is important to note that for minimising seasonality impacts, households were asked about their current water use this or previous month. For these purposes the fieldwork strategy was to conduct the household survey either in spring or autumn.

6.3.3.1 Household water payment

On average, households pay about 2000 AMD per month for water supply with the maximum being 8000 AMD (Figure 6.3.3.1). 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 homogenous. On average, in capital city Yerevan households pay more (median 2127 AMD) for water services per month than households in other urban areas (median 1826 AMD) and in rural areas (median 1822 AMD) (Annex VI-6). The narrower shape of the box for households in other urban areas indicates a relative similarity of payments within this group.

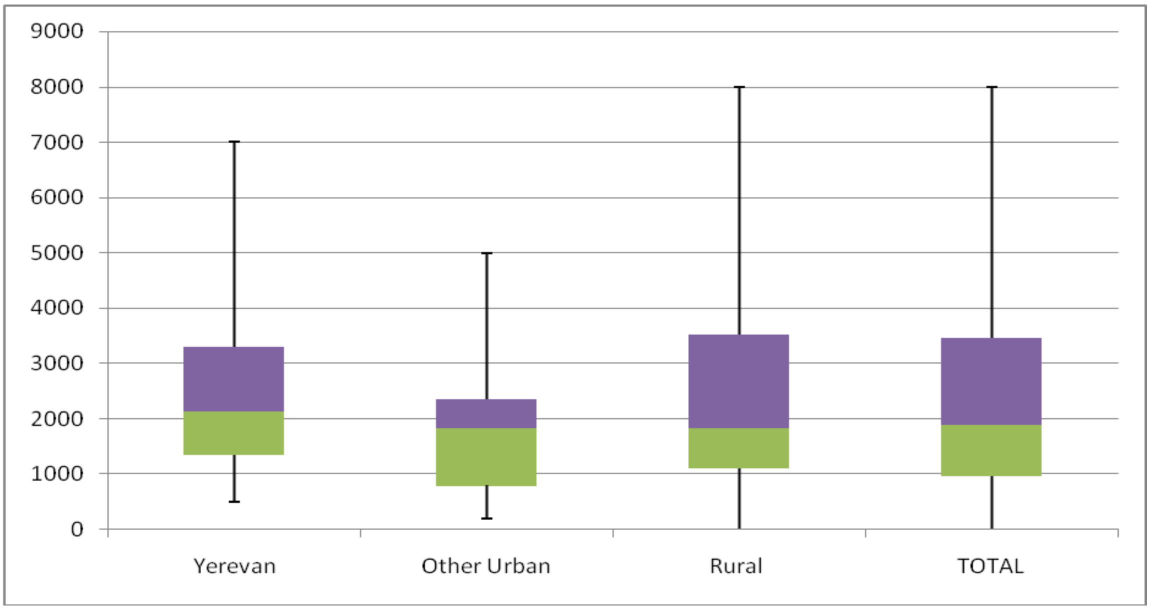


Figure 6.3.3.1 Household monthly bills for water by urban and rural areas (AMD)

[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.]

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 0.60 ($p < 0.1$).

ANOVA

Water payment

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9116309.447	2	4558154.723	2.856	.060
Within Groups	317576641.048	199	1595862.518		
Total	326692950.495	201			

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 VI-6). 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 VI-6). 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 6.3.3.2. 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), while Shirak households pay less with a median of 1414 AMD (Annex VI-6).

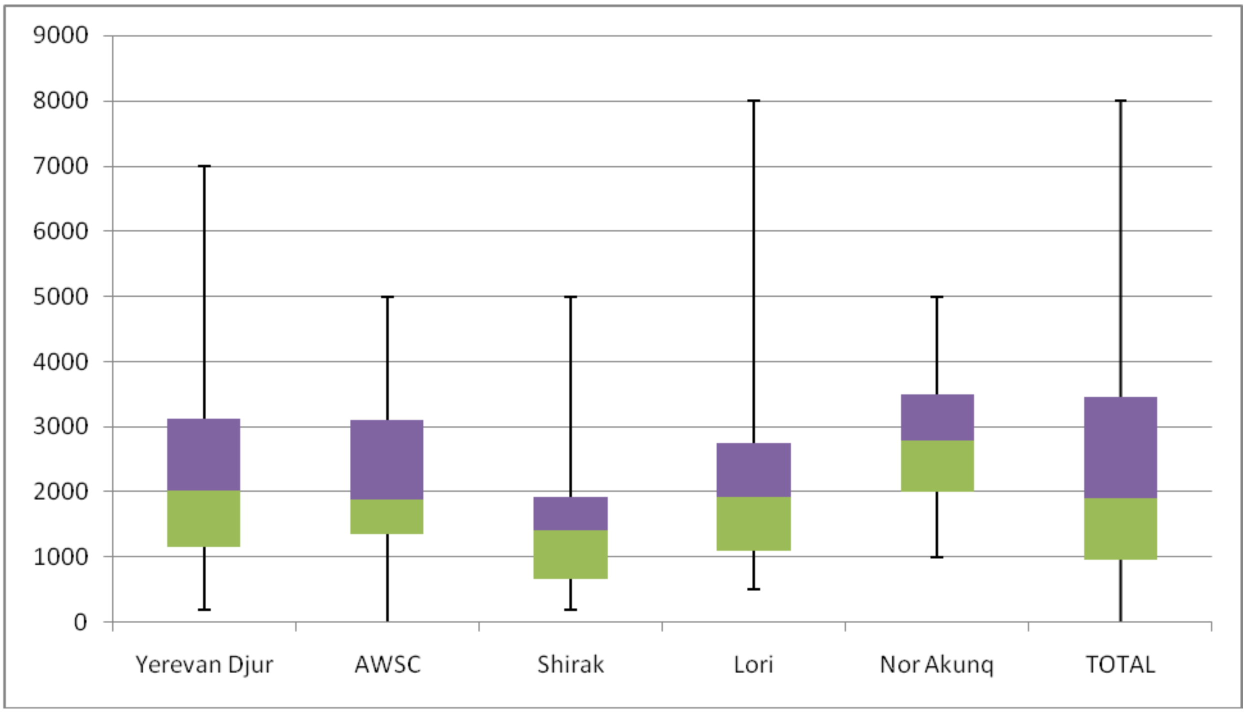


Figure 6.3.3.2 Household monthly bills for water by water utilities (AMD)

[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.]

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 ($p < 0.05$).

ANOVA

Water payment

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	28490374.305	4	7122593.576	4.705	.001
Within Groups	298202576.190	197	1513718.661		
Total	326692950.495	201			

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 VI-6). The mean differences marked with an asterisk indicate the pairs of companies that have real differences with their satisfaction level.

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 VI-7). 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 VI-7). 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 6.3). 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) (Annex VI-8). 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 ($p < 0.05$).

Table 6.3 Relationship between water payment and other variables

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

*. Correlation is significant at the 0.1 level; **. Correlation is significant at the 0.05 level;
. Correlation is significant at the 0.01 level; *. Correlation is significant at the 0.001 level.

Multiple linear regression model

The analysis goes further with development of a multiple linear regression model for predicting the water payment from a combination of a group of several variables (water facilities) with significant zero-order correlation with water payment (above Table 6.3), or to identify which variables are better predictors than the others. It is a model for the relationship between a dependent interval variable and a collection of independent dummy variables. The diagrammatic representation of the multiple linear regression model is presented in Figure 6.3.3.3. The regression coefficients of the model enable to determine the relative importance of the significant predictors when the effects of others are controlled (removed).

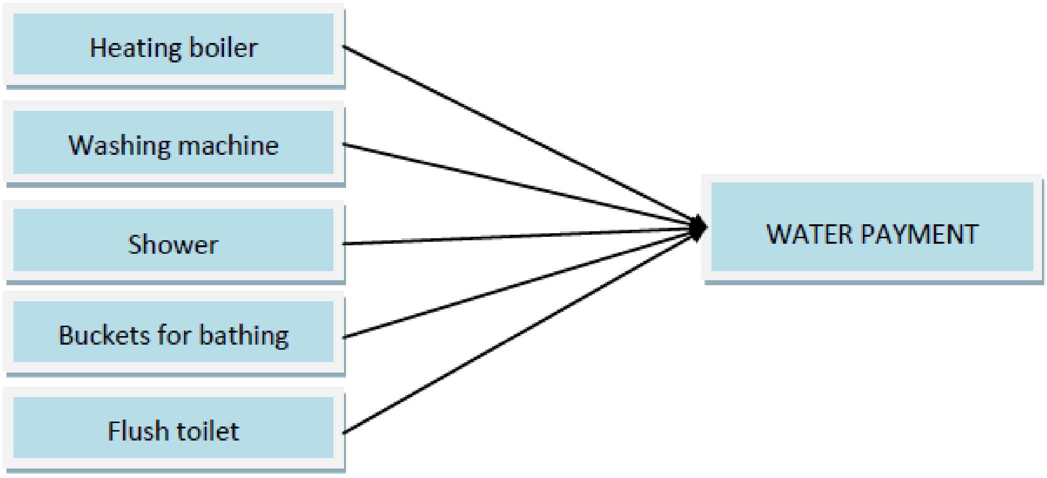


Figure 6.3.3.3 A diagrammatic representation of the multiple linear regression model

A stepwise regression technique was employed in which the choice of predictive variables is carried out by an automatic stepwise procedure: entering one dependent variable at a time and performing F-to-remove statistics with each variable in the model and F-to-enter statistics for each variable not in the model. At the next step, the predictor with the highest F-to-enter statistics is entered and the predictor with the lowest F-to-remove statistics is removed. Each predictor is constantly assessed. The assumptions of the multiple regression are:

1. Variables are normally distributed. Normality test is done for interval variables. For reducing the influence of the outliers, the value transformation method is used by changing the value to the next lowest (non-outlier) number. Normality is tested by examining the skewness (-2:2), kurtosis, histogram of standardized residuals and normal p-p plot of regression standardised residuals (Annex VI-8). The distribution of error of selected variables matches a normal distribution (the points are clustered around a straight line).

2. There is a linear relationship between dependent and independent variables. The linearity detection is used for the examination of residual plots (plots of the

standardised residuals as a function of standardized predicted values). The residuals scatter around 0 line not violating the constant variance assumption.

3. Multicollinearity is a problem that occurs with regression analysis when there is a high correlation of at least one independent variable with a combination of the other independent variables. Collinearity statistics with Tolerance and Variance Inflation Factor analysis is conducted for testing this assumption.

4. Homoscedasticity assumption that suggests that the dependent variable has an equal level of variability for each of the values of the independent variable. The plot of standardised residuals (the errors) by the regression standardized predicted value is examined.

Taking into account that the multiple regression model is based only on dummy independent variables, less stringent assumptions can be followed. In particular, the assumption taken here is that the effect of the predictor variable on the dependent one is independent of other variables and coefficients. It is worth noting that even though predictor variables can affect each other, it can still be assumed that the effect of the predictor variable on the dependent one is unaffected by other predictors.

The "Model Summery" table below provides that overall test for the model with all included predictor variables. There are two models: Model 1 with one included variable and Model 2 with two variables included. The further analysis focuses on Model 2 that shows a higher explanatory power due to higher R square value. The R square value of 0.092 is significant at the level of 0.027 ($p < 0.05$). It indicates that Model 2 accounts for 9% of the variance of the dependent variable. Hence, 9% of variance in the water payment can be explained by all variables included in Model 2 together

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.263[a]	.069	.064	1236.532	.069	14.511	1	195	.000
2	.304[b]	.092	.083	1224.216	.023	4.944	1	194	.027

The "ANOVA" table below shows F values for each model. There is a significant relationship between water payment and predictor variables of Model 1 and Model 2 ($p < 0.01$). Since it is a step wise method, only significant variables are included in both models. Non-significant ones are excluded.

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22187233.939	1	22187233.939	14.511	.000[b]
	Residual	298157410.731	195	1529012.363		
	Total	320344644.670	196			
2	Regression	29596125.400	2	14798062.700	9.874	.000[c]
	Residual	290748519.270	194	1498703.708		
	Total	320344644.670	196			

a. Dependent Variable: Water payment
b. Predictors: (Constant), Shower usage
c. Predictors: (Constant), Shower usage, Washing machine usage

The "Coefficients" table below shows a common test for multicolinearity that is examined by Collinearity Statistics. It shows that none of the independent variables in both models have Tolerance level below 0.2. Tolerance level of 1 and 0.867 means that 0% of variance of Model 1 predictor and 13% of variance of Model 2 predictors are shared with other predictors. Moreover, the Variance Inflation Factor values for both models are not greater than 5, which also indicates the absence of multicollinearity.

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	90.0% Confidence Interval for B		Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Tolerance	VIF
1	(Constant)	1553.019	169.851		9.143	.000	1272.306	1833.732		
	Shower usage	756.773	198.664	.263	3.809	.000	428.440	1085.106	1.000	1.000
2	(Constant)	1058.611	278.790		3.797	.000	597.843	1519.380		
	Shower usage	585.555	211.223	.204	2.772	.006	236.457	934.653	.867	1.153
	Washing machine usage	689.569	310.141	.163	2.223	.027	176.985	1202.152	.867	1.153

a. Dependent Variable: Water payment

Based on the results of multiple linear regression coefficients, the relative importance of the significant predictors can be established when the effects of others are controlled (removed). Model 2 constant unstandardized figure (1059) is the intercept when two predictor variables are zero. Two partial correlations for shower usage (586) and washing machine usage (690) reflect a separate effect of each of these predictor variables on the dependent variable with the effect of the other variable removed (controlled). Regression of water payment with shower usage controlling for washing machine usage is 586. Regression of water payment with washing machine usage controlling for washing machine usage is 690. Expressed in terms of the variables, Model 2 prediction formula is:

Predicted water payment = 1059 + 586*(shower usage) +

690*(washing machine usage)

Based on the multiple linear regression equation, households that use the shower for bathing purposes and use a washing machine are more likely to have high water payments. Water payment is 1059 AMD when two of predictor variables obtain zero. Switching from not using to using the shower increases water payment by 586 AMD per month. Switching from not using to using washing machine increases water payment by 690 AMD per month. These predictor variables have a significance level below 0.01 for shower usage and 0.05 for washing machine usage, which means that in the population these variables are likely to have at least this level of impact.

6.3.3.2 Household water consumption

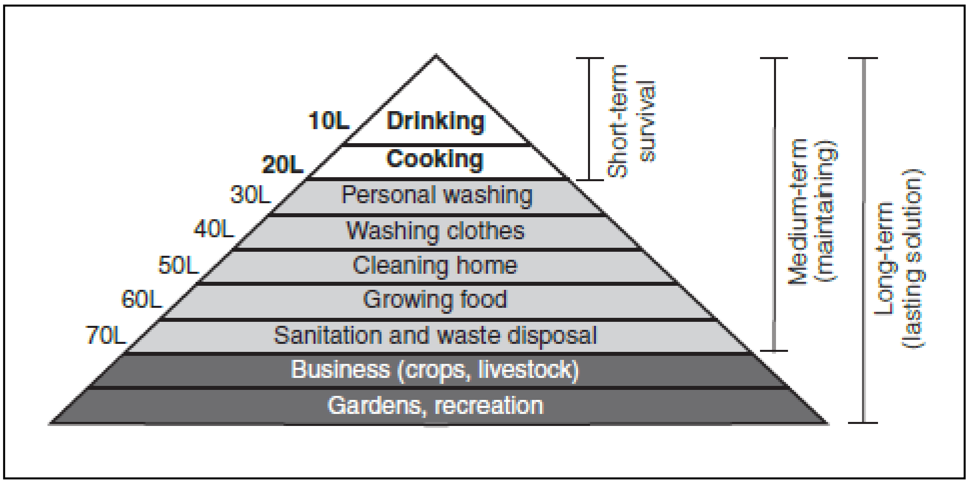
Table 6.4 resents the split of water consumption by water utilities. Interesting thing to highlight is that, contrary to the expectation, in the Nor Akunq service areas where water price is the highest (203 AMD), water consumption is the highest (13 m^3) too, while in Shirak area where water price is the lowest (172 AMD), water consumption is also the lowest (8 m^3).

Table 6.4 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

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 level) that is necessary for drinking and implementing basic hygiene and cooking for an individual is 20 litres per day (Figure 6.3.3.4). 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 6.3.3.4 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.



Source: WHO 2011

Figure 6.3.3.4 Hierarchy of water requirements after Maslow's hierarchy of needs

In this context, average water consumption in Armenia is higher than 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.

6.3.3.3 Water metering

Regarding the level of water metering, over 97% of households have water meters and pay according to meter records (Figure 6.3.3.5). Those who do not have meters installed either pay 250 AMD per person per month or a fixed amount of 1000 AMD per month.

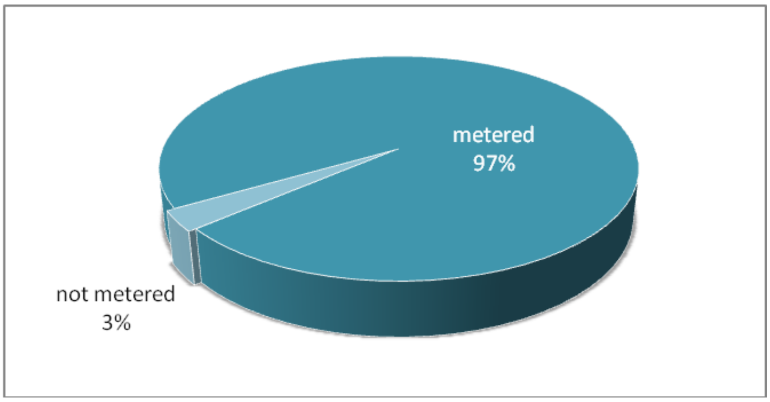


Figure 6.3.3.5 Household water metering level (%)

It is also important to note that none of responds received any technical or financial support with installation of water meters. Some of respondents noted that the minister withdrew the assistance with metering.

6.3.3.4 Water payment debts

Over 8% of all surveyed households (17) declared that they have debt issues with water bill payment. It is important to note that initially water bill payment debt issue was not designed into the survey question and during the fieldwork nothing was asked about debts with water payment. Debt issue was indicated by those who raised it by 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 6.3.3.6 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.

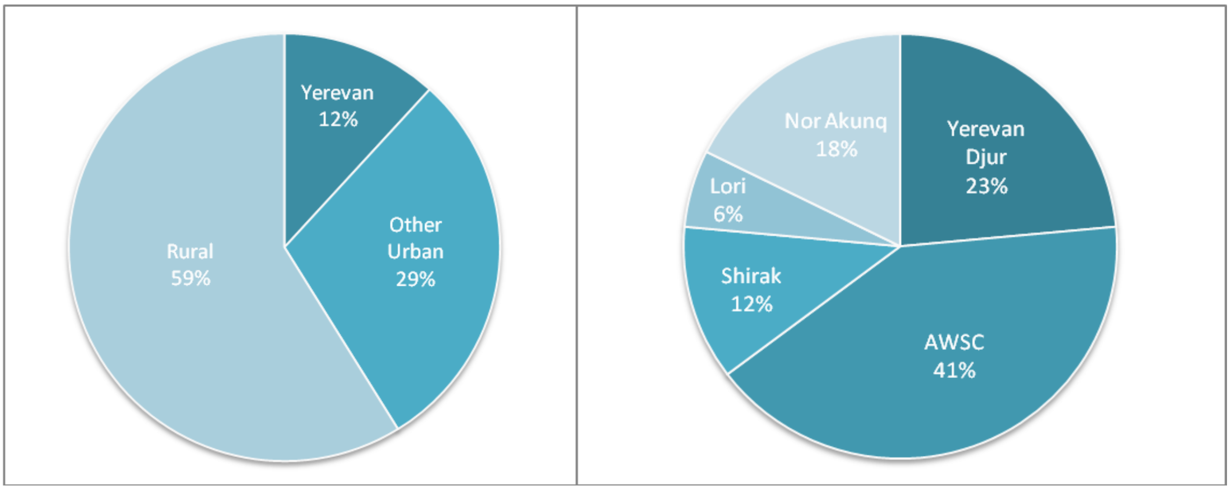


Figure 6.3.3.6 Debts for water utility bills (%)

The study revealed a considerable range of debts that amount from 2400 to 700000 AMD with the mean of 146000 AMD. The median household debt amounts to 45000 AMD. Comparing this amount with the minimum wage of 35000 AMD (84 USD), one can see that in some cases the water payment debts may reach up to 200 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 have received the 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 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 cancelled 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. The cases were also found that poor families were disconnected from water supply due to inability to repay water debts.

6.3.3.5 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 6.3.3.7). 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.

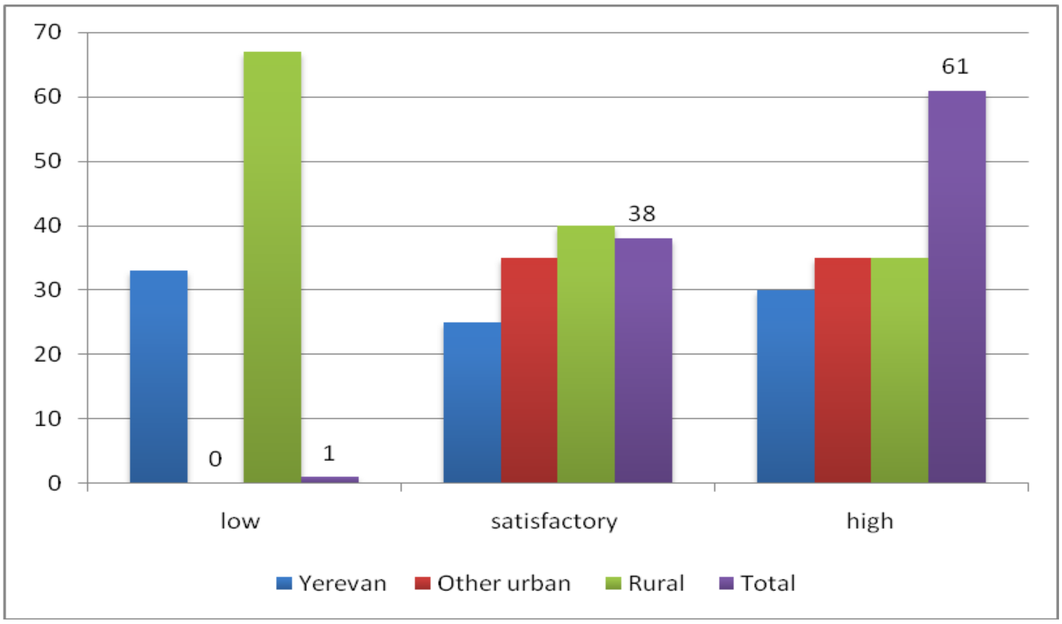


Figure 6.3.3.7 Distribution of water fee rate perception by households (%)

Regarding water payment methods, households usually pay at bank (44%) or at post (38%) (Figure 6.3.3.8). With new technological innovations, there is a new tendency to make payment through ATMs, which is yet practiced mostly in 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.

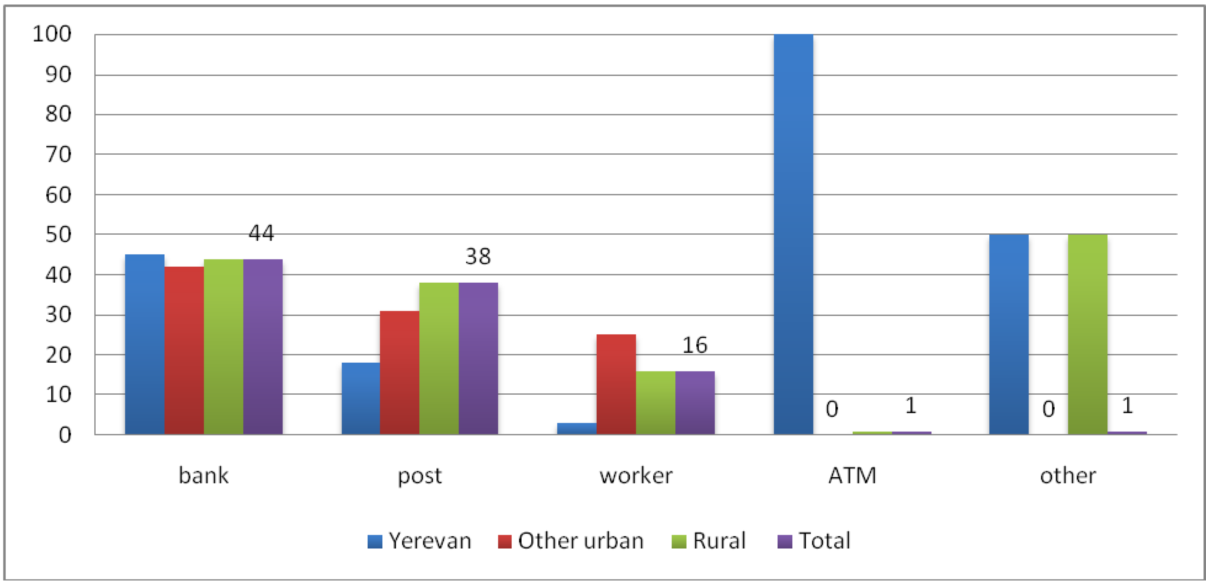


Figure 6.3.3.8 Distribution of water fee payment methods (%)

6.3.4 Perception of the quality of water supply services

This section aims to measure the level of satisfaction with the water supply service quality with variations for water companies, the problems that household face with water supply and the impact of these problems on the domestic life. The communication modes of households with water companies are also analysed.

6.3.4.1 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 satisfied and 54% are satisfied with some remarks (Figure 6.3.4.1). 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.

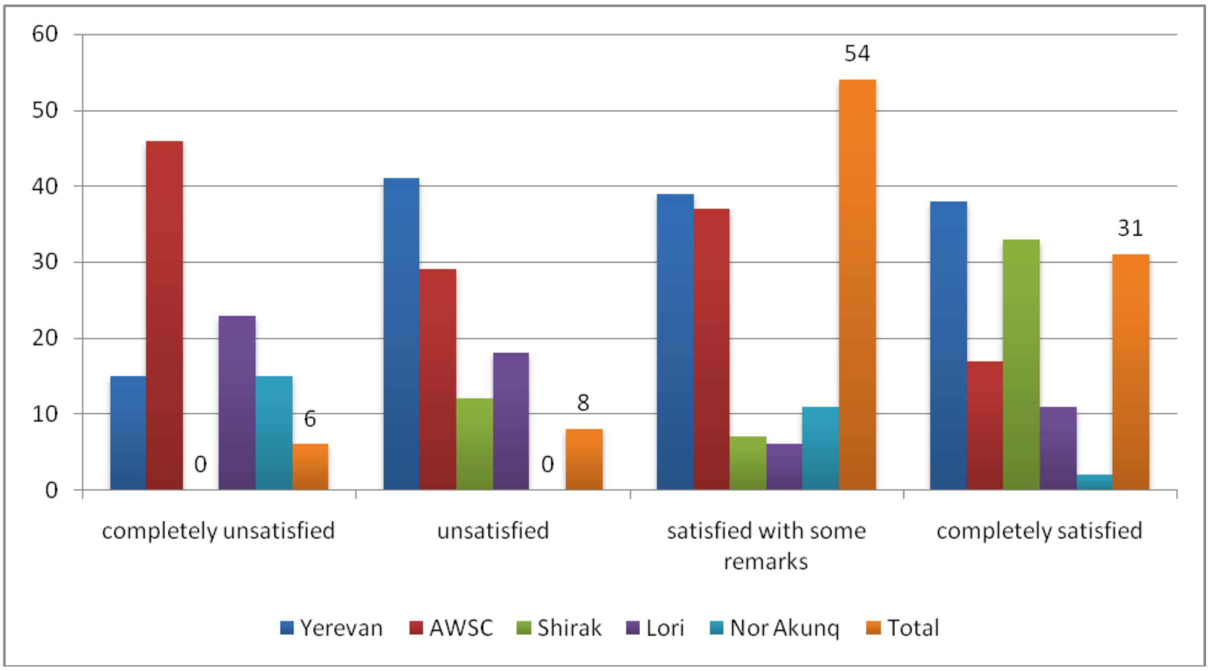


Figure 6.3.4.1 Households perception of the quality of water services for each utility (%)

On average, people are satisfied with water quality but with some remarks with grouped median of 3.19 (Annex VI-9). 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 6.5).

Table 6.5 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*

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 VI-9). 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 VI-9). 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 VI-9). 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 6.6) 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.

Table 6.6 Level of satisfaction with water service quality by urban/rural areas

	No completely unsatisf.	No unsatisf	total unsatisf. No	% of total unsatisf.	% of total HH	No satisf. with remarks	No completely satisf.	total satisf. No	% of total satisf.	% of total HH
Yerevan	1	3	4	13%	2%	33	20	53	31%	26%
Other urban	7	8	15	50%	7%	41	14	55	31%	27%
Rural	5	6	11	37%	5%	36	30	66	38%	32%
Total	13	17	30	100%	15%	110	64	174	100%	85%

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 VI-9), which does not raise the necessity to go further with significance testing.

6.3.4.2 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 6.3.4.2). One thing that is obvious in Figure 6.3.4.2 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.

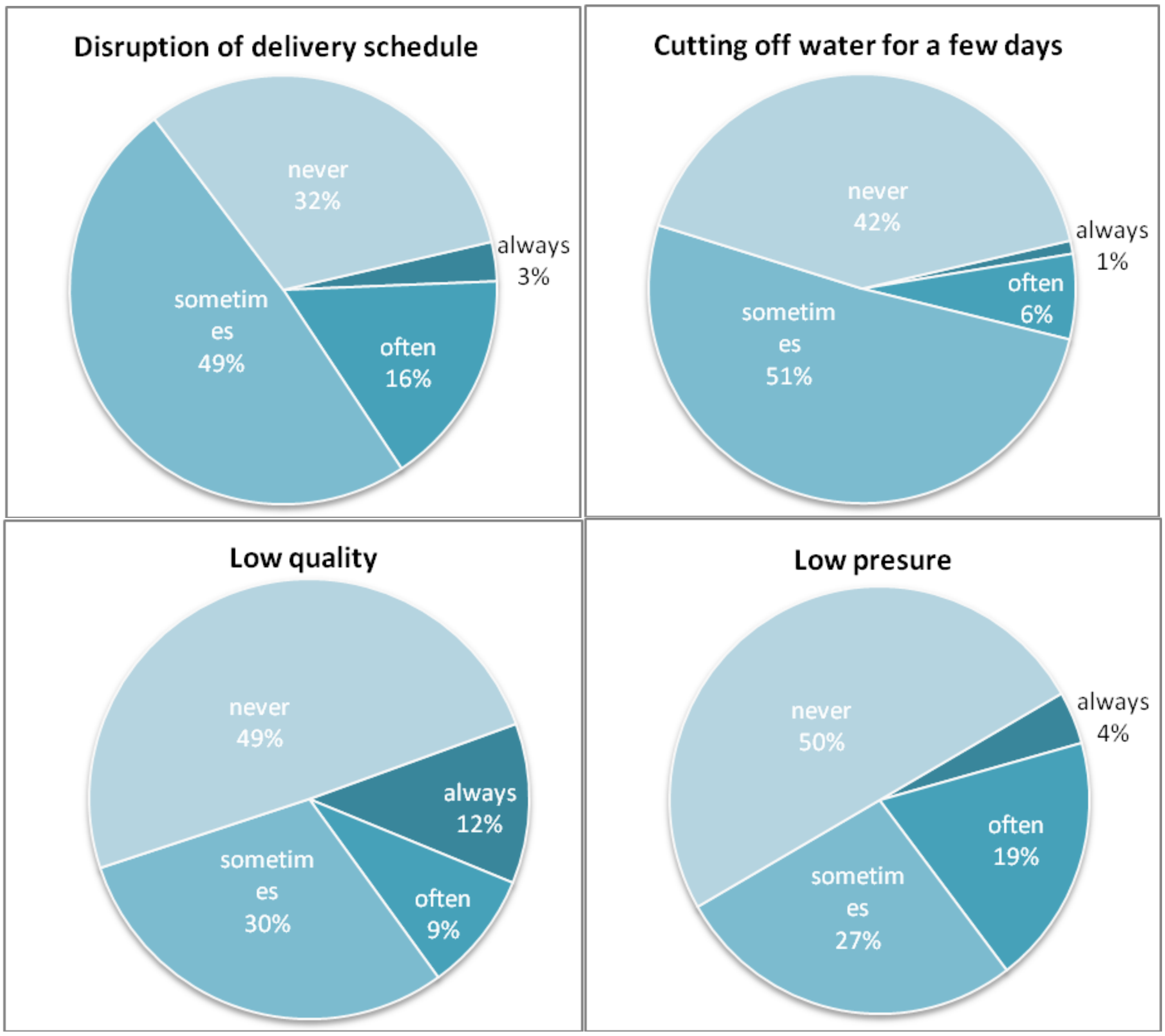


Figure 6.3.4.2 Households perception of water service related problems (%)

6.3.4.3 Quality

Regarding water quality, about 21% of households often or almost always have water quality issues (above Figure 6.3.4.2). About half of households have never had water quality issues. Overall, Armenian households sometimes face problems with water quality (3.36 grouped median) (Annex VI-10). 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 6.7. The higher the rank the better since there is less occurrence of water quality issues.

Table 6.7 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*

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 error (Annex VI-10). 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 VI-10). 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 VI-10). 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 VI-10). 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 6.8). Transparency (12%) and sand after rains (12%) issues were next important issues mentioned. Indeed, because of sediments and bad water quality some households mentioned of buying and installing new water meters.

Table 6.8 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%

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 6.3.4.3). The majority (54%) of those who do not drink tap water is registered with Nor Akunq utility, which is also reflected by the high degree of vended water purchases in Nor Akunq service area.

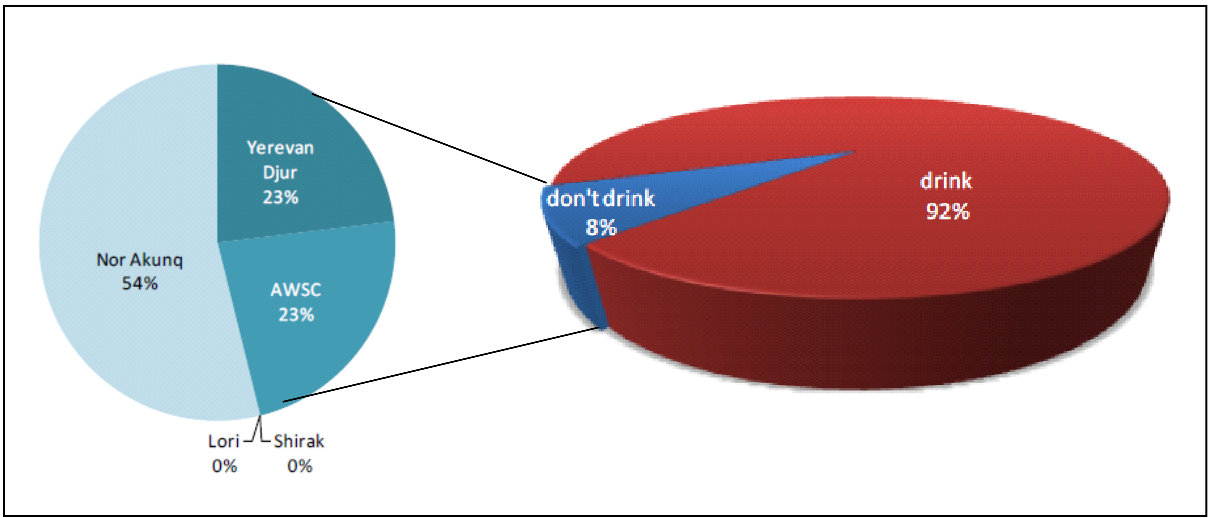


Figure 6.3.4.3 Tap water drinking behaviour (%)

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

6.3.4.4 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 6.3.4.2). 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 VI-11). 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 6.9).

Table 6.9 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*

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 VI-11). 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 negative association (Spearman rho = -0.008) between the floor of the dwelling and the pressure level issue (Annex VI-11). 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 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 6.3.4.4), of which the highest level of pressure complaints is registered in Yerevan Djur area. The small water utilities have much lower level of pressure issues, of which the lowest is in Lori.

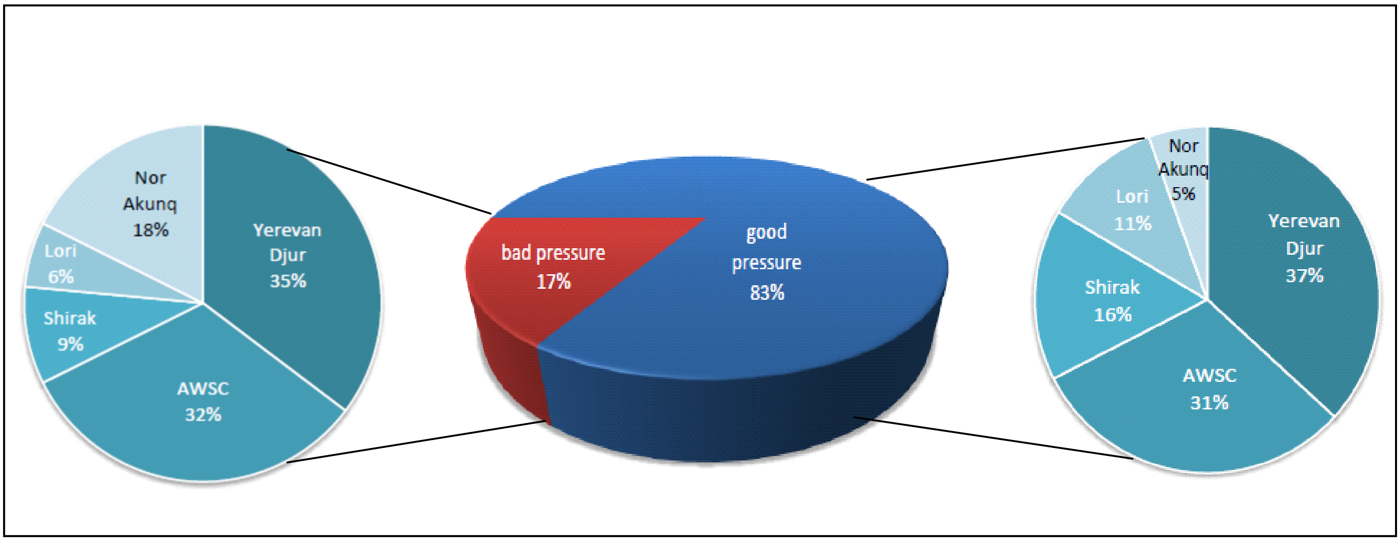


Figure 6.3.4.4 Perception on water pressure by utilities (%)

Among the households that have pressure issues 51% mentioned to have daily pressure variations and 57% have yearly pressure variations with bad pressure in summer time (Annex VI-12). Some households noted that because of water cuts and pressure deviations it is not possible to operate water heaters or washing machines properly.

6.3.4.5 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 6.3.4.2). About 19% of households suffer disruption of water supply hours often or almost always.

Overall, Armenian households sometimes face problems with water schedule disruption (3.15 grouped median) (Annex VI-13). The answers this question show the lower 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 6.10).

Table 6.10 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*

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 low chance that the differences between the mean satisfaction of five water companies is not due to sampling error (Annex VI-13). 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 VI-13).

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 VI-13). The F-test for this pair of variables was significant at the 0.028 level, hence, we can be 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 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 VI-13). Therefore, we continue to assume that, despite this correlation of 0.03, the real correlation is 0.

The mean for water supply schedule is 18 hours per day. At the same time, the median (over 50% of households) is 24 hours (Annex VI-14). Over 61% of households in all five water companies have 24 hours of water supply per day (Figure 6.3.4.5). 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.

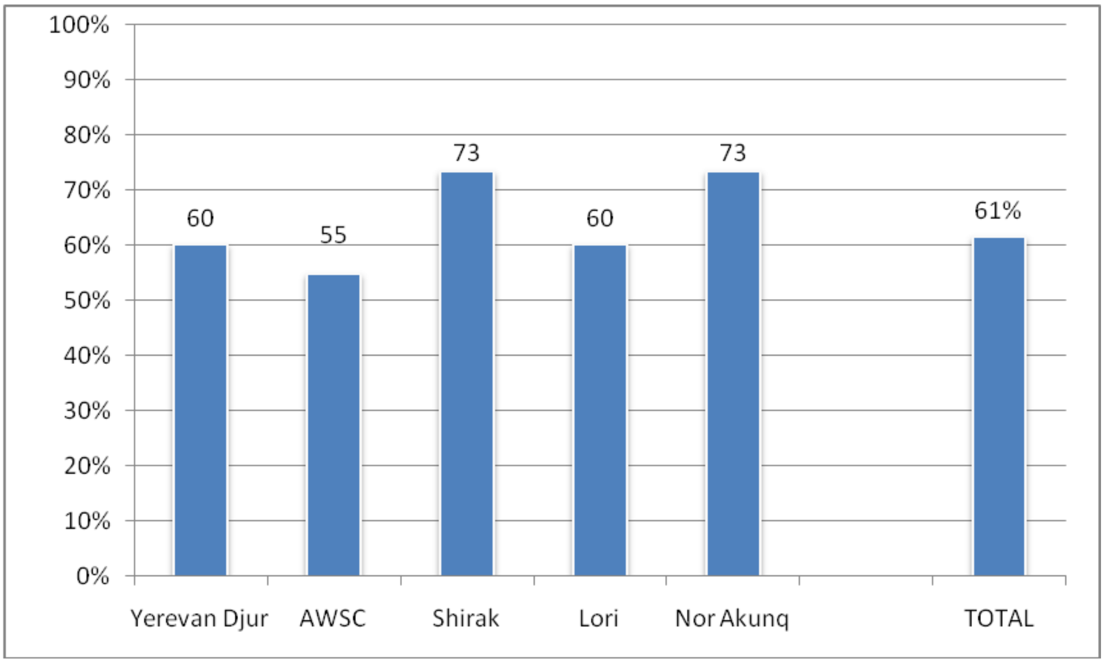


Figure 6.3.4.5 Water supply for 24 hours by utilities (%)

Overall, 62% of households are satisfied with water schedule (Annex VI-14). The highest records for both satisfaction (38%) and dissatisfaction (16%) with water schedule are recorded with Yerevan Djur utility, followed by AWSC (Figure 6.3.4.6).

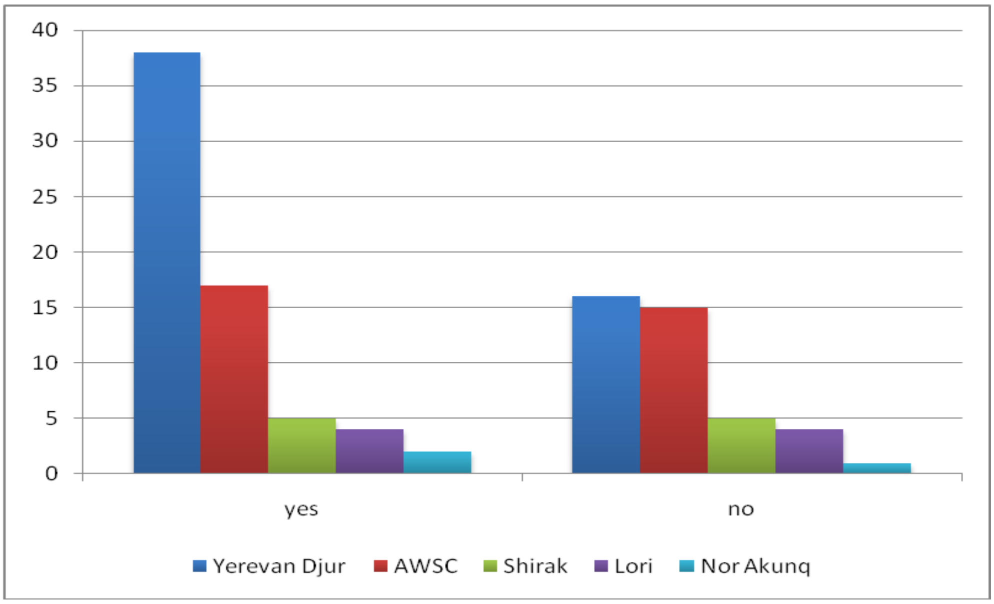


Figure 6.3.4.6 Households' satisfaction with water pressure (%)

Out of 49 surveyed households, 2 noted that schedule deficiency does not disturb their domestic life, which may reflect the memory of bad schedule and recent improvements, as well as the culture of coping with problems by 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 to have difficulties in having guests due to bad schedule, especially from abroad that are used to have frequent water services, such as taking showers. There was also a note that in 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.

6.3.4.6 Cutting off water for a few days

Only 7% of households reported of having water cut for few days frequently, while 42% never have it (above Figure 6.3.4.2). Overall, households sometimes face problems with cutting off for a few days (3.37 grouped median) (Annex VI-15). The answers this question show the least variance compared to questions related to occurrence of all other water issues (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 6.11).

Table 6.11 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*

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 VI-15). 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 VI-15). 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 VI-15). 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 with 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.

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 VI-15). 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 is. 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.

6.3.4.7 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 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 6.12 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.

Table 6.12 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**

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.

6.3.4.8 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 6.13). 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 (Annex VI-16).

Table 6.13 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%	

Regarding the mode of information provision, about the majority of households (about 84%) receive information either via phone and/or television (Figure 6.3.4.7). "Other" option which is more common in rural areas includes water service workers, neighbours or announcements at village administration.

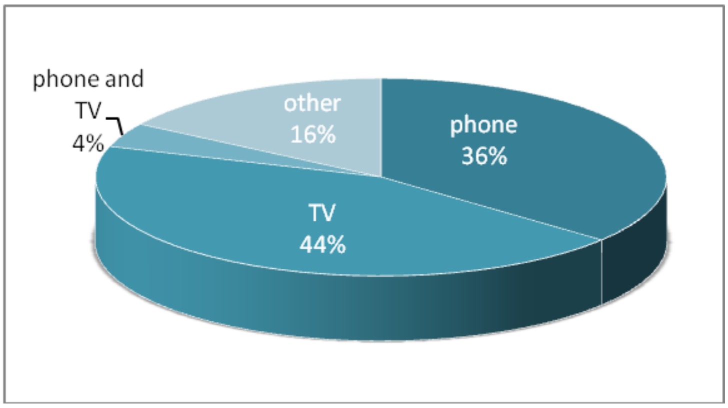


Figure 6.3.4.7 Information provision mode on service interruption (%)

6.3.4.9 Household complaints

More than 60% of surveyed households have never complained to water utilities for water supply service problems (Figure 6.3.4.8). 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) (Annex VI-17). Of those households who complained, about 54% made complaints individually to the local water supplier and 47% did it collectively.

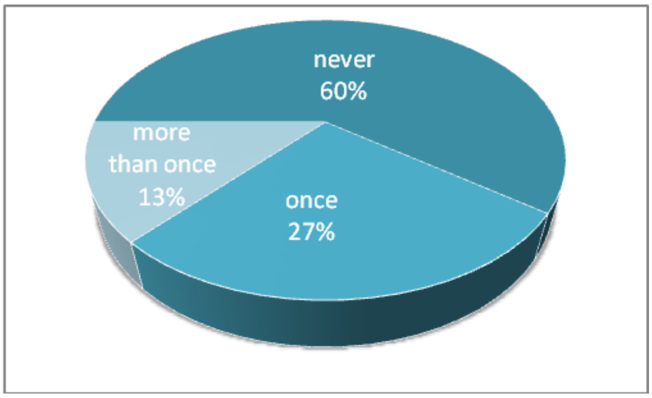


Figure 6.3.4.8 Households complaints (%)

The households were also asked about the reason of their complaints to water utilities. Figure 6.3.4.9 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.

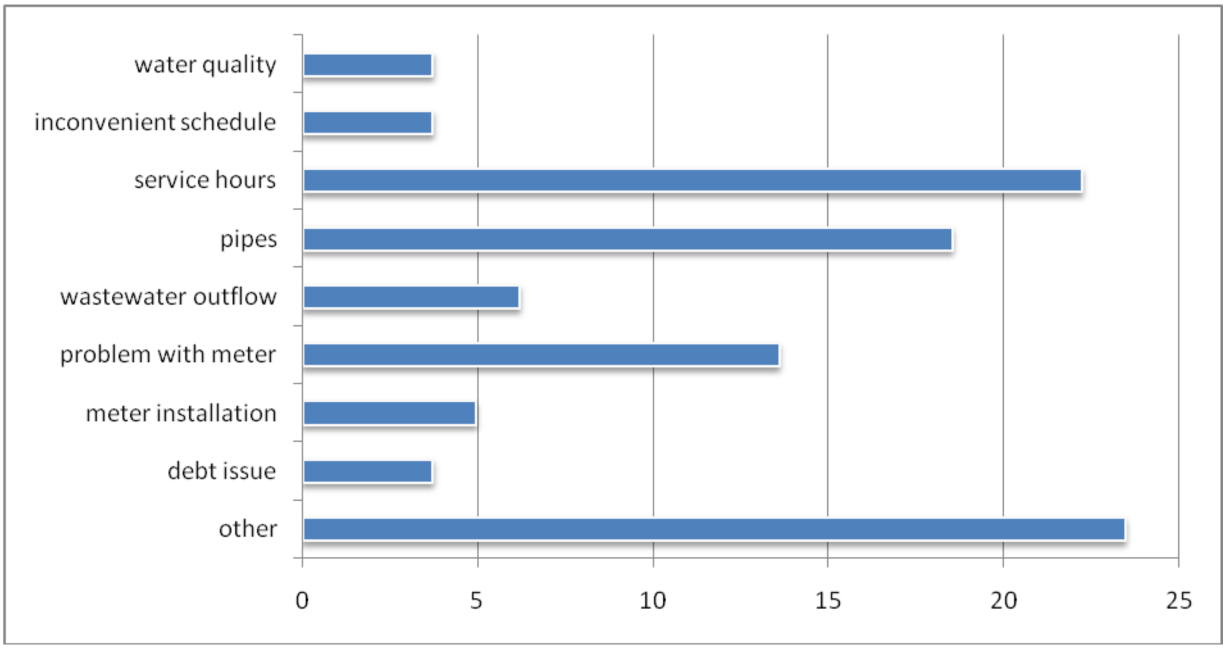


Figure 6.3.4.9 Reasons of households complaints (%)

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 6.3.4.10). 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 neighbours and water workers did the restoration. There were also cases that the outside pipe was restored by households by their own means without any support of water workers.

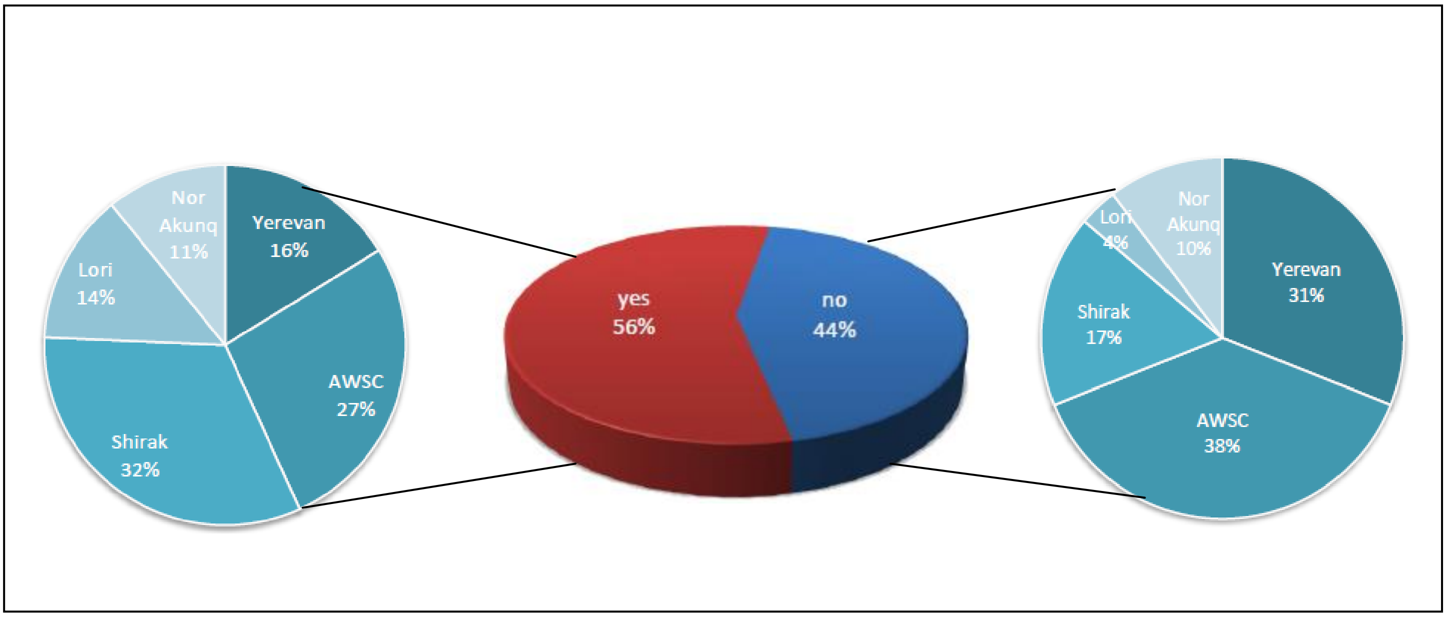


Figure 6.3.4.10 Water utility response to households complaints (%)

Those households that never complained were asked if they would complain in case of insufficiency services. Over 70% of respondents gave a positive answer. As far as their belief whether in case of complaint the services would be improved, again over 70% of households responded positively.

6.3.5 Costs and strategies for coping with water service deficiencies

The analysis above shows that despite improvement during this last decade water services still remain deficient. This section is devoted to the identification of strategies that Armenian households take in response to water supply service deficiencies. Some strategies are related to installation of equipment such as container or a pump. Other strategies are related to behavioural or life style changes such as getting up earlier to collect water, taking shorter shower, scheduling specific activities to be done during water supply time, or avoiding using washing machines during heavy rainy weather because of bad water quality at that times. However, behavioural adaptations may face some difficulties; for example, some respondents noted that they if they could have more precise water supply schedule they could be more prepared for it and get better use of it.

The summary results of the analysis of coping strategies that households undertake to mitigate water service deficiencies are presented in Table 6.14. The list incorporates both the measures that are associated with acquisition of some equipment or other related costs and the behavioural or life-style activities that are difficult to monetise. Water storage is the most popular measure, followed by bottled or vended water. Over 10% of population either get early or wait for water hours in order to perform water related procedures. About 0.5% of households is taking shorter shower due to inconvenient water schedule. Other behavioural activities include respondents' answers such as "we have got used to it" or "we are not being able to use gas heaters properly".

Table 6.14 Distribution of strategies for coping with for water supply deficiency

Activity	No of households	Percentage of all 205 households
Storage tanks or containers	154	75%
Well and secondary water sources	44	21%
Pump	40	20%
Treatment (excluding filter)	27	13%
Filter	5	2%
Bottled or vended water	65	32%
Health costs	9	4%
Unofficial payments	12	6%
Stay home	8	4%
Get early	11	5%
Come back	9	4%
Wait or schedule activity	10	5%
Shorter baths	1	0.5%
Other behavioral activities	22	11%
Total	417*	

* *Total of 417 is higher of the sample size since some households implement simultaneously several measures, for example, have water storage tanks operated with pumps.*

In the following parts of this section, more detailed analysis of coping strategies and related costs is presented. The focus is on the measures that are viable for monetizing for calculating the overall costs of coping strategies and getting the summary on monthly costs borne by Armenian households.

6.3.5.1 Equipment and other costs

This type of data was collected with the purpose of estimating to the degree possible all costs related to the water supply. This is in addition to the monthly water charges that households pay for water supply to water utilities discussed in the above sections and the additional costs that they bear for coping with the deficiencies of water supply services.

It is important to mention that this type of data was difficult to collect since the respondents did not know or do not remember exactly the costs. Therefore, in this section for some variables the analysis is based on a limited number of respondents. In this case, for each cost item the assessment and analysis is done based on the answers of households supplemented by the assumptions that are employed for estimating the costs of coping strategies implemented by households in case of missing data.

6.3.5.1.1 Water storage capacity and related costs

About 75% of all surveyed households are used to store water in a variety of ways: ranging from a minimum of 2 litres to a maximum capacity of 4000 litres (Table 6.15). Over 50% of those who store water have a storage capacity of 60 litres. On average, the total storage capacity of a household is 160 litres of water. The median (50% of the sample of 205 households) water storage capacity is quite small: 10 litres. (Annex VI-18). At the same time, one tenth of all surveyed households have high or very high water storage tanks either plastic or metal with or without pump facilities. About 15% of all respondents have a storage capacity of over 200 litres. The share of households with high (500-1000 litres) and very high (over 1000 litres) storage capacity amounts 7% and 3% of total sample population, respectively. Meanwhile, some respondents indicated that they stored water before the water service quality was improved.

Table 6.15 Distribution of water storage capacity

Storage capacity	No of households	All households percentage	Households with high volume tank
no storage	51	25%	
1 to 50	102	50%	
51 to 200	22	11%	42%
201 to 500	15	7%	29%
501 to 1000	9	4%	17%
1001 to 4000	6	3%	12%
Total	205	100%	100%
Average storage capacity		160 litres	593 litres

The split of water storage capacity of those who practice it by urban and rural areas is presented in Figure 6.3.5.1. The data for the forth (high water storage) quartiles are very much spread. The highest spread (and highest variety within the group) and the highest volume of maximum water storage are recorded in rural areas. At the same time, on average households in other urban areas store more water (median 125 litres) than in rural areas (median 95 litres). This to some expend can be explained by more possibilities for other water source assess in rural areas. In Yerevan city water storage is the lowest median (25 litres) and maximum (700 litres) of water storage, which could be explained by more reliable schedule of water supply and water service interruption warning services by water utilities.

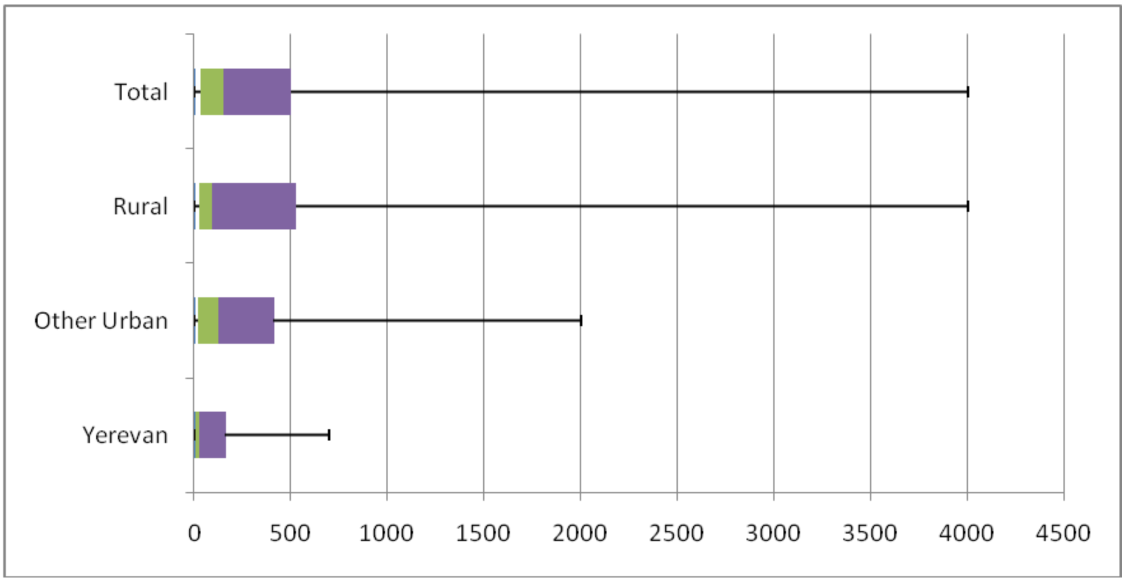


Figure 6.3.5.1 Household water storage capacity by urban and rural areas (litres)

[The boxed section indicates the storage capacity 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.]

The split of water bills by water utilities service areas is presented in Figure 6.3.5.2. The lowest water storage capacity is recorded with Nor Akunq utility. There can be some explanations for this. First, this is the area with the most companies for bad water quality and the highest occurrences of buying vended water for drinking and cooking purposes. Hence, water storage is not a major coping strategy in this area contrast to other regions. The highest variance of water storage capacity is recorded with Yerevan Djur utility followed by AWSC (Figure 6.3.5.2). Coupling with the analysis in rural and urban areas above, this may suggest that within the Yerevan Djur utility area households in rural settlements have the highest water storage capacity and those in Yerevan city have the lowest water storage. At the same time, on average households in AWSC service area (median 150 litres) store 2.5 time more than in Yerevan Djur area (median 60 litres) and almost five times more water than in all other utility areas (median of 30-35 litres).

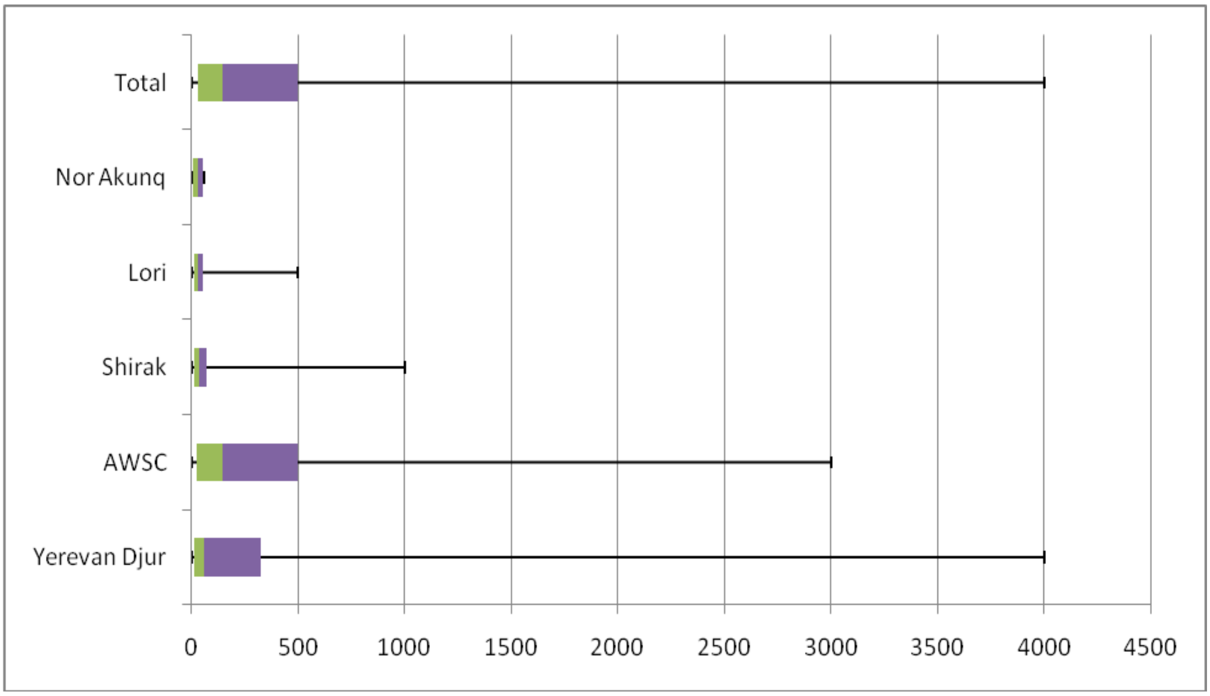


Figure 6.3.5.2 Household water storage capacity by water utilities (litres)

[The boxed section indicates the storage capacity range of the middle 50% of the distribution of utilities. The line in the middle of boxes (marked by colors) indicates the median.]

Interestingly, estimation of the correlations coefficients for identifying the extent to which the storage capacity is related to the degree of water service satisfaction results in a low negative correlation (Kendall's tau = -0.109) (Annex VI-18). Taking into account the direction of the coding the interpretation of this correlation coefficient is as follows: the more the water storage capacity the lower the satisfaction with water services is. The further one-tailed test at p<0.05 results in a significance of 0.026. Hence, it is likely that this kind of relation occurs in the population.

Regarding water storage costs, on average households pay for the water tank about 30000 AMD. Tank installation costs about 15000-20000 AMD. Few households (5) were able to give information about the year of installation of their water tanks. The period varies from 2 till 30 years (Annex VI-18). The median year of water tank installation is 6 years. Normally, households do not drink water from the tanks and store water for drinking purposes separately.

For calculating the costs of water storage the duration of high volume water storage tanks is considered to be 20 years. The cost for medium capacity storage containers (for example, buckets or plastic containers) is 10 000 AMD with the assumption of life duration of 4 years. The cost for small volume water storage vessels is considered nil.

6.3.5.1.2 Well and secondary water sources

In the above Table 6.14, the coping activities start with well and secondary sources. As it was discussed in the section above, secondary water sources include public tap, well, spring, river and other water sources. For the purpose of cost calculation, time and transportation costs for getting to the secondary source water springs along with the cost of digging the well are not included in the analysis because of impossibility of getting any kind of this data from the households.

6.3.5.1.3 Water pump installation and operation costs

One fifth of the surveyed households (20%) have a pump installed on their water systems (40 households). In some cases one pump is shared between several families. The majority of these respondents (65%) gave information about the costs of installation of water pumps, which vary from 8000 to 48000 AMD with the average of 20423 AMD (Annex VI-19). Half of respondents (48%) were able to provide information on the year of pump installation. On average, pumps were installed 36 months ago.

Regarding the amount of hours that the pumps work during the day, data was obtained from 73% of respondents. On average, households use pumps for 2 hours per day. Some households use pump only for bathing purposes. At the same time, half of household respondents (48%) reported pump maintenance costs that related to electricity costs and changing different parts such as motor, monitoring unit or valves. On average, households pay 7110 AMD for annual operation of pumps. For calculating the costs it is assumed that the average price of pump is 20424 AMD with installation costs of 10000 AMD. The pump is of 500 wattage and 10 years lifetime. Electricity costs is 38 AMD per kW/hour.

6.3.5.1.4 Water treatment and related costs

Of all surveyed households 20% reported to treat water before drinking (Figure 6.3.5.3). Households that treat water on occasional bases amount 56%, the rest 44% do it every day. There are a number of ways people treat water: boiling for 62% of the households, use of filter device for 16%, allowing particles to settle down for 9%, and chlorination for 3%. Among "other" option (9%) the respondents mentioned leaving water to run for a while and water cooling.

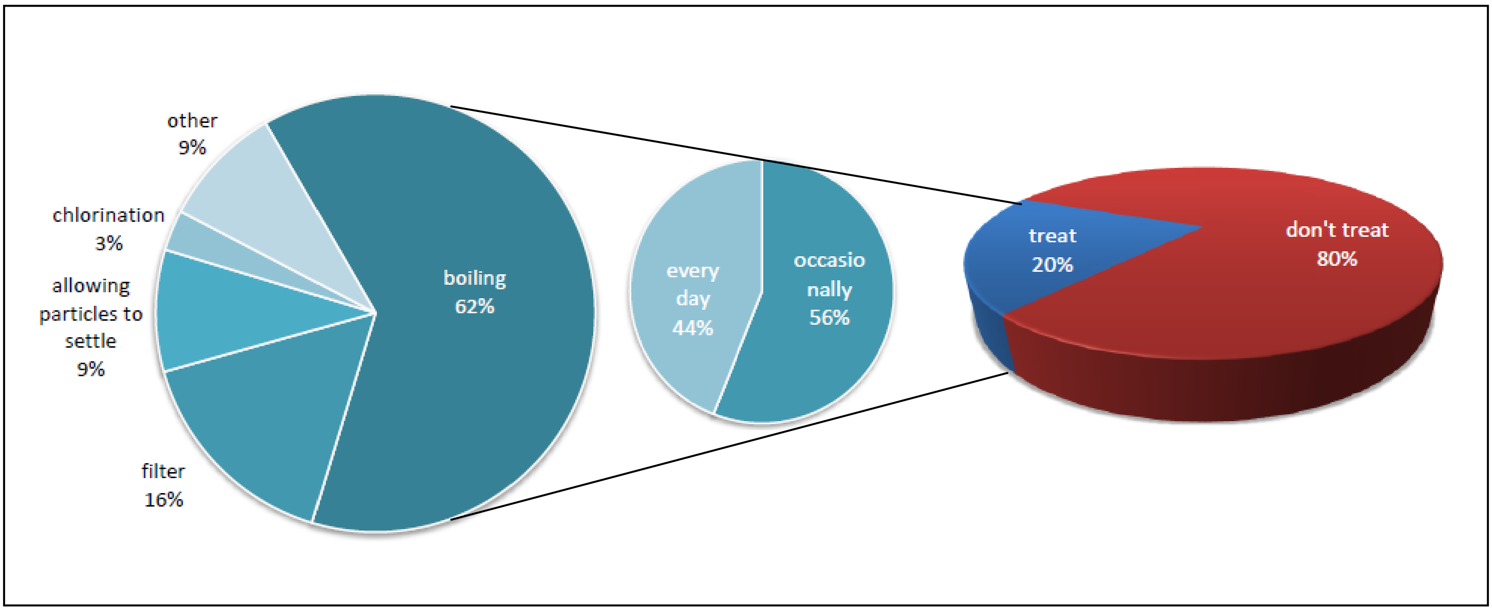


Figure 6.3.5.3 Water treatment behaviour (%)

On an average, households spend 15 minutes on boiling water (Annex VI-20). Data is limited for getting the filter maintenance costs. Few respondents (3 out of 5) were able to provide the costs for operation of their filters. One of the households spends 4500 AMD every three months, another one spends 1000 AMD per year, and the third one spent 1000 AMD just for installation without further maintenance costs. One of the respondents noted that the filter was installed during installation of the water meter and there is no cost related to its maintenance since it can be cleaned manually every two months. The respondent with the expensive filter told that it was brought in Russia and it requires costs for maintenance once in three months. The following assumptions are made for calculating the costs of water treatment. Cost for boiling water is considered nil. Average cost of a filter that is 1000 AMD with usage duration of 5 years. Cost of filter maintenance is 1000 per year.

6.3.5.1.5 Bottled and vended water

One third of all surveyed households (69 households) buy bottled or vended water, including 41% in other urban and 32% in rural (Annex VI-21). About 40% of them do it often or regularly (Figure 6.3.5.4). Some of respondents buy bottled or vended water due to deficiency of supplied water quality (5% of total survey households) or due to inconvenient water supply schedule (13% of total survey households). Those, who buy due to bad water quality, comment that they buy bottled or vended water for cooking and drinking purposes. Besides, households buy bottled water in case of having children or when going outside.

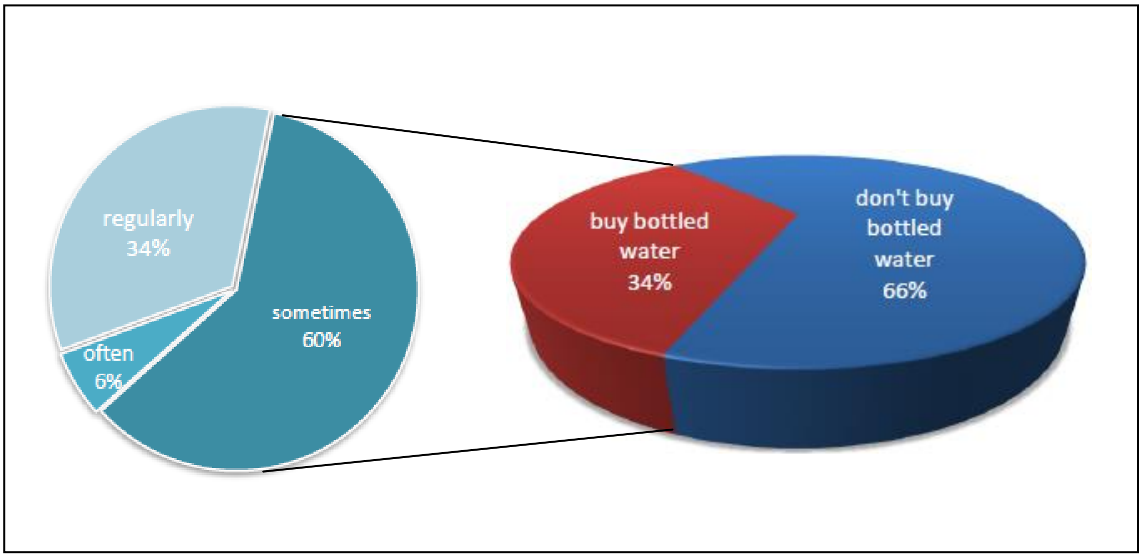


Figure 6.3.5.4 Bottled water buying behaviour (%)

The analysis of all surveyed household data revealed that the monthly costs that households bear for purchasing bottled or vended water range from 100 to 12000 AMD (Annex VI-21). On an average, surveyed households pay 1335 AMD per month.

Important highlight was revealed in Armavir marz served by Nor Akunq utility. Many households are buying vended water brought by tracks from the neighbouring region. People buy it for cooking and drinking purposes since municipal water quality is of very bad quality. For vended water the households pay either 50 AMD per bucket or 10 AMD per litre. Some households reported buying a bucket of water every day; others buy 20-40 litres for 2-3 days.

6.3.5.1.6 Health costs

The respondents were also asked about the incidences of water-related diseases. Few of respondents (9) replied positively. Some of respondents mentioned that not in their families but in their residence area they heard of some cases of people, including children that had got sick due to bad water quality. Two of respondents reported about 8000 AMD and 20000 AMD that they paid for treatment of their children in hospital as they thought because of water quality. The monthly health cost is calculated based on the hypothesis of amortization of health costs over five years. Transportation, time and other opportunity costs related to treatment are considered nil.

In this context it is important to add that the improvements in water supply services in terms of water quantity, quality and reliability have been going together with enhanced security at all water sources, monitoring and treatment practices with application of modern chlorination facilities. This was in line with the sanitation norms of the newly adopted Law on Drinking Water (2008) which corresponds to the WHO Guidelines. This resulted in a significant decreased of water-related disease such as diarrhoea in recent years. Despite this, an increase in intestinal infectious diseases and in the morbidity necessitates more long-term solutions for ensuring adequate quality and quantity of drinking-water, especially outside capital city areas (PWH 2012).

6.3.5.1.7 Other miscellaneous water supply service related costs

During the field work the households raised a number of problems they face with water supply and the costs they bear. The key of them have been discussed above. In this section, the analysis is extended to the discussion of other miscellaneous costs that households bear due to water service deficiency.

First of all, this includes unofficial payments. About 6% of all households claimed that they encountered with unofficial costs related to water services provision. The majority of these payments relate to metering costs ranging from 3000 to 17000 AMD. Related to metering are also the complaints of households for buying and installing new water meters every year due to water quality or in winter because of cold weather which causes disruption of meters that are required to be installed in outside locations. Hence, the calculation of these costs is based on metering with the assumption of a reduced to 3 years replacement period of residential water meters.

Some households also mentioned about the problems and costs related to breaks of taps due to water quality (for example, sand) or too high pressure. A complaint was also reported about the breakage of washing machines due to interruptions or low water pressure. On average, the households (3) pay 6000 AMD per year for the equipment repair and/or replacement.

6.3.5.2 Sewage connection and cleaning costs

Though sanitation is outside the main focus of the current research, for getting more realistic picture of overall situation, problems and costs that the households bear, especially in rural peripheral areas, the need arose to shed a light to this issue as well. This is emphasised by the risks for contamination of the environment and the drinking water and the outbreaks of infectious diseases that are related to the lack of adequate sanitation.

Out of 66 households with no centralized sewage system for toilet or wastewater discharge, only 15 respondents (23%) and 5 respondents (8%) provided information on the costs they bear for maintenance (cleaning) and installation (construction) of toilet facilities, respectively (Annex VI-22). In general, most of these households have pit-latrines that are either empted when full or covered when a new hole is digged. Recently growing trend is for households to have-flush toilets connected to individual septic tanks with cement walls.

The costs for these individual sewage facilities depend on several factors. The respondents noted that they either dig the hall themselves or pay for it. They either dig just a hall in the ground or built a cement tank. Thus, the research reveals that households pay from 20000 AMD up to 400000 AMD (with the mean of 132000 AMD) for constructing the toilet or wastewater discharge system. For avoiding the distorting effect of extreme cases on measuring central tendency value, during the analysis both the bottom and the top quartiles were cut off for getting the middle 50% of costs that range 50000 - 100000 AMD. The median is 90000 AMD. For assessing the monthly cost of individual sewage construction, it is assumed that the septic tank can be used 10 years. The frequency of cleaning of the sewage facilities varies from several times per year to once in 5 years. On average, the households pay 14000 AMD per year.

6.3.5.3 Total monthly costs endured by households

This part is devoted to the estimating of total costs that households endure for water supply services, including official monthly water charges and the costs of coping strategies that households chose for diminishing the deficiencies of water supply services. Table 6.16 presents those cost items and the related monthly cost averages for households that follow the corresponding coping strategy. As it is seen, in addition to official monthly water charge of 2000 AMD, the households may bear up to 3 times more costs ranging from minimum 100 AMD to maximum 6462 AMD per month. This is quite significant, especially taking into account that these costs could be underestimated since the cost list does not include a number of costs, for example, water well digging costs, travel costs for getting water from secondary water sources, opportunity cost of time in case of hospitalization for seeking care and in time taken off work, waiting for water supply hours, time and energy spent on boiling water, and costs for spoiled conserved food spoiled due to bad water quality, etc.

Table 6.16 Coping strategy costs and total monthly costs endured by households

Cost items	Monthly average for households that follow this strategy
Monthly water charge	*2000*
Water connection	333
Individual sewage system construction and maintenance/cleaning	1917
Pump installation and operation	1986
Storage	200
Bottled or vended water	1335
Filter	100
Health costs	233
Other miscellaneous costs	354
Total (AMD per month)	8462

The highest costs that households bear are related to installation and operation of water pumps (1917 AMD). Individual sewage system construction and maintenance is the next most expensive activity (1917) which is commonly borne by rural households. Significant are also bottled or vended water purchases.

Overall, one quarter of all surveyed households pay up to 2000 AMD per month (Table 6.17). Over 43% of households bear costs from 2000 to 3000 AMD. About 14 % of households pay monthly more than 4000 AMD.

Table 6.17 Distribution of total costs per household per month

Cost ranges (AMD)	No of households	Percentage
0 to 2000	51	25%
2000 to 3000	89	43%
3000 to 4000	36	18%
4000 to 6000	2	1%
6000 to 8000	13	6%
8000 to 9000	14	7%
Total respondents	205	100%

6.3.6 Perception of water service cost and willingness to pay

This section presents the results of survey on household financial aspects such as the assessment of households of their financial situation and their perception of water fee as a burden to their family budget. It also describes the water service improvement needs and willingness to pay for the improvements. Finally, the water conservation actions are presented that households would be ready to undertake in case of potential increase of water prices

6.3.6.1 Household financial status

The households were asked to assess their family financial situation. The results are presented in Figure 6.3.6.1. No household described its family financial status as "rich". The median of the financial situation is the "middle level of income" (65%) (Annex VI-23). About one third of household are either "very poor" (8%) or "poor" (22%). The highest share of "very poor" (13%) and "well-off" (10%) within the utility service areas are recorded with Shirk and Nor Akunq utilities, respectively (Annex VI-23).

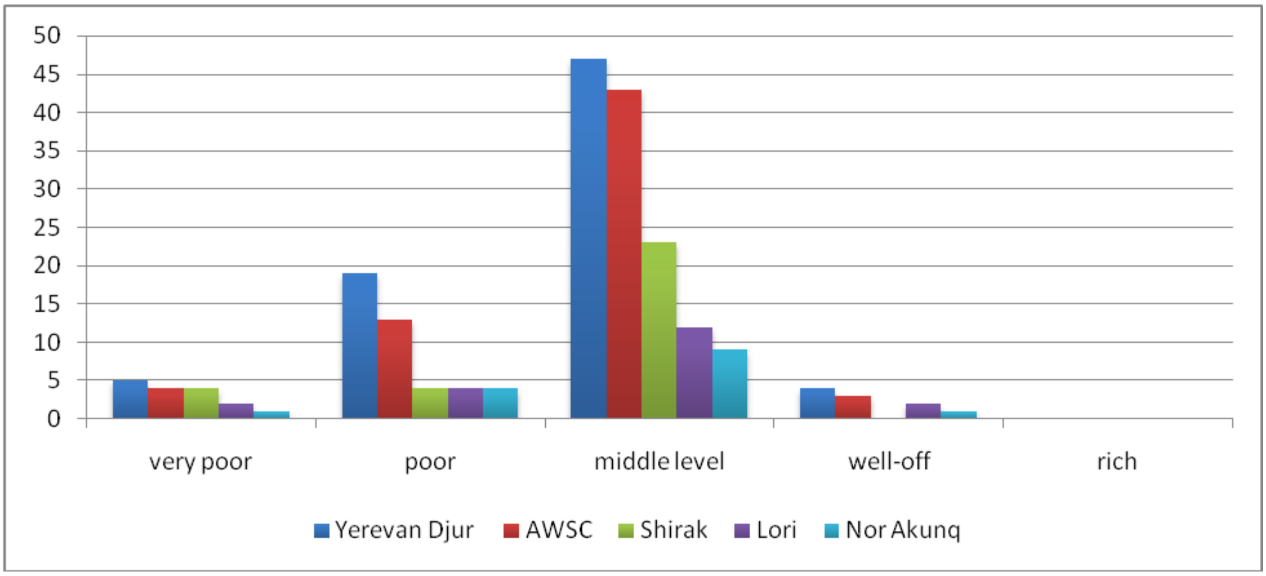


Figure 6.3.6.1 Households' self-assessment of the financial situation (No of households)

6.3.6.2 Perception of water tariffs as a burden for family budget

The households were asked to assess whether the water tariffs were high in view of the current budget of their family. The respondents were given a card with a proposed series of options from which they had to choose one most appropriate option. Figure 6.3.6.2 presents the results. About 62% of surveyed household find that water payment is a problem for their family but not very serious. While 22% mentioned that water payment is not a problem for them, for 15% of households it is a quite serious problem. About 1% of population are not able to pay this sum, mostly because of the problem of very high debts calculated during the restructuring process which is discussed in more details in above section on debts. Other arguments for high burden mentioned by households are very low salaries or pensions, lack of job or irregular payment of salaries.

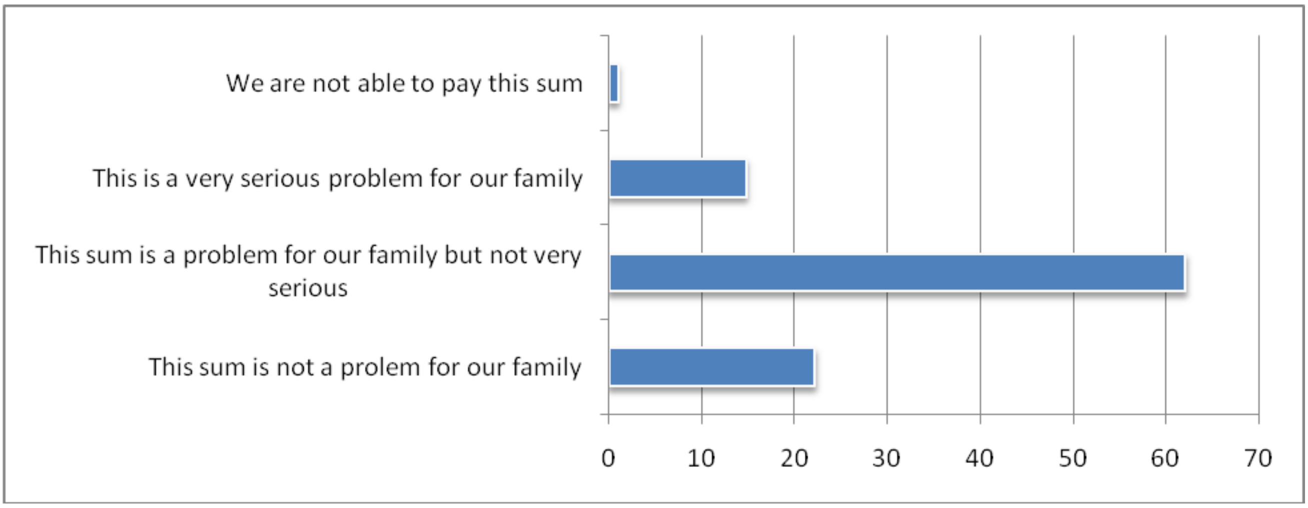


Figure 6.3.6.2 Perception of water payment as a burden for family budget (%)

6.3.6.3 Water payment regularity

More than 94% of households declared to pay the whole sum of water bill on regular basis - every month (Figure 6.3.6.3). Of the remaining households, 2.5% have difficulties with regular water payments because of the accumulated debts, which in some cases may reach up to 200 times the minimum salary (for more details see above section on debts).

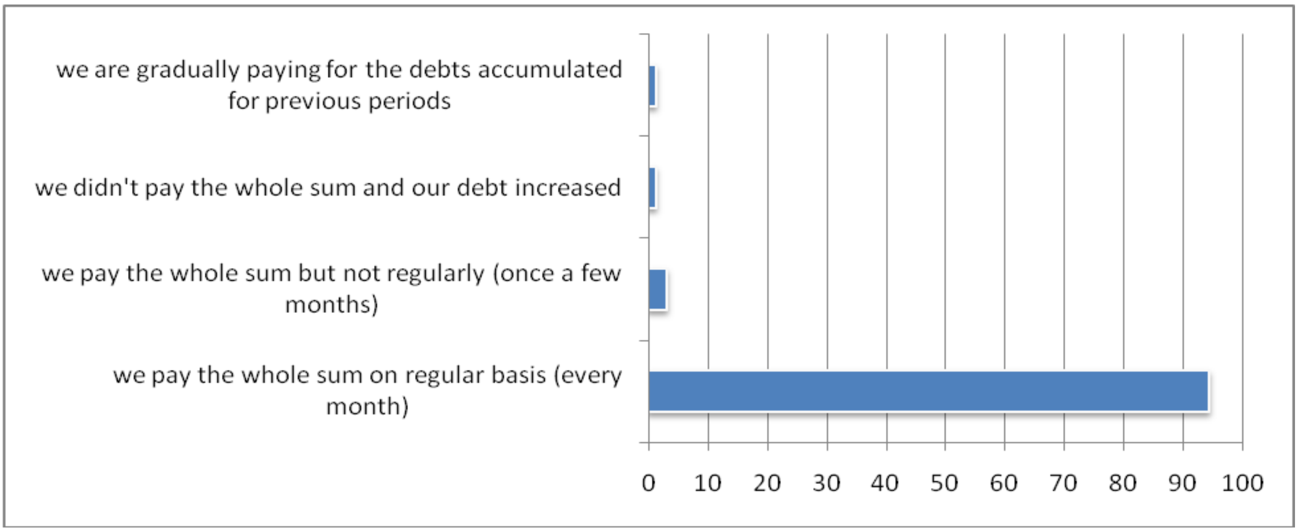


Figure 6.3.6.3 Water payment regularity (%)

On the question whether the households encounter with unofficial fess, more than 6% declared of having paid unofficial payment. These are mostly related to water metering, for example, for putting the water meter seal.

6.3.6.4 Perception of water service change

To measure the level of past water service improvement, the surveyed households were asked to name any type of water supply service changes (Figure 6.3.6.4). The proposed time spam was last few years, since it could be difficult get information from household about service level before privatization because of its long period and because people might not clearly identify the privatization point in time. Almost 36% of households indicated “no change”, of which Yerevan Djur has the highest percentage of 42%, followed by Shirak utility with 18% (Annex VI-24).

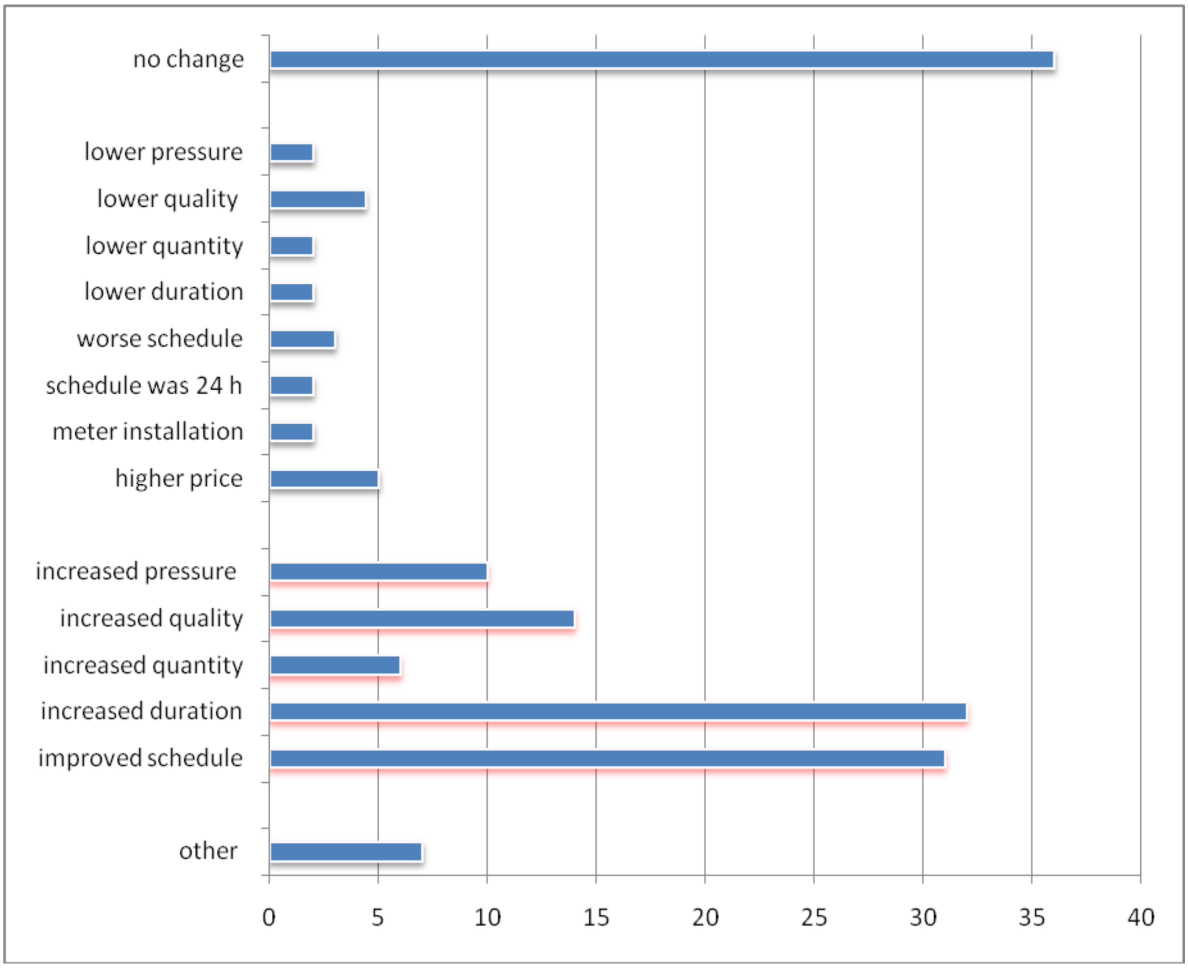


Figure 6.3.6.4 Perception of households for changes in water supply (%)

The changes include both negative and positive changes. More households indicated about positive changes such as "increased duration" (32%) with the highest record of 53% with AWSC, "improved schedule" (31%) with the highest record of 48% with AWSC, "improved water quality" (14%) with the highest record of 64% with AWSC and "increased pressure" (21%) with the highest record of 67% with AWSC (Figure 6.3.6.4, Annex VI-24). Among negative changes the highest percentage is "higher price" (5%) and "lower quality" (4) with highest record of 40% with Yerevan Djur and Nor Akunq utilities (Figure 6.3.6.4, Annex VI-24). Other options include, among others, new or reparation of pipes and not having water supply at all before and carrying it from neighbours.

6.3.6.5 Improvements needed

Surveyed households were asked to answer if they agree with the statement that the services should be improved first and then the cost could be increased. Over 89% of households support this statement (Figure 6.3.6.5).

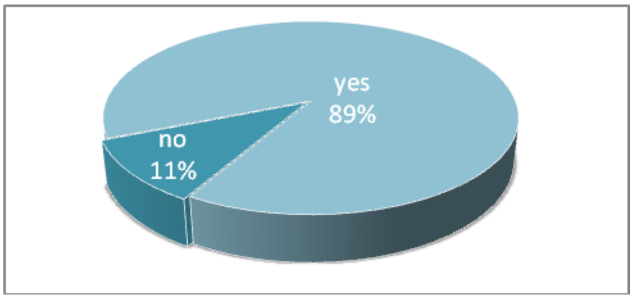


Figure 6.3.6.5 Whether service should be improvement first and then cost increased (%)

The households were asked to propose improvements for water services. Figure 6.3.6.6 presents the aggregate results for all improvements selected by households. "Water quality improvement" is most frequently selected option (35% of households). The option of "no improvement" (30%) is the next frequently mentioned followed by "additional hours of supply" (18%), "health risk reduction" (13%) and "wastewater outflow improvement" (11%). About 2% of households select "central system for all for water" reflecting the high level of central water access, on one hand, and yet still not universal access, on the other hand.

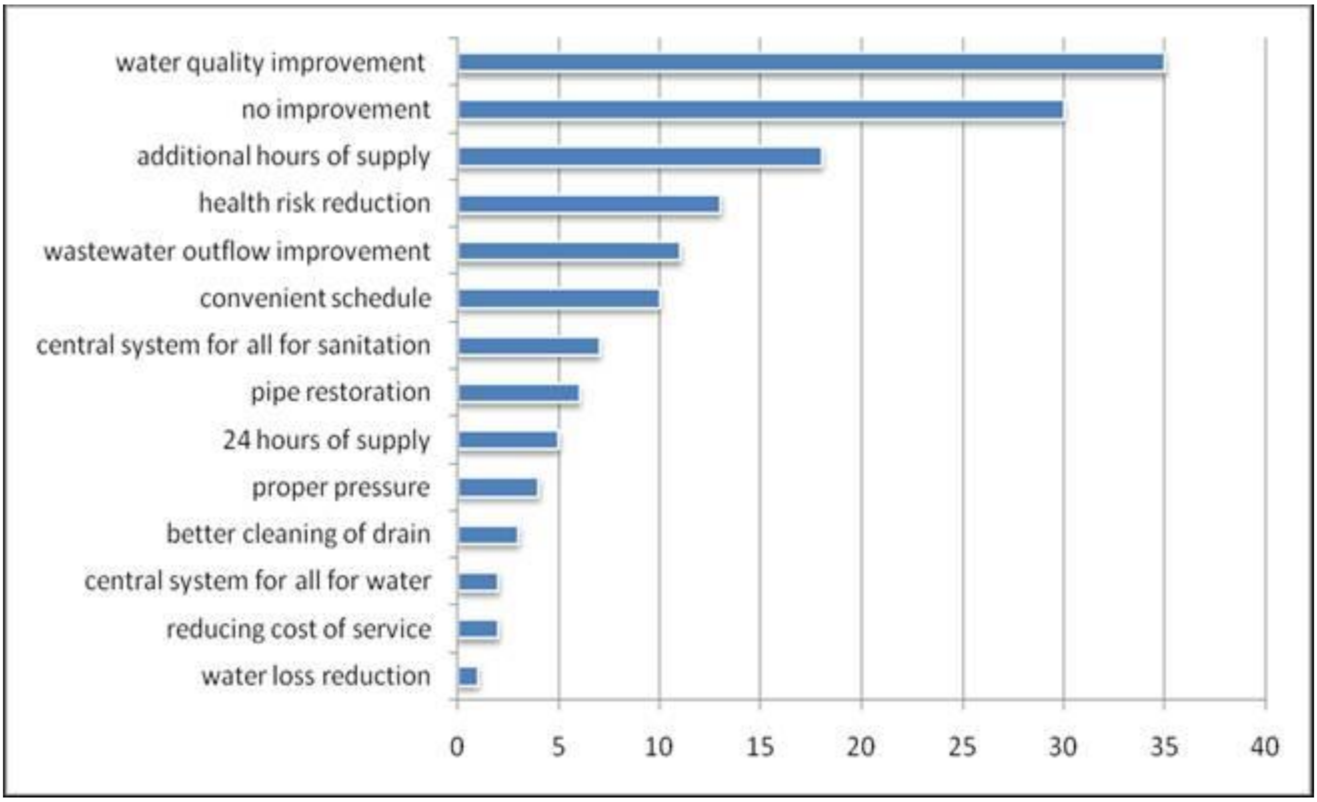


Figure 6.3.6.6 Aggregated choices of households for water service improvement (%)

The first three most important improvements by water utilities and by urban and rural distributions are presented in Table 6.18. In rural and other urban areas additional hours is more important improvement than water quality. At the same time water quality is the highest necessity in Nor Akunq utility area. The highest percentage of "no improvement" is in Yerevan city area.

Table 6.18 Distribution of the aggregate three important improvements (%)

	Utilities						Urban/rural			
	Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total	Yerevan	Other urban	Rural	Total
1.Water quality	33%	36%	6%	8%	17%	100%	24%	43%	33%	100%
2. No improvement	46%	15%	26%	11%	2%	100%	43%	23%	34%	100%
3. Additional hours	27%	41%	14%	16%	3%	100%	14%	51%	35%	100%

Next, the households were asked to select to three improvements in a priority order. As the first priority choice, 45% of the households would prefer to have improved water quality (Figure 6.3.6.7), of which 71% is served by two biggest companies AWSC (38%) and Yerevan Djur (33%), followed by Nor Akunq (18%) (Table 6.19). At the same time, for rural areas the first priority is central system for sanitation (89%), which is not an issues in Yerevan city area (0%) but an issue for surrounding rural settlements (22%). An interesting case is Nor Akunq utility service area, where people are struggling with significant water quality issue and health issues and are not concerned with other improvement options yet.

Table 6.19 Distribution of the first priority improvements (%)

	Utilities						Urban/rural			
	Yerevan Djur	**AWSC**	**Shirak**	**Lori**	**Nor Akunq**	**Total**	**Yerevan**	**Other urban**	**Rural**	**Total**
1.Water quality	33%	38%	3%	8%	18%	100%	24%	43%	33%	100%
2. Additional hours	29%	39%	13%	19%	0%	100%	13%	52%	35%	100%
3. Central system for all for sanitation	22%	45%	33%	0%	0%	100%	0%	11%	89%	100%

As a second priority the households selected health risk reduction (25%), convenient schedule of supply (19%) and water quality improvement (16%) (Figure 6.3.6.7). As a third priority option, the households mentioned sanitation system improvement (28%), additional hours (17%) of supply and convenient schedule (11%). Hence, water quality and additional water hours of supply seem to be an expectation from the improvement. As soon as these are satisfied, households expect to have their sewage system conditions improved too. Interestingly, 24 hours of supply was mentioned by only 1% of households as a first priority.

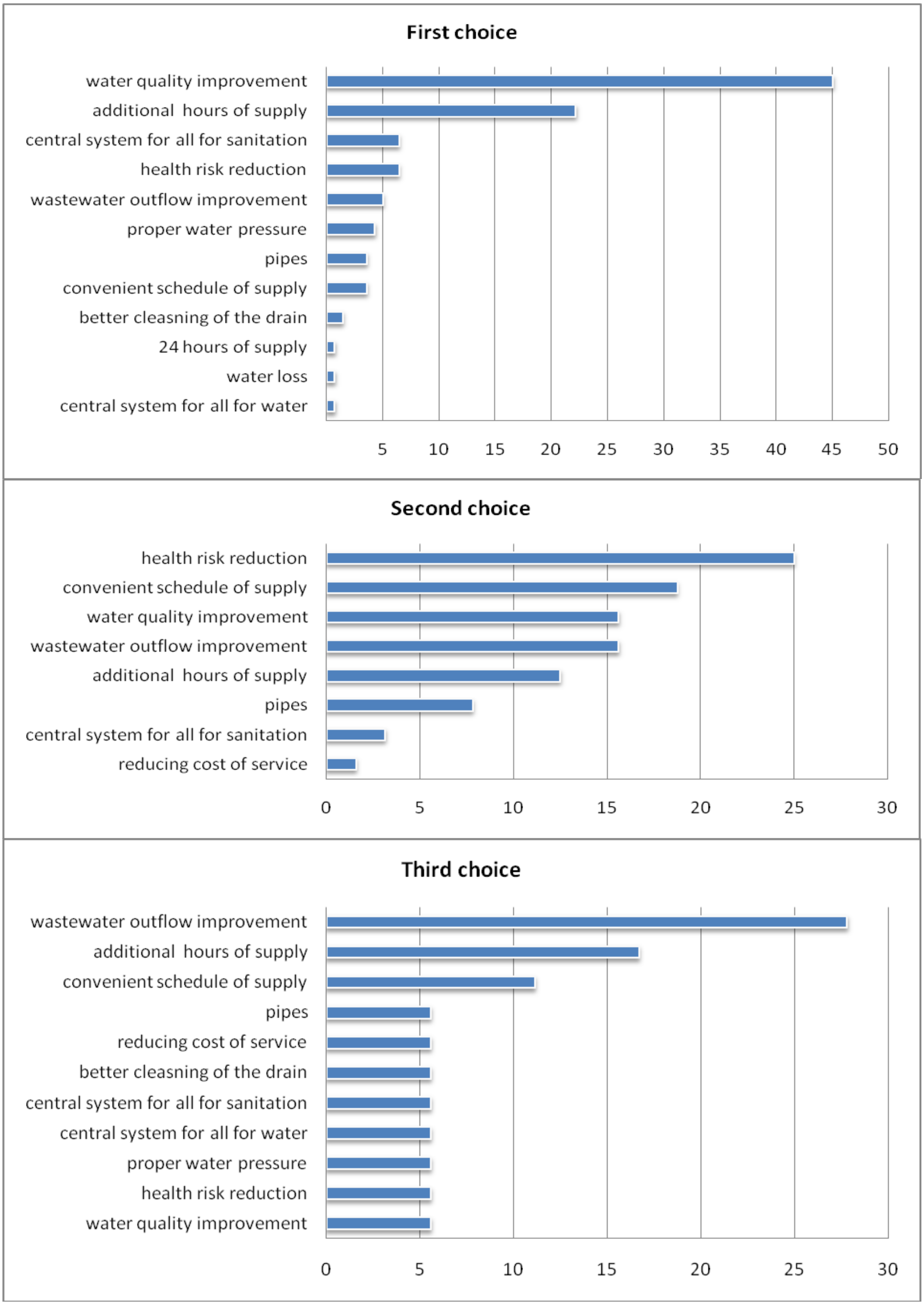


Figure 6.3.6.7 Priority choices of households for water service improvement (%)

6.3.6.6 Willingness to pay for improved water services

The households were asked whether they are ready to pay more for the mentioned priority improvements of the quality of water services. Half of households (50.3) reported their willingness to pay for improved services (Figure 6.3.6.8). While the highest share of those who are not willing to pay is in Yerevan (38%), the highest share of those who are ready to pay for service improvement is in rural areas (45%) reflecting the more need for better water services in rural areas. In general, among the main reasons for refusal to pay for water service improvement the households indicate that water fee is already too expensive and that water is an obligation of water companies and/or the government that should provide it. Some households also mentioned that they would prefer to use their water containers than to have increased water tariffs for improved services. Others are of opinion that they already overpay for the quality that they have now. Finally, some respondents expressed that their doubt that with the price increase they would have better services.

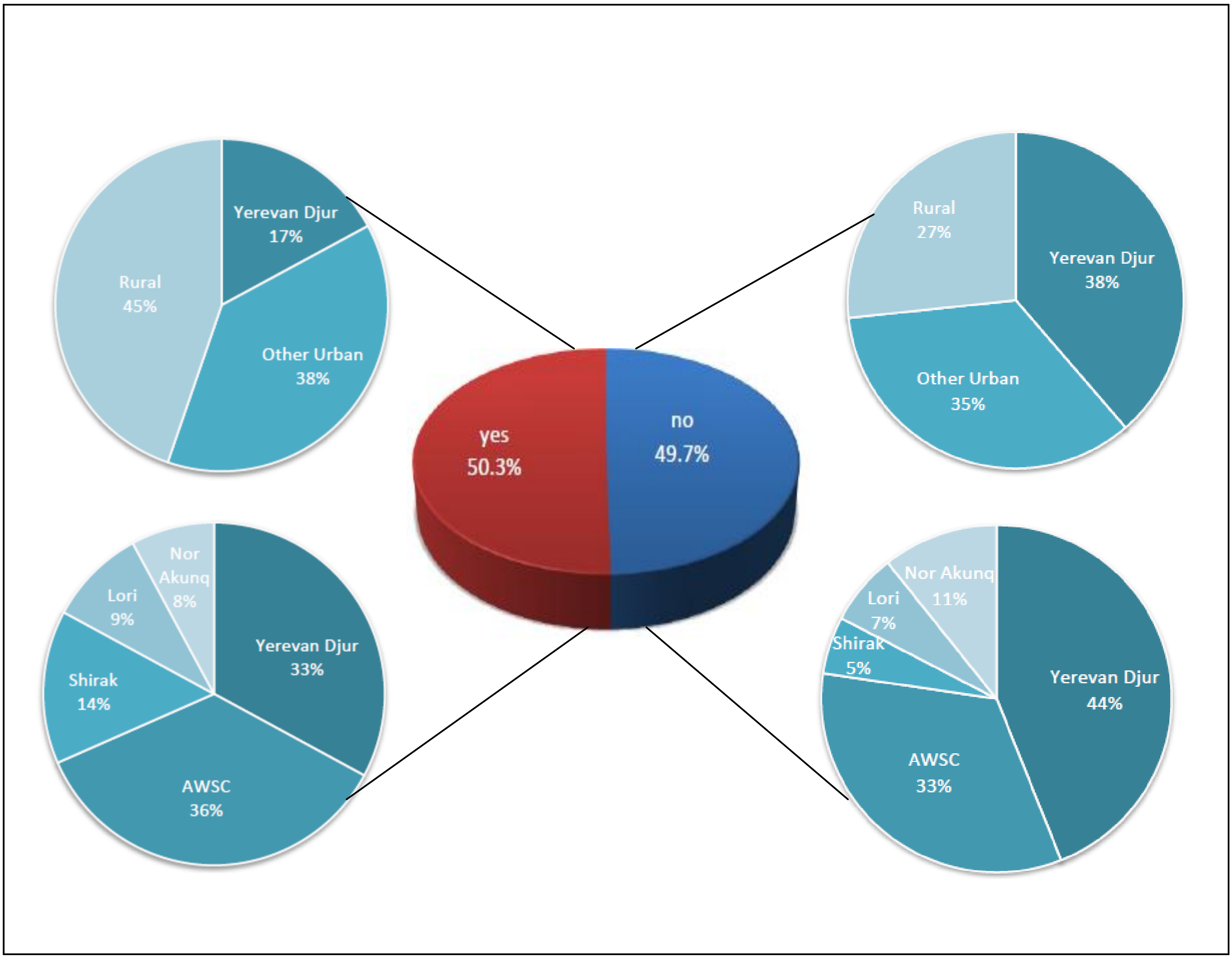


Figure 6.3.6.8 Willingness to pay for improvements

The distribution of willingness to pay by water companies shows that the highest percentage (36%) of willingness to pay is expressed by households residing in AWSC service area. Households (44%) in Yerevan Djur service area express the strongest refusal for additional payment for improved water services.

For identifying the correlation of the household willingness to pay more for water service improvement with the scale of water utilities shows that there is a small positive correlation (Spearman's rho = 0.105) (Annex VI-25). However, this correlation is not significant; hence, it is too likely to be due to sampling error. Therefore, we continue to assume that, despite this correlation of 0.183, the real correlation is 0.

For identifying the correlation of the household willingness to pay more for water service improvement with the level of urbanization shows that there is a moderate positive correlation (Spearman's rho = 0.248) (Annex VI-25). Taking into account the direction of the coding the interpretation of this correlation coefficient is as follows: the more urban the area the lower the willingness to pay more. This correlation is significant at the level of 0.002 ($p < 0.01$), hence, we can assume that Spearman of at least this high is found in the population.

Taking into account the importance of willingness to pay factor, correlation analysis was extended with a number of other variables (Table 6.20). The results indicate that there is statistically significant relationship between the willingness to pay and the following variables:

- Water payment: very weak negative correlation (Pearson's R = 0.144). The correlation is so small that makes it unacceptable.

- Financial situation of family: moderate positive correlation (Spearman's rho=0.229) that is significant at the level of 0.005 ($p < 0.01$). The higher family's financial situation the higher the willingness to pay more for water service improvement.

- Water price level satisfaction: strong negative correlation with (Spearman's rho = -0.313) that is significant at the level of 0.000 ($p < 0.001$). The higher the households' perception of water price level the lower the willingness to pay more for water service improvement.

- Cutting off water for a few days problem: weak negative correlation (Spearman's rho = - 0.160) that is significant at the level of 0.051 ($p < 0.1$). The correlation is small but still is minimally acceptable.

- No improvement: correlation (Chi-sqaure = 4.905) that is significant at the level of 0.031 ($p < 0.05$).

- Proper pressure: correlation (Chi-sqaure = 4.836) that is significant at the level of 0.028 ($p < 0.05$).

- Central Sewage system for all: correlation (Chi-sqaure = 11.163) that is significant at the level of 0.001 ($p < 0.01$).

- Sewage outflow improvement: correlation (Chi-sqaure = 11.308) that is significant at the level of 0.001 ($p < 0.01$).

Table 6.20 Relationship between willingness to pay and other variables

Variables	Level of measurement	Correlation coefficient	Correlation coefficient value	Significance
Water payment	interval	Pearson's R	-0.144*	0.080
Storage	interval	Pearson's R	0.114	0.162
Schedule (hours)	interval	Pearson's R	-0.132	0.109
Financial situation of family	ordinal	Spearman's rho	0.229***	0.005
Satisfied with water service	ordinal	Spearman's rho	0.066	0.421
Water price level satisfaction	ordinal	Spearman's rho	-0.309****	0.000
Schedule disruption problem	ordinal	Spearman's rho	-0.037	0.654
Cutting for few days problem	ordinal	Spearman's rho	-0.160*	0.051
Low pressure problem	ordinal	Spearman's rho	0.051	0.553
Low quality problem	ordinal	Spearman's rho	-0.134	0.102
Electric pump	nominal	Chi-square	1.348	0.246
No improvement	nominal	Chi-square	4.905**	0.031
Quality improvement	nominal	Chi-square	0.532	0.466
Health risk reduction	nominal	Chi-square	0.030	0.862
Additional hours of supply	nominal	Chi-square	0.516	0.473
24 hours of supply	nominal	Chi-square	0.926	0336
Convenient schedule	nominal	Chi-square	0.046	0.830
Proper pressure	nominal	Chi-square	4.836**	0.028
Central water system for all	nominal	Fisher		0.120
Central sewage system for all	nominal	Chi-square	11.163***	0.001
Sewage outflow improvement	nominal	Chi-square	11.308***	0.001
Better drain cleaning	nominal	Fisher		0.209
Reducing cost of services	nominal	Fisher		0.620
Installation of meters	nominal	Fisher		0.497
Pipe restoration	nominal	Chi-square	0.001	0.981
Loss prevention	nominal	Fisher		0.497

*. Correlation is significant at the 0.1 level; **. Correlation is significant at the 0.05 level;
. Correlation is significant at the 0.01 level; *. Correlation is significant at the 0.001 level.

How much are willing to pay?

Those who expressed willingness to pay for their mentioned improvements were asked about the amount of additional payment for water service improvement they are ready to pay. Two questions were asked for assessing the household willingness to pay: 1) an additional payment for the current monthly bill; 2) increased water fee for per square meter.

On average, more than 60% of the households are willing to pay less than 500 AMD in addition to their current monthly water bill for water service improvements (Figure 6.3.6.9).

In general, those households that are willing to pay more than 1000 AMD are ready to for improvements of wastewater flow or pipes.

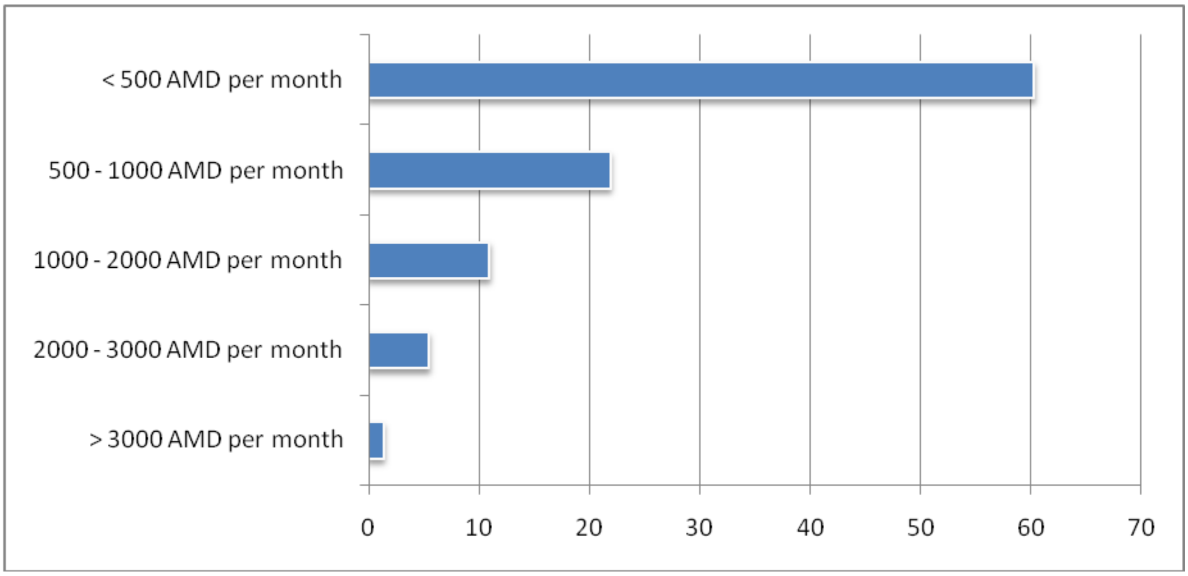


Figure 6.3.6.9 Willingness to pay in addition to monthly bill (No of households)

As for the second type of assessment, the number of households' answers is limited: 12 households. Half of households (50%) reported their readiness to pay 200 AMD per m^3 per month on the condition of having improved water services, which is over 10% higher of their actual payment (Figure 6.3.6.10).

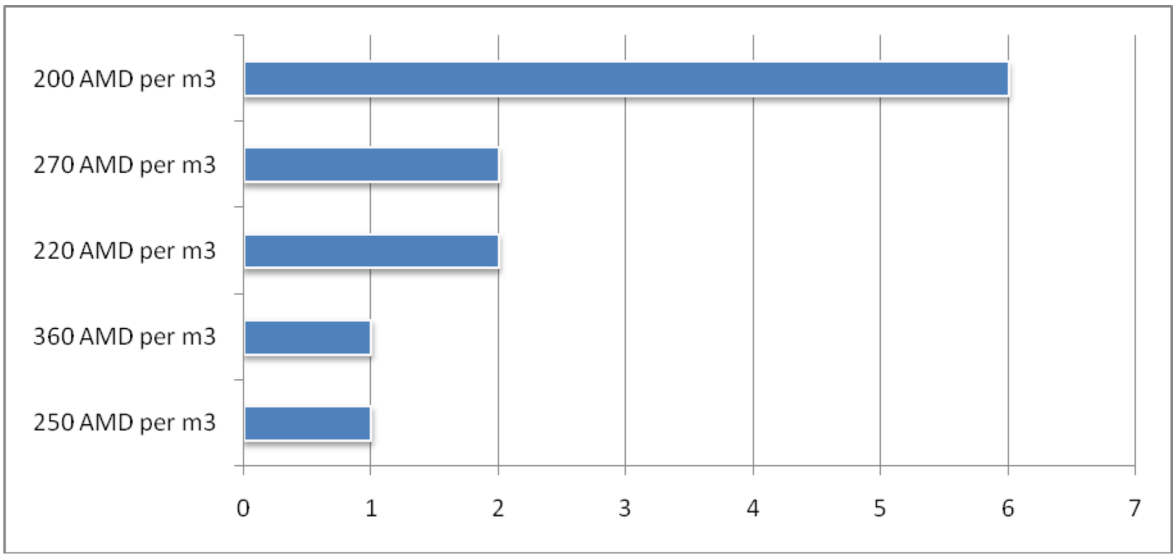


Figure 6.3.6.10 Willingness to pay as an increased water fee per m^3 (No of households)

6.3.6.7 Multiple logistic regression model

Going further, it could be interesting to understand whether the willingness to pay more for water service improvement can be predicted based on a group of variables or to identify the factors that as a group influence the willingness of households to pay for water service improvements. For this purpose, the binomial logistic regression is performed which allows to model dichotomous outcome variables with independent variable that are a mix of categorical and interval.

In the model the outcome (response) variable is binary (0/1); willing or not willing (yes/no). The predictor variable is the willingness to pay (WTP). The six independent variables are:

- level of urbanisation (ordinal variable),
- financial status of households (ordinal variable),
- water price satisfaction (ordinal variable),
- experience of complaint to utility (ordinal variable),
- perception of change from worse schedule (nominal variable),
- need for improvement for better pressure (nominal variable).

All the possible regression equations using all possible combinations of independent variables and assumptions were estimated to get the best subsets. The final selection was based on the best fit by looking for the highest adjusted R square and lowest standard error. Non-significant variables obviously were not interpreted as "predictor" or "influencer" and were removed depending on the strength of its influence on the overall prediction (such as R square). The assumptions of the logistic regression model are:

1. Dependent variable should be measured on dichotomous scale.

2. There are one or more independent variables that are either continuous (interval or ratio) or categorical (ordinal or nominal) variables.

3. There should be independence of observations and the dependent variable should have mutually exclusive and exhaustive categories.

4. Logistic regression does not require making any assumptions of normality, linearity and homogeneity of variance for the independent variable. There is no need that independent variables are normally distributed, linearly related or of equal variance within each group. The relationship between the independent and dependent variables is not a linear function in logistic regression. As an alternative, the logistic regression function is used.

The below “Omnibus Test of Model Coefficients” table provides that overall test for the model with all the predictor variables. The Chi-square value of 40.704 with p<0.001 indicates that the model as a whole fits significantly better that an empty model without predictor variables.

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	40.704	6	.000
	Block	40.704	6	.000
	Model	40.704	6	.000

In order to understand how much variation in the dependent variable can be explained by the model an equivalent of the R square in multiple regression models can be used. The below “Model Summary” table shows that the explanatory power of six variables in variation in the dependent variable is 0.321 (Nagelkerke R square). The higher the R square the more powerful the model is. In the present case, R square is moderate meaning that 32% of the variance in willingness to pay is due to difference in the level of urbanisation, financial status of households, water price satisfaction, experience of complaint to utility, perception of change from worse schedule, need for improvement for better pressure.

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	164.441[a]	.240	.321

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

The below "Classification Table" shows that cut value is 500. The overall percentage of correctly classified is 68.2%, which reflects the percentage of cases that are correctly predicted by the full model.

Classification Table

Observed			Predicted		
			Willingness to pay		Percentage Correct
			no	yes	
Step 1	Willingness to pay	no	48	25	65.8
		yes	22	53	70.7
	Overall Percentage				68.2

a. The cut value is .500

The below "Variables in the Equation" table shows that none of the independent variables in the analysis standard errors larger than 2 which is a common test for multicolinearity in the logistic regression. A standard error larger than 2.0 indicates numerical problems. The "Variables in the Equation" table also shows contribution of each independent variable to the model and its statistical significance. The most important result is that all six variables are statistically significant: urban_rural is significant at $p<0.1$, while all others are significant at $p<0.05$. Hence, these variables are significant predictors of the willingness to pay more for water service improvements. Coefficient for the constant is not significant, but we can just leave it without removing since we are not particularly interested in the intercept. The "Variables in the Equation" table can be used to get the probability of an event occurring based on one unit change in an independent variable when all other independent variables are kept constant.

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	90% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	urban_rural	.481	.251	3.681	1	.055	1.617	1.071	2.442
	financial_status	.913	.341	7.159	1	.007	2.491	1.421	4.366
	price_satisfaction	-1.489	.396	14.146	1	.000	.226	.118	.433
	complaints	.725	.278	6.824	1	.009	2.065	1.308	3.259
	change_worse_shedule	2.796	1.114	6.295	1	.012	16.380	2.620	102.419
	improvement_better_pressure	-3.281	1.415	5.378	1	.020	.038	.004	.385
	Constant	-.074	1.481	.003	1	.960	.928		

a. Variable(s) entered on step 1: urban_rural, financial_status, price_satisfaction, complaints, change_worse_schedule, improvement_better_pressure.

These estimates show the relationship between the independent variables and the dependent variable, where the dependent variables is on the logit scale. The positive (or negative) coefficients indicate about the increase (or decrease) in the predicted log odds of willing to pay more that would be predicted by one unit increase (or decrease) in the predictor, holding all other predictors constant.

The resultant logistic regression equation for predicting the dependent variable from the independent variable is:

$$\log(p/1-p) = b0 + b1x1 + b2x2 + b3x3 + b4x4 + b5x5 + b6x6$$

Expressed in terms of the variables, the logistic regression equation is:

log(p/1-p) = -0.07 + 1.617*urban_rural + 2.491*financial_status – 0.226*price_satisfaction + 2.065*complaints + 16.380*change_worse_schedule – 0.038*improvement_better_pressure

Based on the logistic regression equation, taking into account the direction of urbanization variable, for every one unit decrease in urbanization score, a 1.617 increase in the log-odds of willingness to pay more can be expected, holding other independent variables constant. Next, for every one-unit increase in financial status score, a 2.491 increase willingness to pay more is expected, holding all other variables constant. Similarly, for every one-unit decrease in price satisfaction score, a 0.226 increase of willingness to pay more is expected. For every one-unit increase in complaints score, a 2.065 increase of willingness to pay more is expected. The odds of willing to pay more are kept 16.380 times more for households that have experienced worse schedule in last few years than for those who did not. The odds of willing to pay more are kept 0.038 times less for households that strengthen the need for pressure improvement than for those who do not.

The predictor variables of the logistic model have significance level below 0.01 (prce_satisfaction), below 0.05 (financial_ status; complaints; change_worse_schedule; improvement_better_pressure) or below 0.1 (rural_urban) which means that in the population these variables are likely to have at least this level of impact.

Taking into account the high correlation between the variable “Central sewage system for all improvement” and “willingness to pay” (above Table 20), a logistic regression was performed with that variable too, instead of rural_urban variable. The results proved to be similar with the above discussed logistic model (Model significance at 0.000; Nagelkerke R square = 0.336; overall percentage of 70.9%) but with removal of urban_rural variable. This makes another logistic regression model with the same mix of variables but instead of rural_urban the central_sewage_system_for_all variable is also significant, holding all other predictors constant.

6.3.6.8 Willingness to pay for improved sanitation

Those households that do not have connection to central system for sanitation were asked about the importance of improvements in sanitation services. The responses of 52 households is presented in Figure 6.3.6.11. For the vast majority of these households (84%), improvement of sanitation is an important (17%) or very important (67%) issue. The urban-rural split shows that sanitation is important or very important for 4% of urban and 96% of rural households. Water utility split shows that sanitation is an important or very important issue for all water utilities: 29% of household in Shirak service area, followed by 23% in AWSC, 17% in Yerevan Djur, 8% in Lori and 8% in Nor Akunq areas (Annex VI-26). At the same time, 10% of respondents are not interested with the sanitation issue at all or are neutral (6%) to it (Figure 6.3.6.11).

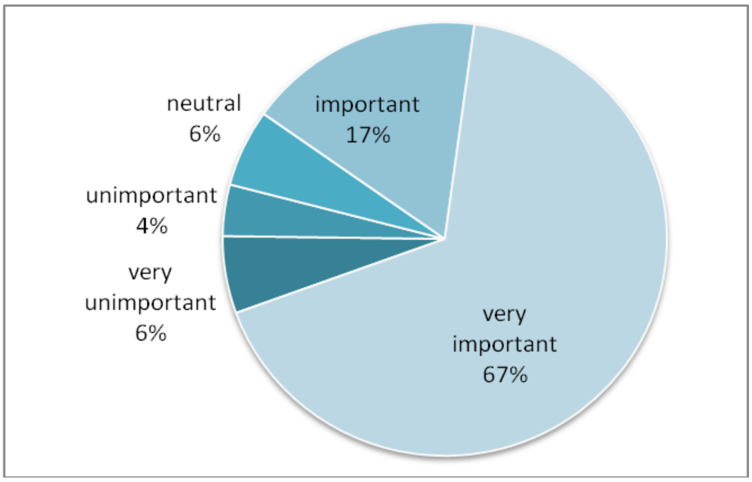


Figure 6.3.6.11 Importance of improved sanitation (%)

Regarding the sanitation, the households were asked to suppose that it would be possible to connect them to a central sanitation system and then to indicate their willingness to pay for sewage connection. Of 44 households that gave an answer to this question, over 18% are ready to pay nothing for sanitation improvement (Table 6.21). The payment range is quite wide: from 1000 AMD to 300000 AMD. On average, people are ready to pay 28682 AMD for central sewage system connection. It is important to note that when this question was asked a lot of respondents expressed they unbelief that it could be ever happen.

Table 6.21 Distribution of willingness to pay for sanitation improvement

Water sources		No of households	Percentage
0		8	18.2%
1000		1	2.3%
3000		2	4.5%
5000		6	13.6%
10000		6	13.6%
15000		2	4.5%
20000		3	6.8%
25000		2	4.5%
30000		2	4.5%
40000		4	9.1%
50000		3	6.8%
55000		1	2.3%
100000		3	6.8%
300000		1	2.3%
Total		44	100%
Average	28 682 AMD		

6.3.7 Actions to mitigate water price increase

The households were asked if they would undertake actions to minimize water use or use water more efficiently in case of significant for their family price increase. Over one third of households (37%) gave a negative answer in adding that they are already using water effectively, especially after installation of water meters (Figure 6.3.7.1). Some households mentioned that unlike in Soviet times they do save water now: open and close the tap while dishwashing, do not open water to run for cooling it for drinking or cooling the water melon. Other stated that irrespective of everything water needed to be saved.

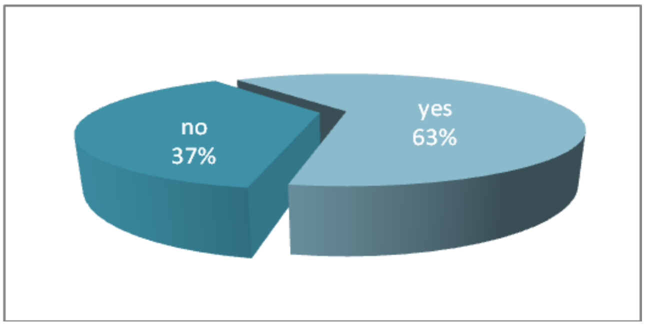


Figure 6.3.7.1 Undertake actions to minimize or use water more efficiently (%)

Those who gave a positive answer were asked about the water saving actions they would do. The results are presented in Figure 6.3.7.2 in the decreasing order of importance.

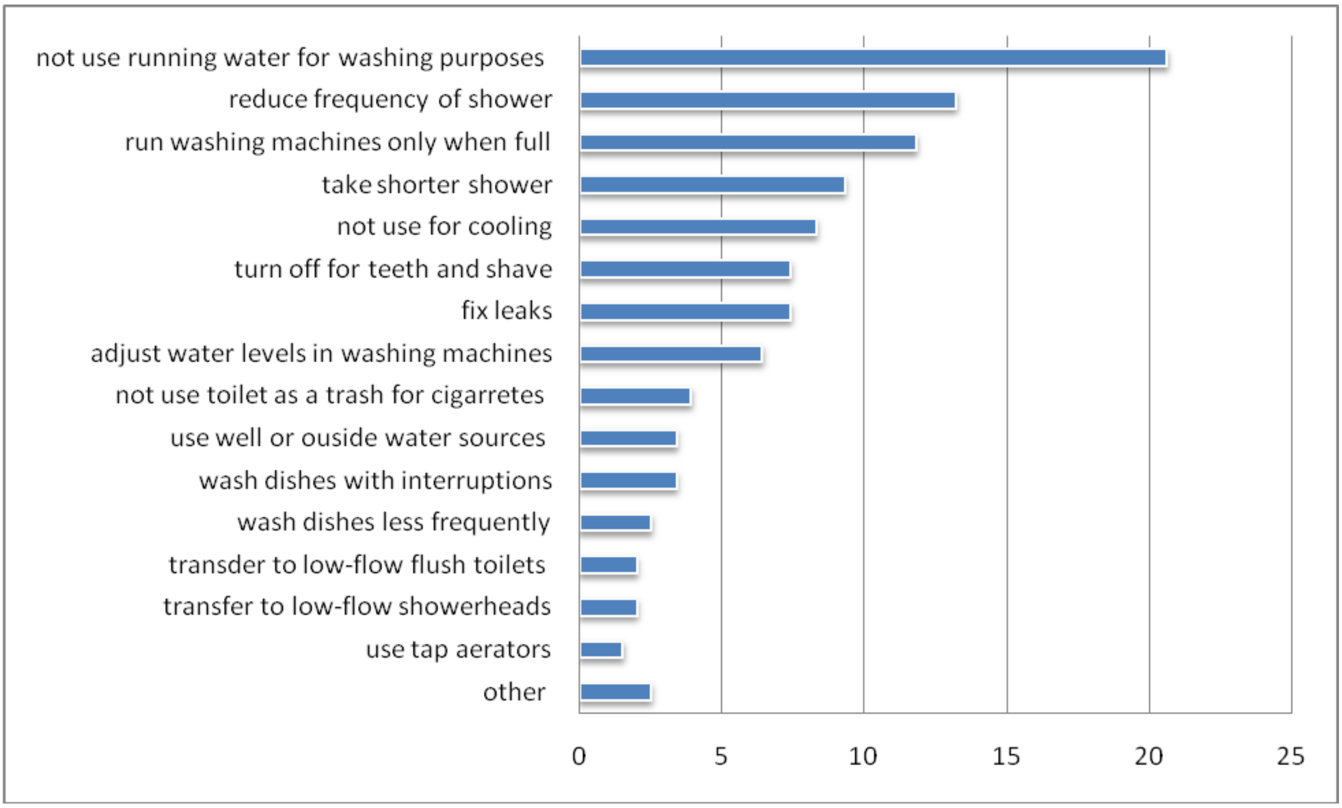


Figure 6.3.7.2 Water use minimization actions if price increases significantly (%)

Over 20% of the surveyed households stated that they would not use running water for various washing purposes, for example, while dishwashing filling a sink or a dishpan. Next important action is reducing the frequency of taking shower (13%), running washing machine only when it is full (12%) and taking shorter shower (9.3%). Other option includes measures such as reusing water or using rain water or irrigation water, for example, for bathing and washing purposes. As it is seen a number of actions taken will minimize water usage but at the expense of reduced hygiene practices and worsened health.

6.4 Summary of key findings and conclusions

This chapter examined the impacts of water privatization on households. In particular, it presented the analysis of the household survey data with application of a various statistical tools. It started with presentation of the detailed analysis of household characteristics and households' water facilities. It then assessed water sources, consumption and payment patterns differentiated by utilities and rural and urban areas. Water debt and water quality and service issues are also referred to along with coping strategy costs that households bear for mitigating water service deficiencies. The estimation and ranking the quality of water services delivered by water utilities in urban and rural areas is performed. The analysis also identifies the level of satisfaction with the water payment rate and with water supply service quality. Finally, the needs for water service improvement are identified and household willingness to pay more for improved water services is assessed. The discussion extends to water sanitation issues as well. The main results of the chapter are the following:

Households in urban areas consume and pay more

There is a positive relationship between the level of urbanization and water consumption and payment. On average, in capital city Yerevan households pay more for water services than households in other urban areas and in rural areas.

Size of water utilities is not related with water consumption and payment

At the same time, the size of water utilities is not related with water consumption and payments. On average households pay more in Nor Akunq service area, while in Shirak households pay less.

Number of people and water amenities are related with water consumption and payment

The higher the number of people in the households the higher the water payment is. The next factor that is strongly positively related with water consumption is shower usage. Among other factors that have moderate relation with water consumption are the availability of heating boiler and washing machines. Interestingly, households consume less if they use pump, which is reflected by moderate negative relation.

Multiple Linear Regression Model: shower and washing machine usage predict 9% of water consumption variance keeping constant a group of other factors

The results of the analysis of the questionnaire were also used for designing a multiple regression models for identifying the sensitivity to specific variable changes to be used further in policy analysis for water industry reforms. Multiple linear regression model was developed to get the effects of a group of variables (water facilities) on water payment. It was used for predicting the level of water payment based on a change in an independent variable when other independent variables are kept constant. Model results with higher explanatory power show that 9% of the variance in the water payment can be explained by two predictors together (shower and washing machine usage). Hence, households that use shower for bathing purposes and use washing machine are more likely to have more water payments.

Average water consumption meets the requirement of medium-term maintaining

Average water consumption in Armenia is higher than that of 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 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.

Almost universal level of water metering

Over 97% of households have water meters and pay according to meter records. Those who do not have meters installed either pay 250 AMD per person per month or a fixed amount of 1000 AMD per month. Opposite to promises for support for meter installation, none of responds received any technical or financial support with installation of water meters.

Water payment debts are wide spread

The unexpected discovery of the household survey was a 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. The study revealed a considerable range of debts that amount from 2400 to 700000 AMD. Comparing this amount with the minimum wage of 35000 AMD (84 USD), one can see that in some cases the water payment debts may reach up to 200 times the minimum salary.

In general, the debts were created immediately after the meter installation at the very beginning of introduction of privatization program. 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. Currently, a number of households have passed or are in court process with water utilities for debts 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 water supply due to 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 cancelled 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.

Water price is perceived to be high

Over 60% of all households consider that is high. This is on the background of a widespread perception that unlike oil or gas the water is the own resource, coming from mountains and it should not be sold to local people.

For the vast majority of surveyed households, water payment is a problem. About 1% of population are not able to pay this sum, mostly because of the problem of very high debts calculated during the restructuring process, low pensions or lack of job.

Water services are perceived as satisfactory

Over 85% of all surveyed households are satisfied completely or with some remarks with the quality of water services. Almost half 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.

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 recorded quite high performance at utility level assessments (discussed in the previous chapter) evidences the lowest score based on household level assessment. This increased the confidence in the rightness of the chosen methods that enabled to trace problems that were not quite visible during top-down method.

Households in rural areas more satisfied with water services

The analysis of water quality satisfaction according to urban and rural areas revels that in total in rural areas households are more satisfied and in urban areas. 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 complains in areas with lower duration and opportunity to observe other districts in the city with 24 hours of water supply.

Water quality is satisfactory

About the half of households have never had water quality issues. Overall, water quality is perceived as satisfactory. In general, households sometimes face some quality issues, such as excess of chlor or other smell issues after cut. At the same time, 92% of households drink tap water. The majority of those who are completely unsatisfied and who do not drink tap water is registered with Nor Akunq utility, which is also reflected by the high degree of vended water purchases in Nor Akunq service area.

Correlation of the household perception of water quality with the scale of water utilities shows that there is a substantial correlation. About 26% of the variance in households' perception of water quality is explained by difference in water company size. 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.

Health improvement due to improved water quality standards and monitoring

Revised drinking water standards set in accordance with WHO guidelines and improvements in water supply services in terms of water quantity, quality and reliability have been going together with enhanced security at all water sources, monitoring and treatment practices with application of modern chlorination facilities. This resulted in a significant decreased of water-related disease such as diarrhoea in recent years. Despite this, an increase in intestinal infectious diseases necessitates more long-term solutions for ensuring adequate quality and quantity of drinking-water, especially outside capital city areas.

Water pressure is satisfactory

More than half of households have not faced problems with pressure. The mostly unsatisfied with low pressure are households in Nor Akunq, the highest record is in Lori area where households almost never have low pressure issues. Interestingly, there is almost no correlation detected between the floor of the dwelling and the pressure level issue. At the same time, households noted that because of water cuts and pressure deviations it is not possible to operate water heaters or washing machines properly.

Water supply schedule improved but 24 hour is not yet universal

The mean for water supply schedule is 18 hours per day. At the same time, over 61% of households in all five water companies have 24 hours of water supply per day. 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.

Households are informed about disruption in water supply services

More than half of households are regularly receiving information about the service interruptions in the water supply, of which in rural areas only 25%. The majority of households receive information either via phone and/or television

Moderate rate of complains to water utilities

More than 60% of surveyed households have never complained to water utilities for water supply service problems. Interestingly, Nor Akunq has the lowest records for complains and AWSC has the highest. Complains related with service hours are the most frequently mentioned reason, followed by problem related with pipes or meters (for example, destroyed meters because of cold, problems with consumption records and bills, or the need for meter installation).

Coping strategies: despite improvement during the last decade water services are still deficient and household may bear to 3 times more costs than the average water payment

The analysis above shows that despite improvement during this last decade water services still remain deficient. In addition to official monthly water charge of 2000 AMD, the households may bear up to 3 times more costs per month. This is quite significant, especially taking into account that these costs could be underestimated since the cost calculation some of cost are not included, for example, water well digging costs, travel costs for getting water from secondary water sources, opportunity cost of time in case of hospitalization for seeking care and in time taken off work, waiting for water supply hours, costs for spoiled conserved food spoiled due to bad water quality, etc.

The highest costs that households bear are related with installation and operation of water pumps. One fifth of the surveyed households have a pump installed on their water systems operating on average 2 hours per day. Individual sewage system construction and maintenance is the next most expensive activity which is commonly borne by rural households. Significant are also bottled or vended water purchases.

Some of strategies that Armenian households take for coping with water supply service deficiencies relate to the installation of equipments such as container or a pump. Others strategies relate to behavioural or life style changes such as getting up earlier to collect water, taking shorter shower, scheduling specific activities to be done during water supply time, or avoiding using washing machines during heavy rainy weather because of bad water quality at that times. However, behavioural adaptations may face some difficulties; for example, is there is no precise time of water supply.

Water storage is the most popular measure, followed by bottled or vended water. The more the water storage capacity the lower the satisfaction with water services is. The highest spread within the group and the highest volume of maximum water storage are recorded in rural areas. At the same time, on average households in other urban areas store more water than in rural areas. This to some expend can be explained by more possibilities for other water source assess in rural areas. In Yerevan city water storage is the lowest, which could be explained by more reliable schedule of water supply and water service interruption warning services by water utilities. Hence, improvement of warning services increases the satisfaction with water quality, helps to improve rescheduling of activities and reduced water storage capacity.

If improvements are needed they are for water quality, additional hours of supply and sanitation

Water quality improvement, no improvement, additional hours of supply and wastewater outflow improvement are among the popular improvements for water services proposed by households. In rural and other urban areas additional hours is more important improvement than water quality. At the same time water quality is the highest necessity in Nor Akunq utility area. The highest percentage of "no improvement" is in Yerevan city area.

As the first priority choice, about half of the households prefer to have improved water quality. In rural areas, almost 90% of households mentioned central system for sanitation as a first priority improvement. An interesting case is Nor Akunq utility service area, where people are struggling with significant water quality issue and health issues and are not concerned with other improvement options yet.

Health risk reduction, convenient schedule of supply and water quality improvement are mentioned a second priority. Third priority improvements include sanitation system improvement and additional hours of supply. Hence, water quality and additional water hours of supply seem to be an expectation from the improvement. As soon as these are satisfied, households expect to have their sewage system conditions improved too.

Willingness to pay

Almost 90% of households support this statement that the services should be improved first and then the cost could be increased.

Half of households expressed their willingness to pay for the proposed improvements in water services. The more urban the area the lower the willingness to pay more: while the highest share of those who are not willing to pay is in Yerevan, the highest share of those who are ready to pay for service improvement is in rural areas reflecting the more need for better water services in rural areas. Other two important factors affecting willingness to pay is water price level satisfaction and financial situation of the family. The higher the households' perception of water price level the lower the willingness to pay more for water service improvement is. The higher family's financial situation the higher the willingness to pay more for water service improvement is.

In general, among the main reasons for refusal to pay for water service improvement households mentioned that water fee was already too expensive and that water was an obligation of water utilities and/or the government that should provide it. Some households prefer to continue using water containers rather than having increased water tariffs for improved services. Others are of opinion that they already overpay for the quality that they have now. Finally, some respondents expressed that their doubt that with the price increase they would have better services.

Willingness to pay is less than 500 AMD for service improvement and more than 1000 AMD for sanitation and pipe restoration

For the improvements, over 60% of the households are willing to pay less than 500 AMD in addition to their current monthly water bill. In general, those households that are willing to pay more than 1000 AMD are ready to for improvements of wastewater flow or pipe restoration.

Multiple Logistic Regression Model: 32% of variance in willingness to pay is predicted by households' financial status, level or urbanization, water price satisfaction, service complains, water supply schedule and pressure

A logistic regression model was performed to get the effects of a group of variables on the likelihood that households are willing to pay. It can be used to get the probability of an event occurring based on a one unit change in an independent variable when all other independent variables are kept constant. The model explains 32% of the variance in willingness to pay. The model results show that increasing household financial status is associated with increase of willingness to pay more for improved water services. At the same time, decrease in the level of urbanization is related with increase of willingness to pay more for improved water services. Similarly, decrease in price satisfaction is associated with increase of willingness to pay. Increasing number of experiences with complains to water utilities is associated with increasing willingness to pay more. Similarly, the households that have experienced worse schedule in last few years are more likely to exhibit willingness to pay more for improved water services than those who did not. Finally, households that stress the need for pressure improvement are less likely to exhibit willingness to pay more for improved water services than those who did not.

Households will undertake actions to reduce water consumption if price increase significantly

The households were asked if they would undertake actions to minimize water use or use water more efficiently in case of significant for their family price increase. Over one third of households gave a negative answer in adding that they are already using water effectively, especially after installation of water meters. Some households noted that unlike in Soviet times they do save water now: open and close the tap while dishwashing, do not open water to run for cooling it for drinking or cooling the water melon. Other stated that irrespective of everything water had to be saved.

The final conclusive message is that even though the water supply services have been improved within the last decade and people are in general satisfied with water services, there are still a number of service deficiencies that households face and try to cope with. There is a lack of sanitation especially in rural areas and high willingness to pay for the improvement. Water payment debts are widely spread. It is still partially satisfying the existing demand with the availability of water supply only for some hours per day or a week in some cases. Coupled with quality and pressure-related issues, it makes water supply not quite predictable especially in summer periods when households are forced to implement a number of service deficiency mitigation measures that require additional costs and or behavioural changes.

CONCLUSION

The present empirical research aimed to investigate the process and impacts of transition from public to private provision of water services in Armenia and to explore the aspects of *the supply side* on the level of water utility performance and *the demand side* on the level of end-users (households) ensuring the proper consideration of social and environmental demands and legal and institutional implications. The three core research questions have been: 1) What are the impacts of privatization on environmental, social and economic performance of water utilities in Armenia? 2) What effects did privatization of the water service have on households in Armenia? 3) What are progress, problem, and policy and institutional implications of introduction of water privatization in Armenia?

One of major strengths and innovation of the present empirical research is the methodology, based on a *holistic approach* through employment of various methodological tools and multiple sources of data to get a clearer picture of the developments in the water governance system. The research has observed developments in a dynamic covering the pre-privation period and the privatization process up to recent years. Moreover, the research studied the impacts from the top-down and bottom-up perspectives. Finally, a number of assessments, such as the sustainability index, the ranking or international comparison of Armenian water utilities has been done for the first time. Thus, the research design allows the innovation of the conceptual framework and contributing to multi-perspective interpretations.

The mixed method approach in the research follows the "merging the data" design with elements of embedding the dataset with the supportive role within the major dataset. The methodological components tailored to the three main research questions were: 1) ex-post benchmarking method; 2) household survey; 3) conversational/stakeholder interviewing; and 4) document analysis.

The conclusion section proceeds with presenting the major summary and concluding statements derived from the overall research. More detail and elaboration on research findings are presented in the final sections of each of the results-based chapters.

Armenian context: water resources

The collective memory of Armenians retains the perception that the water is an abundant resource in the country, which accordingly should be supplied free of charge for people. However, even easier access to fresh water should not be taken for granted. This is especially true for Armenia, which as the research assessments show is not a water rich country. Factually, Armenia can be classified as a water-stress country where availability of renewable water is a limiting factor for development. Another factor breaking the myth is that Armenia ranges within the low water availability category on a per capita basis and ranks the lowest with its water poverty index among CIS countries. The situation is exacerbated by pessimistic climate change impact scenarios and current water-related environmental problems. The temporal decline in water pollution as a result of a drastic reduction in industrial and agricultural output during the transitional years is reverting with a revival of economic activities. This implies growing demand for resources, including water resources, in all sectors with all their related environmental and social implications and stresses the need for ensuring the sustainability of water resource management.

Transition in water governance

In the late 1990's, after a decade of painful transition to a free-market economy accompanied by poor repair and under-investment, the water industry appeared in a condition of an urgent need of reforms under market conditions to restructure the degrading water networks, to reduce the dependence of the sector on state subsidies, to raise revenues from increased collections of water payments based on metered billing, to enhance the management efficiency of water utilities and to improve the availability and quality of water services. The water reforms were undertaken in the context of the broader agenda of structural changes supported by international financial institutions that conditioned the financial and technical support by the introduction of privatization. Basically, water sector privatization became “no other option” in the water reform program.

The present research has demonstrated that experience was an important driving force for privatization. By the start of water reforms, there was a buildup of expertise in dealing with economic and legal aspects of privatization contracts in other sectors. Both the positive and negative privatization cases strengthen the experience and confidence to go into privatization in the water sector. However, in contrast to privatization in other sectors of public services, the public-private partnerships in the water sector were established through competitive bidding avoiding a sole-sourcing regime. Along with that, in the Armenian water sector there is a dominance of international private operators though with the partial participation of local partner companies. Improved transparency in the performance of utilities is ensured by a number of checks and balances of private operator performance through institutionalized systems of financial and technical reporting against performance indicators. At the same time, despite these general governance improvements the reforms did not go without problems such as, for example, conflict of interests due to overlaps and duplications and plundering practices.

One of the research highlights is that Armenia achieved unprecedented rapid and massive privatization in the water sector: in a decade from zero reaching up to 63% of the population.

This accounts the third highest level (after the UK and France) recorded in European countries, where on average 20.5% of the population is served through public-private partnership arrangements. Among the NIS countries, the Armenian case is also unique in terms of the earliest and highest rates of penetration of private sector participation in the water sector. But to make it politically acceptable, a case-by-case rather than a rapid mass privatization approach was adopted: while one utility was privatized, others stayed in state ownership.

The study found that privatization in the water sector goes deeper and wider. Currently, the continuum of public-private partnership contracts is marked with a centralized lease contract and centralized and decentralized management contract frameworks. The rest of the population gets water services from the community self-supply water systems, which have mixed results of success in terms of reliability and quality of water services.

Water privatization impacts on utility performance

The present research has focused on the ex-post assessment of the directional and magnitude impacts of transition to public-private partnership modes of governance in the water sector based on the performance of all five water utilities currently operating in Armenia. The impacts of water privatization were assessed along three sustainability dimensions: economic, social and environmental performance.

The results of ex-post benchmarking assessment show that transition to the public-private partnerships on the whole had a positive impact on the sustainability performance of all water utilities. Under public-private partnership arrangements all water utilities improved their overall absolute sustainability performance. Considerable progress has been made in social followed by environmental performance. Significant environmental and economic benefits have been achieved by extensive energy efficiency measures. The most significant are the gains in operational efficiency with increased levels of water metering and water payment collection rates that enabled improving water supply services through longer continuity of supply. Currently, the revenue collection rate is the exceptionally high compared with international and regional experiences. Inspiring is that within the studied period there was progress in piped water supply in rural areas. At the same time, all utilities are struggling with high non-revenue water and difficulties with recovering operational costs. Within the initial period or reforms, effective measures and low cost (for utilities) measures for tackling commercial losses and to some part physical losses have already been implemented with mass metering actions. There is still significant room for better management practices to reduce commercial losses. The simplification and clarification of meter testing and replacement procedures can facilitate commercial water loss prevention. However, situation still remains with complex with physical leakages that require more significant amounts of investment and better management practices.

An important milestone of the research is the discovery of the unique case of water metering 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 worldwide and unique in that it is individual apartment level metering in contrast to building block level metering. Indeed, the massive metering process has moved the practical implementation of water reforms from the idle point and became a trigger for a chain of water sector improvements – all backed by an enabling legal and institutional environment. It became a key measure in introducing a consumption-based tariff system, enforcing water payments. It has improved reliability of water supplies and increased water use efficiency. Moreover, water metering was a prerequisite for transferring to a new public-private governance system with performance-based service contracting, obtaining more accurate data and making more pragmatic analyses of changes in the water sector. The water conservation effects of metering were higher during the initial period after installation of meters and the last period when the tariff increased. In the short-run, immediately after meter installation, residential water consumption declined nearly four times. However, without the price increase acting as a signal and substantial cuts in water bills observed by households, the result was a rebound in water consumption. In the long-run, however, large-scale water metering was accompanied by an almost 48% reduction of water demand, even in view of improved water supply services, such as increased water supply duration. Moreover, metering helped start the process of tackling water theft and corruption practices, especially related to substantial water uses. At the same time, simplification and clarification of meter testing and replacement procedures can facilitate commercial water loss prevention measures.

The relative ranking assessment on sustainability performance of utilities has revealed a leader utility – Nor Akunq, the smallest regional utility, that demonstrated outstanding performance in many dimensions. Next is Yerevan Djur, the biggest utility that provides services at the municipal level with a high concentration of customers.

The results of absolute sustainability performance, which puts the assessment into the international context, show that compared to the minimum international performance, all Armenian utilities recorded superior performance in both the "before" and "after" privatization cases. Furthermore, some of the companies (Nor Akunq and AWSC) succeed in outperforming the average international performance, while others are operating close to it. Interestingly, in the "before" case the lowest ranked Nor Akunq utility appeared in the top position in the "after" case. Yet again Nor Akunq can be considered as a special case, which will be distinctively referred to in the household survey analysis as well.

The results of the Apgar score assessment for measuring the general health of utility operation show that compared with the "before" case, four out of five companies moved one step up. There was no utility operating in the green (normal) zone in the "before" case. At the same time, in the "after" case there is no utility operating in the critically low zone any more, while some already operate in the green zone.

It is important to emphasize that this is a pioneer study since some of the assessments, such as overall sustainability performance, international comparison, and ranking of water utilities is done for the first time.

Water privatization impacts on households

Another major component of the research is the household survey analysis devoted to the examination of the effects of the privatization on households. By this the empirical study ensures exploring the privatization issues from the bottom-up perspective. The household survey was conducted to collect data from all regions of Armenia, making it a national survey. The multistage cluster sampling technique was used to get a representative sample size of 205 households. Data collection was done through face-to-face interviewing based on the standardized questionnaire. The survey data analysis was done with the application of a mix of univariate, bivariate and multivariate techniques.

The results of the survey demonstrate that households in urban areas consume and pay more for water services. The multiple linear regression model shows that households that are using a washing machine and shower for bathing purposes are more likely to pay more for water. In general, average per capita water consumption in Armenia is higher than that of short-term basic survival level of 20 litres. It meets the requirement of medium-term maintaining. Any policy decisions on price should be made very carefully, taking into account the subsequent impacts on water demand which could be expected to reduce at the expense of health. Another point to be considered is that with increased 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 a wider range of needs for non-domestic use of water such as growing crops or livestock. Water for these activities can be of lower quality than drinking water. Therefore, there is a need in rural areas to improve provision of irrigation water not only in fields but also for house land plots.

The household survey also echoed the results of utility performance assessment on universal metering: over 97% of households have water meters and pay according to meter records. At the same time, the metering and transition to volumetric process provoked the emergence of the wide-spread problem of water payment debts with an astonishingly high percentage of indebted households and extremely high debts, in some cases reaching up to 20 times the minimum wage amount. This issue prompts more attention and the need for clarification on water debt calculation and administration, 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. 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 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.

Interestingly, Nor Akunq utility that records quite high performance at utility level assessments (discussed in the previous chapter) evidences the lowest score in households' assessments. In this utility area households complained about very bad quality of water, which was reflected also in the high degree of vended water purchases. This increased the confidence in the appropriateness of the chosen mix of methods that enabled to trace problems not quite visible in the top-down assessments.

Another discovery is that within the last decade considerable improvement has been reached in terms of water supply duration with the mean of 18 hours per day. However, there are still households that do not have water supply every day. Moreover, the research shows that there are still problems with water pressure and interruptions of water supply. A complex of issues remains with the poor condition of water pipes.

For coping with deficiencies of water services, households are implementing a number of measures which may cost up to three times the average official monthly water charge. This is quite significant, especially taking into account that these costs could be underestimated since some costs are difficult to estimate and are not included in the calculations. In general, some strategies that Armenian households undertake for coping with water supply service deficiencies relate to the installation of equipment such as storage containers or pumps. Other strategies relate to behavioral or life style changes such as getting up earlier to collect water, taking shorter showers, scheduling specific activities to be done during water supply time, etc. However, behavioral adaptations may be problematic, for example, if there is no precise time of water supply.

As for the improvements needed in the water supply services, households prioritize water quality, additional hours of supply and in rural areas the central system for sanitation, for which the rural households expressed the highest willingness to pay. Interestingly, the more urban the area the lower the willingness to pay more: while the highest share of those who are not willing to pay is in Yerevan, the highest share of those who are ready to pay for service improvement is in rural areas, reflecting the stronger need for better water services in rural areas. At the same time, half of the households do not want to pay more for water service improvements, because they find the water fee is already too high or prefer to continue using water containers rather than having increased water tariffs for improved services.

The results of the multiple logistic regression model show that 32% of variance in willingness to pay for water service improvement is predicted by the financial status of households, level of urbanization, water price satisfaction, service complains, water supply schedule and water pressure.

Furthermore, the majority of households claim that the current water price is already high. In case of a significant increase in water price, one third of households is not ready to minimize water consumption since, as households declare, they already use water effectively, especially after installation of water meters, not as in Soviet times when running tap water was used for cooling a water melon.

Concluding remarks and future research

Taken as a whole, what can be concluded from the study? What are the main learning points that come forward? What is the research significance and what are the future research needs? These are the questions discussed in this final part of the Conclusion.

The main concluding remarks and learning points that come forward from the present research are the following. Firstly, intensive marketization trends with related structural changes in legal, regulatory and institutional settings reinforce privatization in public services. Coupled with conditional technical and financial support from donor institutions and urgency dictated by the deteriorating infrastructure can make privatization a “no other option”.

Secondly, although experience in public-private partnership arrangements is a strong provision, for strengthening the political will and the public acceptance of privatization, a more precautionary approach with gradual transition is worth considering.

Thirdly, transparency can be enhanced by a number of checks and balances of private operators’ performance achievements through institutionalized systems of financial and technical reporting against performance indicators. With this regard, metering can become a critical factor for obtaining more accurate and reliable data and making more pragmatic estimations of changes in the water sector.

Fourthly, even under “forced” conditions, privatization still may lead to improvement in sustainability performance of water utilities, also on the international level. Both small and large scale utilities can operate equally successful. However, the scale of the impact of privatization depends on the initial state of the enterprise and the local context. Supportive legislation and regulation is needed for ensuring the attractiveness and incentives for private sector participation and operation and for protecting consumers from monopoly abuse.

Furthermore, after the high return and low risk *low hanging fruits* are reached during the first generation reforms to solve urgent needs, more efforts 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.

Finally, utility sustainability measurement and the ranking of utilities may be useful for comparing with and learning from others, bringing to light the performance gaps, (re)defining targets for each utility and focusing on management areas requiring top priority improvement measures. The regulatory context with explicitly formulated sustainability goals can signal trends towards sustainability and foster the process.

The results of this comprehensive study seek to be of benefit for scholarship, policy and practice. In particular, they can be used by policy makers and scholars to broaden their understanding of the status, issues and challenges in the water sector and different opinions on advancements, and to incorporate in their decision making process the estimates of the relevant conditions that make private provision of water services work effectively and efficiently. The conclusions are of particular importance for transition countries which share similarities in terms of the introduction of gradual liberalization, inheritance of common infrastructure patterns, specific public infrastructure policies and investment practices.

Though comprehensive, the present empirical study can be complemented by further research in various directions. For example, it may be important to make assessment of future water sector dynamics in terms of water resource availability, short- and long-term demand trends for specific user-groups (industrial, institutional, and domestic) and waste water production and treatment potential. More research is also needed for studying the financial status of water utilities with the identification of the overall indebtedness and capacity for transferring to the cost recovery state. With this regard, the study of the cost structure (assets and capital investment, depreciation, operation cost, interest, taxes, tariffs and fees, overhand costs etc.)

can be emphasized for individual water utilities. Furthermore, taking into account the magnitude and prevalence of water debt issue, it will be important to research on court cases, impacts on poor families, as well as on affordability of water services.

REFERENCES

ABS Energy Research. 2010. URL: www.absenergyresearch.com (December 03, 2010)

Agger, G. 1999. Intertextuality Revisited: Dialogues and Negotiations in Media Studies. *Canadian Journal of Aesthetics*, 4

Al-Madfaei, M. 2009. *The Impact of Privatization on the Sustainability of Water Resources in the United Arab Emirates*. Thesis submitted for PhD degree, University of Reading, Department of Geography, UK

Australian Competition and Consumer Commission (ACCC). 2010. "Evaluating infrastructure reforms and regulation: a review of methods." *Working paper* No. 2, August 2010

American Water Works Association (AWWA). 2000. Commercial and Institutional End Uses of Water. *AWWA Research Foundation and American Water Works Association*, USA. URL: http://ufdc.ufl.edu/WC13511002/00001/pdf (March 10, 2011)

Babayan, A. *et al*. 2006. Lake Sevan. Experience and Lessons Learned Brief. URL: http://www.ilec.or.jp/eg/lbmi/pdf/21_Lake_Sevan_27February2006.pdf (November 30, 2010)

Babayan, A. 2003. Experience and Lessons Learned Brief concerning Lake Sevan. Draft, December 16, 2003

Babbie, E. 1990. *Survey Research Methods*. Second Edition. Wadsworth Publishing Company, Belmont, California

Bakker, K. 2003. From public to private to … mutual? Restructuring water supply governance in England and Wales. *Geoforum*, 34, pp. 359-374

Bakker, K. 2003. Good governance in restructuring water supply: a handbook. *Federation of Canadian Municipalities*, Ontario

Barraque, B. 2003. Past and future sustainability of water policy in Europe. *Natural resource Forum*, 27, pp. 200-211

Barrera-Osorio, F. and M., Olivera. 2007. Does society win or lose as a result of privatization? Provision of public services and welfare of the poor: the case of water sector privatization in Colombia. *Inter- American Development Bank*, Washington, DC

Bazeley, P. 2004. Issues in Mixing Qualitative and Quantitative Approaches to Research. In *Applying qualitative methods to marketing management research.* Buber, R., Gadner, J. & Richards, L. (eds). UK: Palgrave Macmillan, pp. 141-156

Beltran, E. 2004. Water, Privatization and Conflict: Women from the Cochabamba Valley. *Heinrich Böll Foundation North America,* 2004

Berg, C. and A., Danilenko. 2010. The IBNET Water Supply and Sanitation Performance Blue Book: The International Benchmarking Network for Water and Sanitation Utilities Databook. World Bank, ISBN: 978-0-8213-8582-1; SKU: 18582

Bhattacharyya, A. *et al.* 1995. "Specification and Estimation of the Effects of Ownership on the Economic Efficiency of the Water Utilities." *Regional science and Urban Economics*, Vol. 25, No. 6, pp. 759 – 84

Bithas, K. and C., Stoforos. 2006. Estimating Urban Residential Water Demand Determinant and Forecasting Water Demand for Athens Metropolitan Area, 2000-2010. *South-Eastern Europe Journal of Economics,* 1, 47-59

Bruggink, T. 1982. Public versus regulated private enterprise in the municipal water industry: A comparison of operating costs. *Quarterly Review of Economics and Business*, 22, pp. 111-125

Bulmer, M. 1979. Principles of Statistics. New York: Dover

Burns, R. 2000. *Introduction to Research Methods*. SAGE Publications, London

Canadian Water and Wastewater Association (CWWA). 2009. *Water conservation and efficiency performance measures and benchmarks within the municipal sector*. URL: http://www.cwwa.ca/pdf_files/CWWA%20Water%20Efficiency%20Benchmarking...Final%20Report%20v4.pdf (January 21, 2009)

Center for Ecology and Hydrology (CEH). 2003. Annual Report 2002-2003. URL: http://www.ceh.ac.uk/ (November 10, 2010)

Chong, E. *et al*. 2006. Public-private partnerships and prices: evidence form water distribution in France. *Review of Industrial Organization*, 29, pp. 149–169

Clarke, G., Kosec, K. and S., Wallesten. 2009. Has Private Participation in Water and Sewerage Improved Coverage? Empirical Evidence from Latin America. Journal *of International Development*, 21, pp. 327–361

Cordell, D. *et al*. 2003. Collecting residential end use data from primary source: do's and dont's. *Efficiency 2003: Efficiency Use and Management of Water for Urban Supply Conference*, Tenerife, 2-4 April 2003

Corton, M. 2003. Benchmarking in the Latin American water sector: the case of Peru. *Utilities Policy*, 11, pp. 133-142

Department of Energy (DOE). 2007. Metering. Best Practices. A Guide to achieving utility resource efficiency. URL: http://eere.pnl.gov/building-technologies/pdf/mbpg_guide_08.pdf (November 25, 2010)

De Vaus, D. 2002. *Surveys in social research*. 5th ed. London: Routledge

Drozdov, S. 2002. "Use of water consumption metering as a tariff policy tool: Moldova's experience." Paper prepared for the 1st workshop on the Municipal Water Tariff Reform in NIS, Paris, URL: http://www.oecd.org/env/outreach/2403012.pdf (March 01, 2013)

Efimova, T. 2007. "EECCA-wide trends of water utility performance." OECD EAP Task Force presentation, Helsinki, URL: www.oecd.org/dataoecd/46/20/39168466.ppt (December 05, 2011)

Environment Agency (EA). 2008. "Water and the Environment. International comparison of domestic per capita consumption." Report prepared for the Environment Agency by Aquaterra, Reference L219/B5/6000/025b, Bristol, URL: http://a0768b4a8a31e106d8b0-50dc802554eb38a24458b98ff72d550b.r19.cf3.rackcdn.com/geho0809bqtd-e-e.pdf (March 05, 2010)

Estrin, S. 2007. Impact of Privatization in Transition Economies. Article for the New Palgrave Dictionary of Economics, 2nd Edition, London School of Economics and Political Science

European Environment Agency (EEA). 2007. "Sustainable consumption and production in South East Europe and Eastern Europe, Caucasus and Central Asia." *Joint UNEP-EEA report on the opportunities and lessons learned*, Report No 3, Copenhagen, URL: www.eea.europa.eu/publications/eea_report_2007_3 (March 20, 2013)

European Environment Agency (EEA) and United Nations Environment Programme (UNEP). 1997. Water Stress in Europe - can the challenge be met? New Year Message. URL: http://www.unep.ch/roe/publications/assessment/01_eurowater.pdf (November 29, 2010)

Espey, M., Espey, J. and W., Shaw. 1997. Price elasticity of residential demand for water: A meta-analysis. Water Resources Research, 1997, 33(6), pp. 1369-1374

European Environment Agency (EEA) and United Nations Environment Programme (UNEP). 1997. Water Stress in Europe - can the challenge be met? New Year Message. URL: http://www.unep.ch/roe/publications/assessment/01_eurowater.pdf (November 29, 2010)

Falkenmark, M. and G., Linch. 1976. Water for a Starving World. Westview Press, Boulder, Colorado

Fankhauser, S. and S., Tepic. 2007. Can poor consumers pay for energy and water? An affordability analysis for transition countries. Energy Policy, 35(2), pp. 1038-1049

Food and Agriculture Organisation (FAO). 2008. Irrigation in the Middle East region in figures – AQUASTA Survey 2008. FAO Land and Water Division. URL: ftp://ftp.fao.org/docrep/fao/012/i0936e/i0936e00.pdf (November 12, 2010)

FAO AQASTAT. 2010. URL: http://www.fao.org/nr/water/aquastat/globalmaps/index.stm (November 10, 2010)

Fink, A. and J., Kosecoff. 1985. *How to Conduct Surveys. A Step-by-Step Guide*. SAGE: London

Foster, V. *et al*. 2005. Ch. 3. *Utility Reforms. Analyzing the Distributional Impact of Reforms.* Vol.1. IBRD/WB.ISBN 0-8213-6181-3

Freeman, R. Undated. Social Science and Public Policy. Frequently asked Question. URL: http://www.richardfreeman.info/answer.php?id=18 (October 20, 2011)

Gassner, K. *et al*. 2007. An empirical assessment of private sector participation in electricity and water distribution in developing and transition countries. Final paper, *Public-private Infrastructure Advisory Facility*

Gevorkyan, A. 2014. Regional Maps

Gleick, P. 2003. Water Use. *Annu. Rev. Environ. Resour*. 28, pp. 275–314

Government of Armenia (GOA) Decree N130-N on "Drinking Water Supply and Wastewater Rules", January 22, 2004

Government of Armenia Decree N1030-N on "Amendments to Drinking Water Supply and Wastewater Rules", August 16, 2012

Graig, J. *et al*. 2001. *Resources of the Earth. Origin, Use and Environmental Impact.* Third edition. Prentice-Hall Inc., Upper Saddle River, New Hersey

Gray, P. 2002. Public versus Private Provision of Public Services. Presentation to Poverty Day, October 17, 2002

Greene, J., Caracelli, V. and W., Graham. 1989. Toward a conceptual framework for mixed-method evaluation designs. *Educational Evaluation and Policy Analysis*, 11(3), pp. 255-274

Greenwood, N. 1965. Developments in the Irrigation Resources of the Sevan-Razdan Cascade of Soviet Armenia. *Annals of the Association of American Geographers*, Vol. 55, No 2. pp. 291-307

Gregory, R. 2009. “Metering Secondary Water in Residential Irrigation. All Graduate Theses and Dissertations.” *Systems Utah State University*. Paper 391. URL: http://digitalcommons.usu.edu/etd/391 (November 25, 2010)

Greswell, J. and V. Clark. 2007. Ch. 1. Understanding Mixed Methods Research. In *Designing and Conducting Mixed Methods Research*. SAGE: London

Grout, P. 2003. Public and private sector discount rates in public-private partnerships. *The Economic Journal*, 113 C62-C68

Groves, R. *et al*. 2009. *Survey Methodology*. John Wiley & Sons Inc, New Jersey, USA

Gunatilake, H. *et al.* 2007. *Good Practices for Estimating Reliable Willingness-to-Pay Values in the Water Supply and Sanitation Sector*. Asian Development Bank, ERD Technical Note Series No. 23, ISSN 11655-5236

Hakim, C.1987. *Research Design. Strategies and Choices in the Design of Social Research*. Routledge: London and New York

Hall, D. and E., Lobina. 2008. “Water Privatization.” *Public Service International Research Unit,* London

Hall, D., Lobina, E. and R., Motte. 2005. Public resistance to privatization in water and energy. *Development in Practice*, Vol. 15, No 3-4, June 2005

Hall, D., Lobina, E. and R. Motte. 2004. Making water privatisation illegal: new laws in Netherlands and Uruguay. *Public Services International* (PSI – www.world-psi.org)

Harris, J., Tate, D., and S., Renzetti. 2002. “Econometric principles and concepts as applied to municipal water utilities.” Final report, Acres Associated Environment Limited, URL: http://inyo-monowater.org/wp-content/uploads/2012/10/Economicprinciplesconceptsmunicipalutilities.pdf (March 12, 2013)

Harutyunyan, N. 2012. “State versus private sector provision of water services in Armenia.” *Frontiers of Environmental Science and Engineering*, 6, 1-11. URL: www.springerlink.com/content/e120t15628u31754/?MUD=MP (December 17, 2012)

Harutyunyan, N. 2014 (a). Alternative partnership models for water governance: a case study in Armenia. *WIT Transactions on Ecology and the Environment*, Vol. 191, pp. 1609-1620, WIT Press, Arshurst, UK, ISSN 1743-3541, doi:10.2495/SC141372. URL: http://www.witpress.com/elibrary/wit-transactions-on-ecology-and-the-environment/191/29628 (December 7, 2014)

Harutyunyan, N. 2014 (b). Metering Drinking Water in Armenia: the Process and Impacts. *Elsevier’s Journal of Sustainable Cities and Society*, Vol. 14, pp. 351–358, DOI:10.1016/j.scs.2014.05.014, URL: http://www.sciencedirect.com/science/article/pii/S2210670714000614 (January 05, 2015)

Harutyunyan, N. 2015. Going More Private and Sustainable? Ex-post Assessment of Armenian Water Utilities. *The International Journal of Sustainable Development and Planning* [in press]

Harvey, L. 2004. *Analytic Quality Glossary*, Quality Research International. URL: http://www.qualityresearchinternational.com/glossary/ (October 09, 2011)

Haykazyan, V. and J. Pretty. 2006. Sustainability in Armenia: New Challenges for the Agricultural Sector. *Centre for Environment and Society Occasional Paper* 2006-1. University of Essex, Colchester UK

Heffernan, C. 2001. The Irish media and the lack of public debate on new reproductive technologies (NRTs) in Ireland, *Health*, 5 (3), pp. 355-371. URL: http://hea.sagepub.com/cgi/content/abstract/5/3/355 (October 10, 2011)

Healey, J. 1996. *Statistics. A Tool for Social Research*. 4th Edition. Wadsworth Publishing

Herbert, M. 1990. *Planning a Research Project*. Cassell: London

Hoffmeyer-Zlotnik, J. 2003. New Sampling designs and the quality of data. *In: Development in Applied Statistic.* Ferligoj, A. and Mrvar, A. (eds.), Metodološki zvezki, 19, Ljubljana: FDV, 2003. URL: http://www.stat-d.si/mz/mz19/hoff.pdf (November 04, 2010)

Hovhannisyan, R. *et al.* 2005. Lake Sevan: Lessons in Nature Use. Russian Conservation News. No 39, Summer 2005. URL: http://www.armeniatree.org/thethreat/resources/rcn_armenian_environment_summer05.pdf (November 30, 2009)

Howe, C. 2011. The effects of privatization of public services: the case of urban water. *University of Colorado at Boulder.* URL: http://opensiuc.lib.siu.edu/cgi/viewcontent.cgi?article=1185&context=jcwre (September 22, 2011)

Hukka, J. and T. Katko. 2003. Water privatization revisited. Panacea or pancake? IRC International Water and Sanitation Centre, the Netherlands

Hukka, J. and T. Katko. 2003. Refuting the paradigm of water services privatization. *Natural Resources Forum*, 27, 142-155

Inman, D., and P. Jeffrey. 2006. “A review of residential water consumption tool performance and influence on implementation effectiveness.” *Urban Water Journal*, 3 (3), pp. 27-143.

International Benchmarking Network for Water and Sanitation Utilities (IBNET). 2005. *Benchmarking Methodologies*, the World Bank, URL: http://www.ib-net.org/ (February 10, 2013).

Intergovernmental Panel on Climate Change (IPCCC). 2001. IPCC Third Assessment Report Working Group II: Impacts, Adaptation and Vulnerability. Published to the web by GRID-Arendal

Jacobs, H. and J. Haarhoff. 2004. Structure and data requirements of an end-use model for residential water demand and return flow. *Water SA*, Vol. 30, No. 3, July 2004

Jones, T. 2003. “Pricing water. Water pricing is becoming more widespread, with the dual aim of expanding supply and encouraging more responsible use.” *OECD Observer*, OECD Environment Directorate, No 236. URL: http://www.oecdobserver.org/news/fullstory.php/aid/939/Pricing_water.htm (September 5, 2012).

K’Akumu, O. 2006. Sustainability prospects for water utilities privatization in Kenya. *International Journal of Technology Management and Sustainable Development*, 5 (3), pp. 271-280

Kirkpatrick, C. *et al.* 2004. “State versus Private Sector Provision of Water Services in Africa: An empirical Analysis.” *Presentation at the Centre on Regulation and Competition 3rd*

International Conference, Pro-Poor regulation and Competition: Issues, Policies and Practices, Cape Town, South Africa, September 7-9

Kirkpatrick, C. Parker, D. and Y., Zhang. 2006. State versus Private Sector Provision of Water Services in Africa: An Empirical Analysis. *The World Bank Economic Review*, Washington, vol. 20, issue 1, p. 143

Kvale, S. 1996. *Interviews. An Introduction to Qualitative Research Interviewing*. Sage: London

Lampietti, J. e*t al*. 2001. Utility Pricing and the Poor. Lessons from Armenia. World Bank Technical Paper No. 497, May 2001

Lankoski, J. and M., Ollikainen. 2011. Counterfactual approach for assessing agri-environmental policy: Theory with an application to Finnish water protection policy. The paper is a part of the project "Cost-efficient instruments for the Protection of the Baltic Sea", June 17, 2011

Leiberherr, E. and B., Truffer. 2014. The impact of privatization on sustainability transitions: A comparative analysis of dynamic capabilities in three water utilities. *Environmental Innovation and Societal Transitions*

Lin, C. 2005. Service quality and prospect for benchmarking: Evidence form the Peru water sector. *Utility Policy*, 13, pp. 230-239

Markandya, A. e*t al*. 2001. *Dictionary of Environmental Economics*. Earthscan Publications ltd, London, UK

Marin, P. 2009. "Public-Private partnerships for Urban Water Utilities: a Review of Experiences in Developing Countries." *Presentation at World Bank Water Week*, Washington DC, February 17

Martinez-Espineira, R. 2002. Residential Water Demand in the Northwest of Spain, *Environmental and Resource Economics*, 21, pp. 161-187

Mazzotti, F. and J. Vinci. 2010 (reviewed). Validation, Verification, and Calibration: Using Standardized Terminology When Describing Ecological Models. *Wildlife Ecology and Conservation Department* (series), Document WEC 216, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. First published: April 2007

Mayer, P. *et al*. 2004. National Multiple Family Submetering and Allocation Billing Program Study. *Aquacraft, Inc and the East Bay Municipal Utility District*, USA.

Melikyan, L. 2003. *Economic and Social Aspects of Reforming Water Resource Management: Case of Armenia*. Drop by Drop: Water Management in the South Caucasus and Central Asia. Published by the Local Government and Public Service Reform Initiative, OSI–Budapest

Ministry of Nature Protection of the Republic of Armenia (MNP). 1999. *First National Report on The Convention on Biological Diversity Incorporating A Country Study on the Biodiversity of Armenia*. Yerevan, 1999

MNP. 2000. *National Report on the State of the Environment in Armenia in 2000*. Yerevan, 2000

MNP. 2002. *National Action Program to Combat Desertification in Armenia.* Yerevan, 2002

MNP. 2003. *National Report on the State of the Environment in Armenia in 2002*. Yerevan, 2003

MNP. 2009. *Vulnerability of Water Resources in the Republic of Armenia under Climate Change*. Yerevan, 2009

Mkhitaryan, L. 2009. Towards Performance Based Utility Sector in Armenia: Case of Drinking Water Supply Service. The Caucasus Research Resource Centers – Armenia. Research #C08-0198

Mkhitaryan, L. 2009. Towards Performance Based Utility Sector in Armenia: Case of Drinking Water Supply Services. Research 3C08-0198. Caucasus Research Resource Partnership (CRRC)

Moss, S. 2008. Categorical regression analysis. URL: http://www.psych-it.com.au/Psychlopedia/article.asp?id=160 (August 20, 2014)

Municipality of Yerevan–Yerevan Djur (MY-YD). 2013. "Lease Contract for the Water System in the Yerevan Water & Sewage CJSC Service Area Technical, O & M, and Management Audit for Lease Contract, Year 7 (1st June 2012 to 31st May 2013)." Final Audit Report, Ref 000001, September 2013. URL: http://www.veoliadjur.am/armenia-water/ressources/documents/1/51746,Technical-audit-eng.pdf (January 05, 2014)

Nanyan, G. 2010. Worries Over Groundwater Depletion. A1plus News. October 22, 2010. URL: http://www.a1plus.am/en/social/2010/10/22/water (November 30, 2010)

National Cooperative Highway Research Program. 2011. A Guide for Sustainability Performance Measurement for Transportation Agencies. Report 708, Transportation Research Board of the National Academies, ISBN 978-0-309-21365-3

National Statistical Service of Armenia (NSSA). URL: http://www.armstat.am (December 5, 2010)

Ndandiko, C. 2010. *Public Provision of Private Services in Developing Countries*. PhD. Dissertation, University of Twente, the Netherlands

Organisation for Economic Co-operation and Development (OECD). 2004 (a). Consumer Protection in Urban Water Sector Reform in Armenia: Ability to Pay and Social Protection of Low Income Households. Final report, OECD, Paris, URL: http://www.oecd.org/countries/armenia/35052145.pdf (February 10, 2013)

OECD. 2008. Promoting the Use of Performance-Based Contracts between Water Utilities and Municipalities in EECCA Case study no. 2: Armenian Water and Wastewater Company SAUR Management Contract. URL: http://www.oecd.org/dataoecd/25/20/40572630.pdf (December 5, 2010)

Olsen, W. 2004. Triangulation in Social Research: Qualitative and Quantitative Methods Can Really be Mixed. Final Version forthcoming as a chapter in *Developments in Sociology* in ed. M. Holborn Ormskirk: Causeway Press

Ozis, U. *et al.* 2010. Ancient Water Works in Anatolia. *Latest Trends on Cultural Heritage and Tourism*

Promptov, Y. Statyi ob Ozere Sevan. Po Armyanskomy Nagoryu. URL: http://armenia.h1.ru/Priroda/Ozero/stat%27ya/stat%27i_sevan_ru.html (September 2014)

Ouyahia, M. 2006. Public-private partnerships for funding municipal drinking water infrastructure: what are the challenges? Discussion paper, PRI project, Sustainable Development, ISBN 0-662-43362-9. URL: http://www.pppcouncil.ca/pdf/muni_water_p3_report_govcanada_052006.pdf (October 28, 2011)

Parker, D. and D., Saal. 2003. International Handbook on Privatization. Edward Elgar Publishing Ltd., UK, ISBN 1 84064 613 6

Patton, M. 1988. Paradigms and pragmatism. In *Qualitative approaches to evaluation in education: the silent scientific revolution.* D. M. Fetterman (eds.). NY: Praeger, pp. 116-137

Pelling, M. 2003. Towards a political ecology of urban environmental risk: the case of Guyana. In Zimmerer, K. and Bassett, T. (2003) eds. Political Ecology: An integrative approach to geography and environment-development studies, New York: the Guilford Press

Pisu, M., Hoeller, P. and I., Joumard. 2012. Options for benchmarking infrastructure performance. Paper for the meeting of Working Party 1 of the Economic Policy Committee, March 2012

Polischuk, L. 2008. Public-Private Partnership in Armenia. *United Nations of United Nations Development Programme Armenia,* Concept Note, Yerevan 2008

Pontin, K. 2010. Techniques to use in Qualitative Evaluation and Research. Freelance Museum Consultancy. URL: http://www.katepontin.co.uk/html/validity.html (October 28, 2011)

Protocol on Water and Health (PWH). 2012. Target setting process under the Protocol on Water and Health in Armenia. Project Proposal submitted at the meeting of the Ad Hoc Project Facilitation Mechanism (AHPFM) by the Government of the Republic of Armenia, Geneva, July 1, 2009

Punch, K. 2006. *Developing Effective Research Proposals*. Second Edition. SAGE: London

Rada1, V. and V., Martin. 2012. Random Route and Quota Sampling: Do They Offer Any Advantage over Probably Sampling Methods? *Open Journal of Statistics*, 2014, 4, pp. 391-401. URL: http://www.scirp.org/journal/ojs (August 25, 2014)

RAU. 2004. User's Guide. Chapters 1-7. Water Research Group, University of Johannesburg, URL: http://ujdigispace.uj.ac.za:8080/dspace/bitstream/10210/468/2/HJ2004Doc(b)text(doublepages).pdf (November 20, 2010).

Renwick, M. and R., Green. 2000. Do Residential Water Demand Side Management Policies Measure Up? An Analysis of Eight California Water Agencies. Journal of Environmental Economics and Management 40, pp. 37-55

Roe, A. *et al*. 2003. Water Sector Reform in Armenia. Poverty and Social Impact Analysis. *The UK Department for International Development* (DFID)

Romero, C. and G., Ferro. 2007. Efficiency in Water and Sanitation Sector. A survey on Empirical Literature. Working paper 22, *Universidad Argentina de la Empresa*, p. 25

Ruane, J. 2005. *Essentials of Research Methods. A guide to Social Science Research*. Blackwell:Oxford, UK

Rykiel, E. 1996. Testing ecological models: the meaning of validation. *Ecological Modeling*, 90:229-244. URL: http://www.asu.edu/clas/csdc/events/pdf/validation_ecology.pdfv (November 02, 2011)

Sargsyan, V. 2007. Lake Sevan in Armenia. Socioeconomic Analysis for Secure development Policies. Environmental Security in Harbors and Costal Areas. NATO Security Through Science Series, 2007, 439-449, DOI: 10.1007/978-1-4020-5802-8_32. URL: http://www.springerlink.com/content/26768010201h1532/ (November 15, 2010)

Seasons, M. 2005. Indicators and Core Area Planning: Applications in Canada's Mid-Sized Cities. In *Community Indicators Measuring Systems*, edited by Phillips, R.: Ashgate Publishing Ltd, England

Silverman, D. 1993. Interpreting Qualitative Data, Methods for Analysing Talk, Text and Interaction. London: SAGE

Slaper, T. and T., Hall. 2011. The triplebottom line: what is it and how does it work. Indiana University Kelly School of Business. URL: www.ibrc.indiana.edu/ibr/2011/spring/pdfs/article2.pdf (March 10, 2013)

Spronk, S. 2009. Water Privatization and the Prospects for Trade Union Revitalization in the Public Sector: Case Studies from Bolivia and Peru. *Just Labour: A Canadian Journal of Work and Society*, Vol. 14, Autumn 2009

Staddon, C. 2008. "Do water meters reduce domestic consumption? A summary of available literature." Working paper. Department of Geography and Environmental Management, University of the West of England, Bristol.

Stiglitz, J. 2002. Globalization and its discontents. Session 8, Princeton University. URL: http://www.princeton.edu (August 10, 2014)

Training Resources and Data Exchange (TRADE). 1995. How to Measure Performance: A Handbook of Techniques and Tools. The document describes activities performed under Contract No. DE-AC05-76OR00033 between the U.S. Department of Energy and Oak Ridge Associated Universities. URL: http://www.orau.gov/pbm/handbook/handbook_all.pdf (January 20, 2014)

Tsang, C. 1992. The Modeling Process and Model Validation. Earth Science Division, Lawrence Berkeley Laboratory, University of California. URL: http://info.ngwa.org/gwol/pdf/912955207.PDF (April 21, 2011)

Tumanyan, D. 2002. Local Government in Armenia. *Developing New Rules in the Old Environment*. OSI/LGI: Budapest, Hungary. URL: http://lgi.osi.hu/publications/2001/84/Ch6-Armenia.pdf (November 15, 2012).

United Nations (UN). 2006. Guidelines for review and appraisal of the Madrid International Plan of Action on Ageing Bottom-up participatory approach. *United Nations*, New York

United Nation Development Programme (UNDP). 2006. Review of the national policy, legislative and institutional environment necessary for the establishment of municipal public private partnerships (PPPs) for public service delivery and local development in the Europe and CIS region. Caucasus. UNDP Capacity 2015/PPPUE – Public Private Partnership Programme

United Nations Economic and Social Council (UN ECOSOC). 2006. Definition of basic concepts and terminologies in governance and public administration. Compendium of basic terminology in governance and public administration. Note by the Secretariat, Committee of Experts on Public Administration, fifth session, E/C.16/2006/4, New York, March 27-31, 2006

United Nations Economic Commission for Europe (UNECE). 2007. Freshwater Abstraction (EECCA CSI 8) - Assessment May 2007. URL: http://www.unece.org/env/europe/monitoring/EECCA_CSI/EECCA%20CSI%20_Eng/EECCA_CSI%208_Freshwater_abstraction_eng.doc (December 01, 2010)

United States Environment Protection Agency (EPA). 2009. "Control and Mitigation of Drinking Water Losses in Distribution Systems." Review Draft, EPA 816-D-09-001, November 2009. URL: https://www.google.com/#q=water+meters+in+points+in+water+systems+helps+to+reduce+water+losses (January 03, 2014)

Vlasceanu, L., Grunberg, L., and D., Parlea. 2004. *Quality Assurance and Accreditation: A Glossary of Basic Terms and Definitions* (Bucharest, UNESCO-CEPES) Papers on Higher Education, ISBN 92-9069-178-6

Vuglinskiy, V. e*t al.* 2009. Water Level, Water Level in Lakes and Reservoirs, Water Storage. GTOS Secretariat, FAO, Rome. URL: http://www.fao.org/gtos/doc/ECVs/T04/T04.pdf (November 15, 2010)

Walker, G. 2007. "International experience of sub-metering." Final Report, the Waterwise Project, London. URL: www.waterwise.org.uk (April 12, 2012)

Weisberg, H. *et al.* 1996. *An Introduction to Survey Research, Polling, and Data Analysis*. SAGE: London

Wollmann, H. 2011. From public sector-based to privatized service provision – and reverse? Service provision in European countries between State, local government and market. Draft paper presented at the APPAM Conference on "Improving the quality of public services", Higher School of Economic (HSE), Moscow, June 27-29, 2011

World Bank (WB). 2001. *Armenia Towards Integrated Water Resource Management*. Technical Paper of Environmentally and Socially Sustainable Department

WB. 2011. Republic of Armenia, Water Sector Note. Report No.: 61317-AM, Sustainable Development Department, Europe and Central Asia Region, International Bank for Reconstruction and Development / The World Bank. URL: http://siteresources.worldbank.org/ARMENIAEXTN/Resources/110711_watersector_eng.pdf (May 10, 2012)

WB. 2012. Proposed loan in the amount of US$ 15 million to the Republic of Armenia for a Municipal Water Project, Report No: 66277-AM, January 27, 2012. URL: http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2012/02/27/000386194_20120227234632/Rendered/PDF/662770PAD0Box30sclosed0Feb027020120.pdf (January 03, 2014).

Woodbury, K. and B., Dollery. 2003. "Efficiency Measurement in Australian Local Government: The Case of NSW Municipal Water Services.". *University of New England*, Working Paper Series in Economics, No 2003-13

World Health Organization (WHO). 2011. How much water is needed in emergencies? Technical notes on drinking water, sanitation and hygiene in emergencies. URL: http://www.who.int/water_sanitation_health/publications/2011/WHO_TN_09_How_much_water_is_needed.pdf?ua=1 (August 20, 2014)

World Research Institute (WRI). EarthTrends database. URL: http://earthtrends.wri.org/searchable_db/index.php?theme=2&variable_ID=1299&action=select_countries (November 10, 2011)

Yerevan Djur (YD). 2011. Annual Report, Year 5, June 1, 2010 – May 31, 2011. URL: http://www.veoliadjur.am/armenia-water/ressources/documents/1/33692,5.pdf (January 15, 2014).

YD. 2013. Lease Contract for the Water System in Yerevan "Water and Sewage" CJSC Service Area. Annual report, Year 7, June 1, 2012 – May 31, 2013. URL: http://www.veoliadjur.am/armenia-water/ressources/documents/1/50138,Annual-Report-2012-2013-eng.pdf (January 04, 2014).

Zerah, M. 2002. Water Supply and Sanitation in Vijayawada: Analysis of households' situation towards modes and cost of access, consumption and level of satisfaction. *Centre for Economic Studies in India*, India, Report Number 2/2002

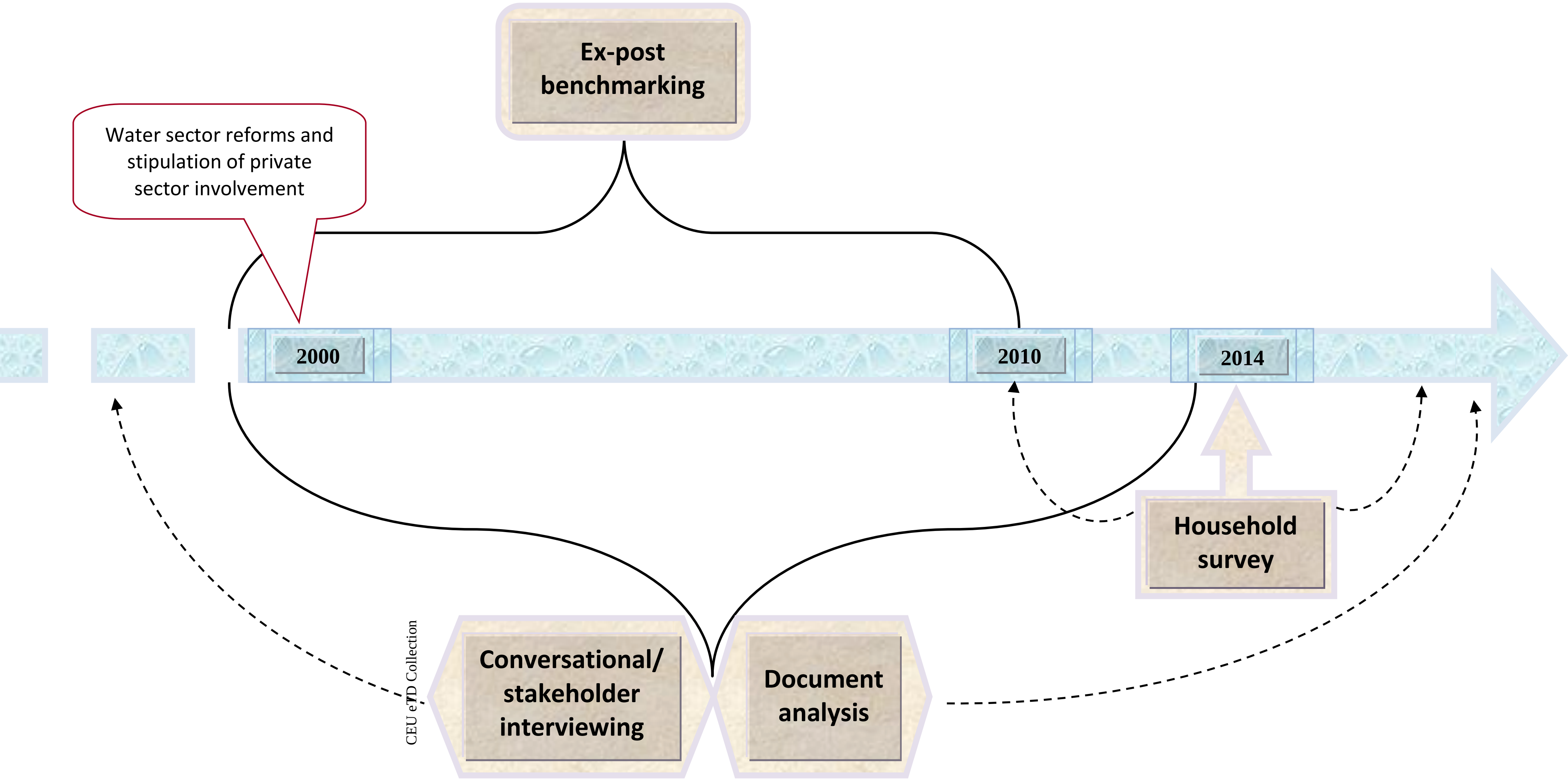
Zetland, D. and H. Weikard. 2011. "Payment by the drop: The move to water metering in England and Wales." D3.1 - Review reports. Prepared under contract from the European Commission. URL: http://www.feem-project.net/epiwater/docs/d32-d6-1/CS12_United%20Kingdom.pdf (March 01, 2013).

ANNEXES

Annex I Methodological and data considerations for research questions

Research Questions	Aim	Methods	Data Source	Periods
Question 1: What are the impacts of privatization on environmental, social and economic performance of water utilities in Armenia?	To estimate the sustainability effects of governance modes on the performance of all water utilities currently operating in Armenia under various forms of public-private partnerships	Ex-post benchmarking analysis, counterfactual analysis	IBNET, utility data	2000- 2010
Question 2: What effects did privatization of the water service have on households in Armenia?	To scrutinize the level of water services delivered by water utilities and households' satisfaction; to identify the households coping strategies for overcoming water service issues; identify the main factors determining household water consumption; to estimate the costs that households bear for water supply and sanitation services; to measure the level of expectations and willingness to pay for service improvements	Structured household questionnaire; semi-structured stakeholder interviews, documentary analysis	Households, stakeholders, archives, files, public records, annual reports, surveys, studies, newspapers, and journals	2000-2014 2014+
Question 3: What are progress, problem, and policy and institutional implications of introduction of water privatization in Armenia?	To examine the structural and process changes in the water sector as an aggregate mechanism of policies, legal and regulatory rules and procedures, organizational structures, and financing systems; to identify the current challenges and possible improvement opportunities	Semi-structured stakeholder interviews, document analysis	Stakeholders, legislature, archives, files, public records, annual reports, surveys, studies, newspapers, and journals	2000-2014 2014+

Annex II Integrated research continuum



Annex VI-1 Sample area

Sample area by marzes

Marzes	Frequency	Percent	Cumulative percent
Yerevan	73	35.6	35.6
Aragatsotn	7	3.4	39.0
Ararat	5	2.4	41.5
Armavir	15	7.3	48.8
Gegharkunik	4	2.0	50.7
Lori	19	9.3	60.0
Kotayk	7	3.4	63.4
Shirak	38	18.5	82.0
Syunik	20	9.8	91.7
Vayoys Dzor	3	1.5	93.2
Tavush	14	6.8	100.0
Total	**205**	**100.0**	

Annex VI-2 Number of household residents

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Number of household residents	205	4.20	1.936	.557	.170	.156	.338
Valid N (listwise)	205						

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Number of household residents	205	4.20	1.936	.135

One-Sample Test

	Test Value = 0					
					90% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Number of household residents	31.058	204	.000	4.200	3.98	4.42

Annex VI-3 Number of household residents

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Household income level / precise	66	93469.70	77231.365	9506.524

One-Sample Test

	Test Value = 0					
					90% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Household income level / precise	9.832	65	.000	93469.697	77606.77	109332.62

Annex VI-4 Water facilities

Bath facilities

Statistics

		bath facilities: shower/ event time (minutes)	bath facilities: shower/ event time range lower (minutes)	bath facilities: shower/ event time ranger higher (minutes)
N	Valid	147	61	61
	Missing	58	144	144
Mean		19.31	13.52	22.05
Median		18.00	10.00	20.00
Mode		30	10	15

Access to wastewater discharge modes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	central canalization system	136	66.3	67.3	67.3
	open road side drain	1	.5	.5	67.8
	soak pit or septic tank	65	31.7	32.2	100.0
	Total	202	98.5	100.0	
Missing	System	3	1.5		
Total		205	100.0		

Crosstabulation

Urban or rural * wastewater discharge mode

			wastewater discharge mode			
			central canalization system	open road side drain	soak pit or septic tank	Total
urban or rural	Yerevan	Count	58	0	0	58
		% within urban or rural	100.0%	0.0%	0.0%	100.0%
		% within wastewater discharge mode	42.6%	0.0%	0.0%	28.7%
		% of Total	28.7%	0.0%	0.0%	28.7%
	Other Urban	Count	62	0	7	69
		% within urban or rural	89.9%	0.0%	10.1%	100.0%
		% within wastewater discharge mode	45.6%	0.0%	10.8%	34.2%
		% of Total	30.7%	0.0%	3.5%	34.2%
	Rural	Count	16	1	58	75
		% within urban or rural	21.3%	1.3%	77.3%	100.0%
		% within wastewater discharge mode	11.8%	100.0%	89.2%	37.1%
		% of Total	7.9%	.5%	28.7%	37.1%
Total		Count	136	1	65	202
		% within urban or rural	67.3%	.5%	32.2%	100.0%
		% within wastewater discharge mode	100.0%	100.0%	100.0%	100.0%
		% of Total	67.3%	.5%	32.2%	100.0%

Annex VI-5 Other water sources

Crosstabulation

Other indoor water source * urban or rural

			1.4.urban or rural			
			Yerevan	Other Urban	Rural	Total
Other indoor water source	no	Count	56	53	52	161
		% within Other indoor water source	34.8%	32.9%	32.3%	100.0%
		% within Urban or rural	97%	76%	68%	79%
		% of Total	27.3%	25.9%	25.4%	78.5%
	public/street tap	Count	1	2	2	5
		% within Other indoor water source	20.0%	40.0%	40.0%	100.0%
		% within Urban or rural	2%	3%	3%	2%
		% of Total	.5%	1.0%	1.0%	2.4%
	well	Count	0	0	10	10
		% within Other indoor water source	0.0%	0.0%	100.0%	100.0%
		% within Urban or rural	0%	0%	13%	5%
		% of Total	0.0%	0.0%	4.9%	4.9%
	spring	Count	0	13	13	26
		% within Other indoor water source	0.0%	50.0%	50.0%	100.0%
		% within Urban or rural	0%	19%	17%	13%
		% of Total	0.0%	6.3%	6.3%	12.7%
	river	Count	0	1	0	1
		% within Other indoor water source	0.0%	100.0%	0.0%	100.0%
		% within Urban or rural	0%	1%	0%	0%
		% of Total	0.0%	.5%	0.0%	.5%
	other	Count	1	1	0	2
		% within Other indoor water source	50.0%	50.0%	0.0%	100.0%
		% within Urban or rural	2%	1%	0%	1%
		% of Total	.5%	.5%	0.0%	1.0%
Total		Count	58	70	77	205
		% within Other indoor water source	28.3%	34.1%	37.6%	100.0%
		% within Urban or rural	100%	100%	100%	100%
		% of Total	28.3%	34.1%	37.6%	100.0%

Annex VI-6 Water payment: urbanization

Report

Water payment

Yerevan, other urban, rural	Mean	N	Std. Deviation	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

Descriptive Statistics

	N	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Water payment	202	2080.50	1274.887	1.422	.171	3.126	.341
Valid N (listwise)	202						

Post Hoc test

Multiple Comparisons

Scheffe Dependent Variable: water payment

(I) Yerevan, other urban, rural	(J) Yerevan, other urban, rural	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval	
					Lower Bound	Upper Bound
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.

Correlations

			Yerevan, other urban, rural	Water payment
Kendall's tau_b	Yerevan, other urban, rural	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

*. Correlation is significant at the 0.05 level (2-tailed).

Annex VI-7 Water payment: utility size

Report

Water payment

Water company	Mean	N	Std. Deviation	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

Multiple Comparisons

Scheffe Dependent Variable: Water payment

(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval	
					Lower Bound	Upper Bound
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.

Correlations

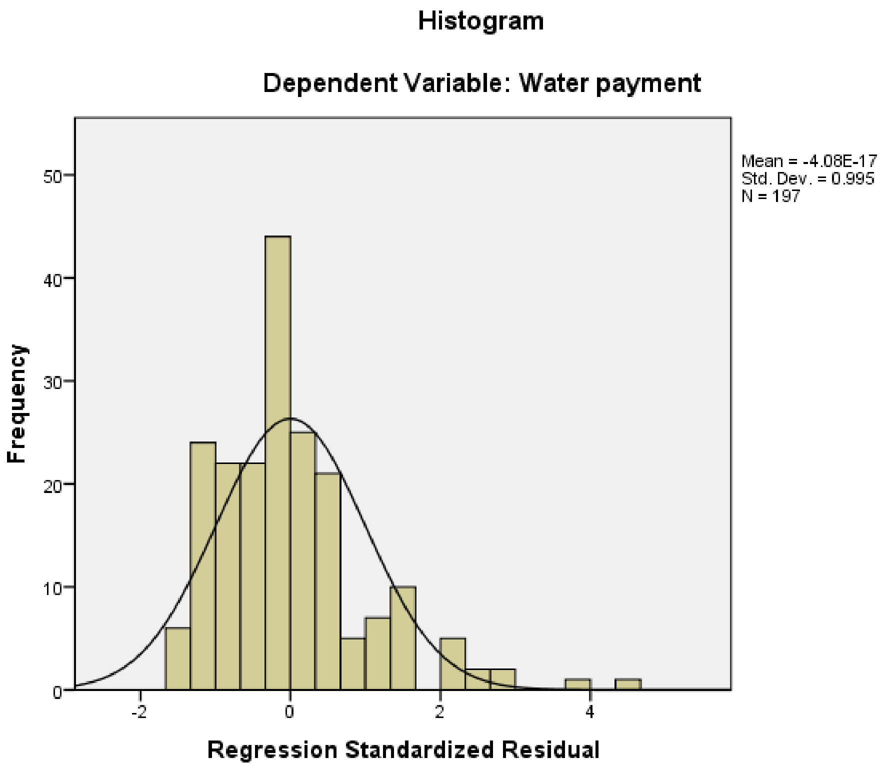
			Water company	Water payment
Kendall's tau_b	Company for water supply	Correlation Coefficient	1.000	-.050
		Sig. (2-tailed)	.	.360
		N	205	202
	Water payment	Correlation Coefficient	-.050	1.000
		Sig. (2-tailed)	.360	.
		N	202	202

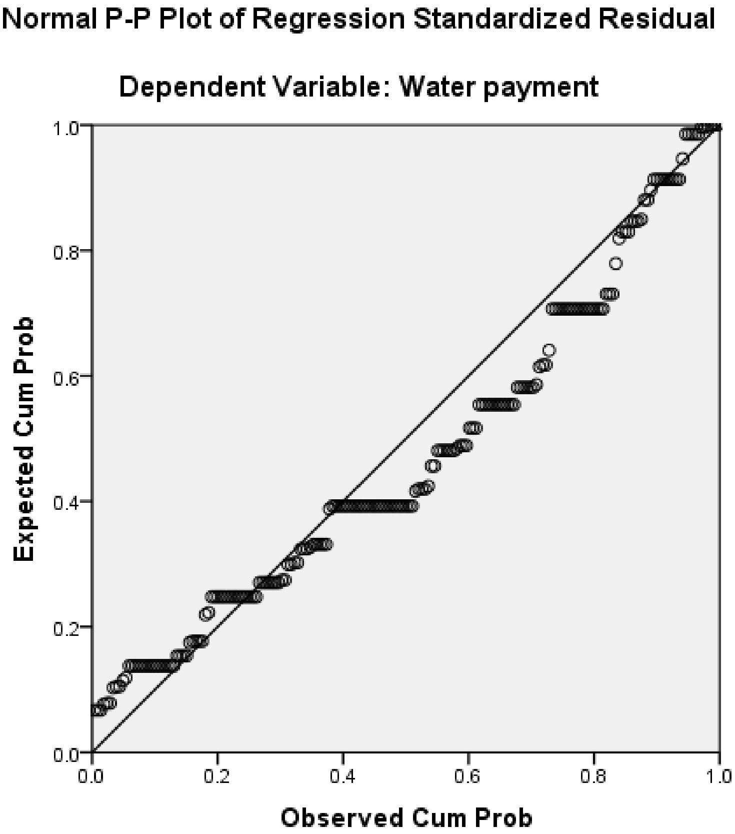
Correlations

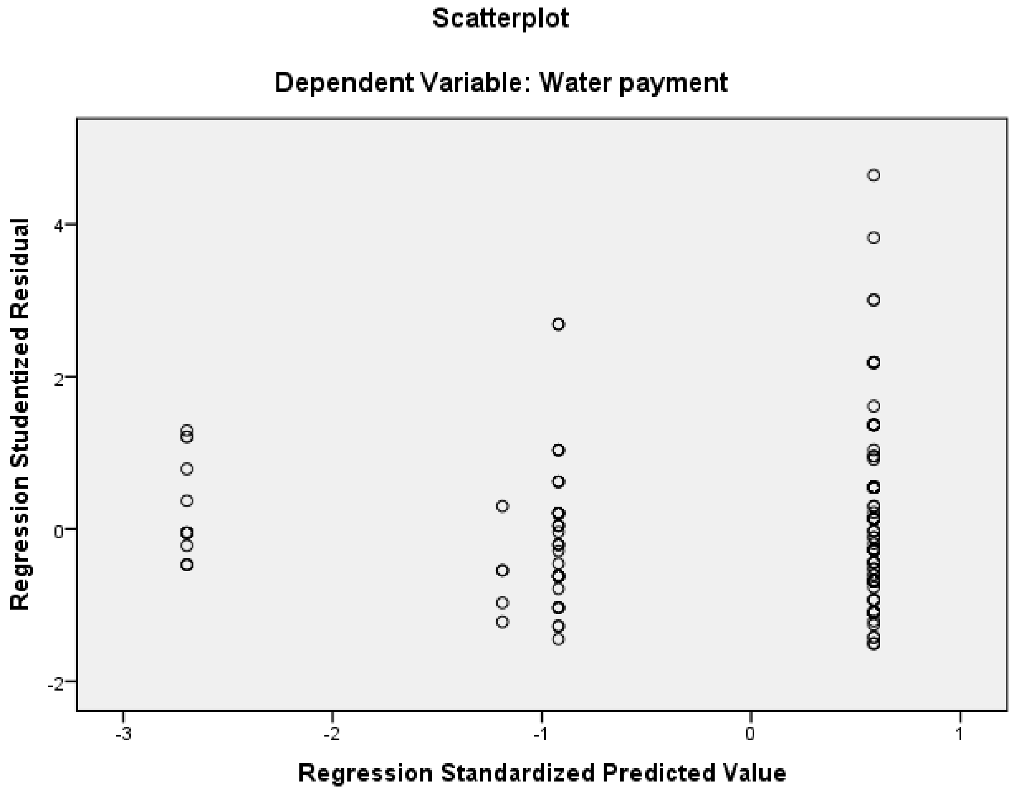
			Monthly income	Water payment
Kendall's tau_b	Monthly income	Correlation Coefficient	1.000	.233**
		Sig. (2-tailed)	.	.000
		N	196	194
	Water payment	Correlation Coefficient	.233**	1.000
		Sig. (2-tailed)	.000	.
		N	194	202

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

Annex VI-8 Multiple linear regression model




Normal P-P Plot of Regression Standardized Residual
Dependent Variable: Water payment
Expected Cum Prob
Observed Cum Prob
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


Scatterplot
Dependent Variable: Water payment
Regression Studentized Residual
Regression Standardized Predicted Value
4
2
0
-2
-3
-2
-1
0
1

Annex VI-9 Water service quality satisfaction

Report

Satisfaction with water service quality

Water company	Mean	N	Std. Deviation	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

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Satisfaction with water service quality * Water company	Between Groups	(Combined)	13.495	4	3.374	5.692	.000
	Within Groups		118.553	200	.593		
	Total		132.049	204			

Measures of Association

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

Correlations

			Yerevan, other urban, rural	Service satisfaction
Spearman's rho	Yerevan, other urban, rural	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

Multiple Comparisons

Scheffe test   Dependent Variable: Satisfaction with water service quality

(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval Lower Bound	Upper Bound
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 VI-10 Water service problems: quality

Report

Low quality

Water company	Mean	N	Std. Deviation	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

ANOVA Table

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

Measures of Association

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

Correlation (quality)

			Yerevan, other urban, rural	Low quality
Spearman's rho	Yerevan, other urban, rural	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

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 Bound	Upper Bound
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 VI-11 Water service problems: low pressure

Report

Low pressure

Water company	Mean	N	Std. Deviation	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

ANOVA Table

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

Measures of Association

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

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 VI-12 Pressure

Crosstabulation

Water company * What is pressure level

			What is pressure level		Total
			good	bad	
Water company	Yerevan Djur	Count	60	12	72
		% within Water company	83.3%	16.7%	100.0%
		% within What is pressure level	36.8%	35.3%	36.5%
		% of Total	30.5%	6.1%	36.5%
	AWSC	Count	50	11	61
		% within Water company	82.0%	18.0%	100.0%
		% within What is pressure level	30.7%	32.4%	31.0%
		% of Total	25.4%	5.6%	31.0%
	Shirak	Count	26	3	29
		% within Water company	89.7%	10.3%	100.0%
		% within What is pressure level	16.0%	8.8%	14.7%
		% of Total	13.2%	1.5%	14.7%
	Lori	Count	18	2	20
		% within Water company	90.0%	10.0%	100.0%
		% within What is pressure level	11.0%	5.9%	10.2%
		% of Total	9.1%	1.0%	10.2%
	Nor Akunq	Count	9	6	15
		% within Water company	60.0%	40.0%	100.0%
		% within What is pressure level	5.5%	17.6%	7.6%
		% of Total	4.6%	3.0%	7.6%
Total		Count	163	34	197
		% within Water company	82.7%	17.3%	100.0%
		% within What is pressure level	100.0%	100.0%	100.0%
		% of Total	82.7%	17.3%	100.0%

Daily pressure variations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	63	30.7	49.2	49.2
	yes	65	31.7	50.8	100.0
	Total	128	62.4	100.0	
Missing	don't know	4	2.0		
	System	73	35.6		
	Total	77	37.6		
Total		205	100.0		

Yearly pressure variations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	50	24.4	42.7	42.7
	yes	67	32.7	57.3	100.0
	Total	117	57.1	100.0	
Missing	don't know	2	1.0		
	System	86	42.0		
	Total	88	42.9		
Total		205	100.0		

Annex VI-13 Water service problems: schedule

Report

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

ANOVA Table

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

Measures of Association

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

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

Multiple Comparisons

Scheffe test Dependent Variable: Disruption of schedule

(I) Water company	(J) Water company	Mean Difference (I-J)	Std. Error	Sig.	90% Confidence Interval Lower Bound	90% Confidence Interval Upper Bound
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 VI-14 Schedule

Water supply, hours per day

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	3	1.5	1.5	1.5
	2	9	4.4	4.5	5.9
	3	6	2.9	3.0	8.9
	4	11	5.4	5.4	14.4
	5	5	2.4	2.5	16.8
	6	11	5.4	5.4	22.3
	7	2	1.0	1.0	23.3
	8	4	2.0	2.0	25.2
	9	1	.5	.5	25.7
	10	5	2.4	2.5	28.2
	11	2	1.0	1.0	29.2
	12	4	2.0	2.0	31.2
	13	2	1.0	1.0	32.2
	14	1	.5	.5	32.7
	15	4	2.0	2.0	34.7
	17	1	.5	.5	35.1
	18	1	.5	.5	35.6
	19	1	.5	.5	36.1
	20	5	2.4	2.5	38.6
	24	124	60.5	61.4	100.0
	Total	202	98.5	100.0	
Missing	don't know	2	1.0		
	System	1	.5		
	Total	3	1.5		
Total		205	100.0		

Mean: 18

Crosstabulation

Water supply, hours per day * Water company

Count		Water company					Total
		Yerevan Djur	AWSC	Shirak	Lori	Nor akunq	
Water supply, hours per day	1	0	2	0	1	0	3
	2	1	4	2	2	0	9
	3	2	2	1	1	0	6
	4	7	3	0	1	0	11
	5	3	1	1	0	0	5
	6	3	6	2	0	0	11
	7	0	1	1	0	0	2
	8	2	1	0	1	0	4
	9	0	0	0	1	0	1
	10	1	2	0	0	2	5
	11	1	1	0	0	0	2
	12	3	1	0	0	0	4
	13	1	1	0	0	0	2
	14	1	0	0	0	0	1
	15	3	0	0	0	1	4
	17	0	1	0	0	0	1
	18	0	0	0	0	1	1
	19	0	0	1	0	0	1
	20	2	2	0	1	0	5
	24	45	34	22	12	11	124
Total		75	62	30	20	15	202

Satisfied with schedule

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	no	41	20.0	38.3	38.3
	yes	66	32.2	61.7	100.0
	Total	107	52.2	100.0	
Missing	System	98	47.8		
Total		205	100.0		

Annex VI-15 Water service problems: cutting off

Report

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

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
Cutting off for few days * Water company	Between Groups	(Combined)	6.292	4	1.573	4.052	.004
	Within Groups		76.485	197	.388		
	Total		82.777	201			

Measures of Association

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

Correlation (cutting off)

			Yerevan, other urban, rural	Cutting for few days
Spearman's rho	Yerevan, other urban, rural	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

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 Bound	90% Confidence Interval Upper Bound
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.

Annex VI-16 Information provision

Crosstabulation

Are you provided with info on supply interruption * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Are you provided with info on supply interruption	no	Count	19	40	13	11	12	95
		% within Are you provided with info on supply interruption	20.0%	42.1%	13.7%	11.6%	12.6%	100.0%
		% within Water company	25.7%	64.5%	41.9%	55.0%	80.0%	47.0%
		% of Total	9.4%	19.8%	6.4%	5.4%	5.9%	47.0%
	yes	Count	55	22	18	9	3	107
		% within Are you provided with info on supply interruption	51.4%	20.6%	16.8%	8.4%	2.8%	100.0%
		% within Water company	74.3%	35.5%	58.1%	45.0%	20.0%	53.0%
		% of Total	27.2%	10.9%	8.9%	4.5%	1.5%	53.0%
Total		Count	74	62	31	20	15	202
		% within Are you provided with info on supply interruption	36.6%	30.7%	15.3%	9.9%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	36.6%	30.7%	15.3%	9.9%	7.4%	100.0%

Annex VI-17 Household complaints

Crosstabulation

Did you complained to water company * Water company

			10.1. Company for water supply					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Did you complained to water company	never	Count	54	34	14	10	10	122
		% within Did you complained to water company	44.3%	27.9%	11.5%	8.2%	8.2%	100.0%
		% within Water company	71.1%	54.8%	45.2%	52.6%	66.7%	60.1%
		% of Total	26.6%	16.7%	6.9%	4.9%	4.9%	60.1%
	once	Count	13	18	15	4	4	54
		% within Did you complained to water company	24.1%	33.3%	27.8%	7.4%	7.4%	100.0%
		% within Water company	17.1%	29.0%	48.4%	21.1%	26.7%	26.6%
		% of Total	6.4%	8.9%	7.4%	2.0%	2.0%	26.6%
	more than once	Count	9	10	2	5	1	27
		% within 10.15.Did you complained to water company	33.3%	37.0%	7.4%	18.5%	3.7%	100.0%
		% within Water company	11.8%	16.1%	6.5%	26.3%	6.7%	13.3%
		% of Total	4.4%	4.9%	1.0%	2.5%	0.5%	13.3%
Total		Count	76	62	31	19	15	203
		% within 10.15.Did you complained to water company	37.4%	30.5%	15.3%	9.4%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	37.4%	30.5%	15.3%	9.4%	7.4%	100.0%

Annex VI-18 Storage capacity

Storage capacity of water / liters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	51	24.9	24.9	24.9
	2	11	5.4	5.4	30.2
	3	7	3.4	3.4	33.7
	4	2	1.0	1.0	34.6
	5	11	5.4	5.4	40.0
	6	2	1.0	1.0	41.0
	10	21	10.2	10.2	51.2
	15	4	2.0	2.0	53.2
	20	10	4.9	4.9	58.0
	30	12	5.9	5.9	63.9
	32	1	.5	.5	64.4
	40	14	6.8	6.8	71.2
	50	7	3.4	3.4	74.6
	60	5	2.4	2.4	77.1
	80	1	.5	.5	77.6
	90	1	.5	.5	78.0
	100	6	2.9	2.9	81.0
	110	1	.5	.5	81.5
	120	1	.5	.5	82.0
	150	2	1.0	1.0	82.9
	160	1	.5	.5	83.4
	200	4	2.0	2.0	85.4
	260	1	.5	.5	85.9
	300	1	.5	.5	86.3
	350	1	.5	.5	86.8
	360	1	.5	.5	87.3
	400	5	2.4	2.4	89.8
	450	1	.5	.5	90.2
	500	5	2.4	2.4	92.7
	550	1	.5	.5	93.2
	600	1	.5	.5	93.7
	700	2	1.0	1.0	94.6
	750	2	1.0	1.0	95.6
	1000	3	1.5	1.5	97.1
	2000	3	1.5	1.5	98.5
	2020	1	.5	.5	99.0
	3000	1	.5	.5	99.5
	4000	1	.5	.5	100.0
	Total	205	100.0	100.0	

Mean: 160

BAK years of installation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2	1	.5	20.0	20.0
	4	1	.5	20.0	40.0
	6	1	.5	20.0	60.0
	7	1	.5	20.0	80.0
	30	1	.5	20.0	100.0
	Total	5	2.4	100.0	
Missing	System	200	97.6		
Total		205	100.0		

Correlations (service capacity)

			Storage capacity of water	Service satisfaction
Kendall's tau_b	Storage capacity of water	Correlation Coefficient	1.000	-.109*
		Sig. (1-tailed)	.	.026
		N	205	205
	Service satisfaction	Correlation Coefficient	-.109*	1.000
		Sig. (1-tailed)	.026	.
		N	205	205

*. Correlation is significant at the 0.05 level (1-tailed).

Annex VI-19 Pump Costs

Pump installation costs / AMD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	8,000	1	.5	3.8	3.8
	12,000	3	1.5	11.5	15.4
	13,000	2	1.0	7.7	23.1
	14,000	1	.5	3.8	26.9
	15,000	6	2.9	23.1	50.0
	18,000	1	.5	3.8	53.8
	20,000	3	1.5	11.5	65.4
	25,000	2	1.0	7.7	73.1
	27,000	2	1.0	7.7	80.8
	28,000	1	.5	3.8	84.6
	29,000	1	.5	3.8	88.5
	30,000	1	.5	3.8	92.3
	40,000	1	.5	3.8	96.2
	48,000	1	.5	3.8	100.0
	Total	26	12.7	100.0	
Missing	don't know	3	1.5		
	System	176	85.9		
	Total	179	87.3		
Total		205	100.0		

Mean: 20,423 AMD

Pump operation costs / AMD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	6	2.9	31.6	31.6
	500	1	.5	5.3	36.8
	1,000	2	1.0	10.5	47.4
	2,500	1	.5	5.3	52.6
	3,000	2	1.0	10.5	63.2
	3,600	1	.5	5.3	68.4
	4,000	1	.5	5.3	73.7
	8,500	1	.5	5.3	78.9
	15,000	2	1.0	10.5	89.5
	30,000	1	.5	5.3	94.7
	48,000	1	.5	5.3	100.0
	Total	19	9.3	100.0	
Missing	don't know	1	.5		
	System	185	90.2		
	Total	186	90.7		
Total		205	100.0		

Mean: 7,111 AMD

Annex VI-20 Treatment Costs

Time to spend for boiling water / minutes

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	2	1.0	14.3	14.3
	10	4	2.0	28.6	42.9
	15	3	1.5	21.4	64.3
	20	3	1.5	21.4	85.7
	25	1	.5	7.1	92.9
	30	1	.5	7.1	100.0
	Total	14	6.8	100.0	
Missing	System	191	93.2		
Total		205	100.0		

Mean: 14.29

Annex VI-21 Bottle or vended water costs

Crosstabulation

Urban or rural * Buy bottled or vended water because of service deficiency

		7.15. Buy bottled water because of service deficiency / Presense		Total
		no	yes	
1.4.urban or rural	Yerevan	39	19	58
	Other Urban	42	28	70
	Rural	55	22	77
Total		136	69	205

How much spend per month for bottled or vended water / AMD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	100	1	.5	1.5	1.5
	150	2	1.0	3.1	4.6
	200	9	4.4	13.8	18.5
	220	1	.5	1.5	20.0
	250	2	1.0	3.1	23.1
	300	6	2.9	9.2	32.3
	400	4	2.0	6.2	38.5
	500	5	2.4	7.7	46.2
	600	4	2.0	6.2	52.3
	800	3	1.5	4.6	56.9
	1000	4	2.0	6.2	63.1
	1200	1	.5	1.5	64.6
	1350	1	.5	1.5	66.2
	1500	5	2.4	7.7	73.8
	1600	2	1.0	3.1	76.9
	1800	3	1.5	4.6	81.5
	2000	1	.5	1.5	83.1
	2400	2	1.0	3.1	86.2
	3000	1	.5	1.5	87.7
	3600	2	1.0	3.1	90.8
	4000	2	1.0	3.1	93.8
	4500	3	1.5	4.6	98.5
	12000	1	.5	1.5	100.0
	Total	65	31.7	100.0	
Missing	System	140	68.3		
Total		205	100.0		

Mean: 1,335

Annex VI-22 Sanitation Costs

Cost for sanitation installation / AMD

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20000	1	.5	20.0	20.0
	50000	1	.5	20.0	40.0
	90000	1	.5	20.0	60.0
	100000	1	.5	20.0	80.0
	400000	1	.5	20.0	100.0
	Total	5	2.4	100.0	
Missing	System	200	97.6		
Total		205	100.0		

Mean: 132 000 AMD

Cost for cleaning sanitation / AMD per year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3000	1	.5	6.7	6.7
	4000	1	.5	6.7	13.3
	5000	2	1.0	13.3	26.7
	8000	1	.5	6.7	33.3
	10000	3	1.5	20.0	53.3
	15000	3	1.5	20.0	73.3
	20000	3	1.5	20.0	93.3
	50000	1	.5	6.7	100.0
	Total	15	7.3	100.0	
Missing	System	190	92.7		
Total		205	100.0		

Mean: 14,000 AMD

Annex VI-23 Financial situation

Financial situation of family

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	very poor	16	7.8	7.8	7.8
	poor	44	21.5	21.6	29.4
	middle level of income	134	65.4	65.7	95.1
	well-off	10	4.9	4.9	100.0
	Total	204	99.5	100.0	
Missing	System	1	.5		
Total		205	100.0		

Median: “middle level of income”

Crosstabulation

Financial situation of family * Water company

			10.1. Company for water supply					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Financial situation of family	very poor	Count	5	4	4	2	1	16
		% within Financial situation of family	31.3%	25.0%	25.0%	12.5%	6.3%	100.0%
		% within Water company	6.7%	6.3%	12.9%	10.0%	6.7%	7.8%
		% of Total	2.5%	2.0%	2.0%	1.0%	.5%	7.8%
	poor	Count	19	13	4	4	4	44
		% within Financial situation of family	43.2%	29.5%	9.1%	9.1%	9.1%	100.0%
		% within Water company	25.3%	20.6%	12.9%	20.0%	26.7%	21.6%
		% of Total	9.3%	6.4%	2.0%	2.0%	2.0%	21.6%
	middle level of income	Count	47	43	23	12	9	134
		% within Financial situation of family	35.1%	32.1%	17.2%	9.0%	6.7%	100.0%
		% within Water company	62.7%	68.3%	74.2%	60.0%	60.0%	65.7%
		% of Total	23.0%	21.1%	11.3%	5.9%	4.4%	65.7%
	well-off	Count	4	3	0	2	1	10
		% within Financial situation of family	40.0%	30.0%	0.0%	20.0%	10.0%	100.0%
		% within Water company	5.3%	4.8%	0.0%	10.0%	6.7%	4.9%
		% of Total	2.0%	1.5%	0.0%	1.0%	.5%	4.9%
Total		Count	75	63	31	20	15	204
		% within Financial situation of family	36.8%	30.9%	15.2%	9.8%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	36.8%	30.9%	15.2%	9.8%	7.4%	100.0%

Annex VI-24 Service changes

Crosstabulation

No change* Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
No change	no	Count	42	50	17	8	10	127
		% within No change	33.1%	39.4%	13.4%	6.3%	7.9%	100.0%
		% within Water company	58.3%	82.0%	56.7%	40.0%	66.7%	64.1%
		% of Total	21.2%	25.3%	8.6%	4.0%	5.1%	64.1%
	yes	Count	30	11	13	12	5	71
		% within No change	42.3%	15.5%	18.3%	16.9%	7.0%	100.0%
		% within Water company	41.7%	18.0%	43.3%	60.0%	33.3%	35.9%
		% of Total	15.2%	5.6%	6.6%	6.1%	2.5%	35.9%
Total		Count	72	61	30	20	15	198
		% within No change	36.4%	30.8%	15.2%	10.1%	7.6%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	36.4%	30.8%	15.2%	10.1%	7.6%	100.0%

Crosstabulation

Increased duration * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Increased duration	no	Count	60	28	24	16	12	140
		% within Increased duration	42.9%	20.0%	17.1%	11.4%	8.6%	100.0%
		% within Water company	78.9%	45.2%	77.4%	80.0%	80.0%	68.6%
		% of Total	29.4%	13.7%	11.8%	7.8%	5.9%	68.6%
	yes	Count	16	34	7	4	3	64
		% within Increased duration	25.0%	53.1%	10.9%	6.3%	4.7%	100.0%
		% within Water company	21.1%	54.8%	22.6%	20.0%	20.0%	31.4%
		% of Total	7.8%	16.7%	3.4%	2.0%	1.5%	31.4%
Total		Count	76	62	31	20	15	204
		% within Increased duration	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%

Crosstabulation

Improved schedule * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Improved schedule	no	Count	52	32	25	18	14	141
		% within Improved schedule	36.9%	22.7%	17.7%	12.8%	9.9%	100.0%
		% within Water company	68.4%	51.6%	80.6%	90.0%	93.3%	69.1%
		% of Total	25.5%	15.7%	12.3%	8.8%	6.9%	69.1%
	yes	Count	24	30	6	2	1	63
		% within Improved schedule	38.1%	47.6%	9.5%	3.2%	1.6%	100.0%
		% within Water company	31.6%	48.4%	19.4%	10.0%	6.7%	30.9%
		% of Total	11.8%	14.7%	2.9%	1.0%	.5%	30.9%
Total		Count	76	62	31	20	15	204
		% within Improved schedule	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%

Crosstabulation

Increased quality * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Increased quality	no	Count	69	44	30	18	15	176
		% within Increased quality	39.2%	25.0%	17.0%	10.2%	8.5%	100.0%
		% within Water company	90.8%	71.0%	96.8%	90.0%	100.0%	86.3%
		% of Total	33.8%	21.6%	14.7%	8.8%	7.4%	86.3%
	yes	Count	7	18	1	2	0	28
		% within Increased quality	25.0%	64.3%	3.6%	7.1%	0.0%	100.0%
		% within Water company	9.2%	29.0%	3.2%	10.0%	0.0%	13.7%
		% of Total	3.4%	8.8%	.5%	1.0%	0.0%	13.7%
Total		Count	76	62	31	20	15	204
		% within Increased quality	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%

Crosstabulation

Increased pressure * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Increased pressure	no	Count	71	48	29	20	15	183
		% within Increased pressure	38.8%	26.2%	15.8%	10.9%	8.2%	100.0%
		% within Water company	93.4%	77.4%	93.5%	100.0%	100.0%	89.7%
		% of Total	34.8%	23.5%	14.2%	9.8%	7.4%	89.7%
	yes	Count	5	14	2	0	0	21
		% within Increased pressure	23.8%	66.7%	9.5%	0.0%	0.0%	100.0%
		% within Water company	6.6%	22.6%	6.5%	0.0%	0.0%	10.3%
		% of Total	2.5%	6.9%	1.0%	0.0%	0.0%	10.3%
Total		Count	76	62	31	20	15	204
		% within Increased pressure	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%

Crosstabulation

Lower quality * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Lower quality	no	Count	72	61	30	20	11	194
		% within Lower quality	37.1%	31.4%	15.5%	10.3%	5.7%	100.0%
		% within Water company	94.7%	98.4%	96.8%	100.0%	73.3%	95.1%
		% of Total	35.3%	29.9%	14.7%	9.8%	5.4%	95.1%
	yes	Count	4	1	1	0	4	10
		% within Lower quality	40.0%	10.0%	10.0%	0.0%	40.0%	100.0%
		% within Water company	5.3%	1.6%	3.2%	0.0%	26.7%	4.9%
		% of Total	2.0%	.5%	.5%	0.0%	2.0%	4.9%
Total		Count	76	62	31	20	15	204
		% within Lower quality	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%

Crosstabulation

Lower quality * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
Lower quality	no	Count	72	61	30	20	11	194
		% within Lower quality	37.1%	31.4%	15.5%	10.3%	5.7%	100.0%
		% within Water company	94.7%	98.4%	96.8%	100.0%	73.3%	95.1%
		% of Total	35.3%	29.9%	14.7%	9.8%	5.4%	95.1%
	yes	Count	4	0	1	0	4	9
		% within Lower quality	44.4%	0.0%	11.1%	0.0%	44.4%	100.0%
		% within Water company	5.3%	0.0%	3.2%	0.0%	26.7%	4.4%
		% of Total	2.0%	0.0%	0.5%	0.0%	2.0%	4.4%
	2	Count	0	1	0	0	0	1
		% within Lower quality	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%
		% within Water company	0.0%	1.6%	0.0%	0.0%	0.0%	0.5%
		% of Total	0.0%	0.5%	0.0%	0.0%	0.0%	0.5%
Total		Count	76	62	31	20	15	204
		% within Lower quality	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	37.3%	30.4%	15.2%	9.8%	7.4%	100.0%

Annex VI-25 Willingness to pay

Crosstabulation

Willingness to pay more for improved water services * Water company

Count

		Water company					Total
		Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	
Willingness to pay more for improved water services	no	33	25	4	5	8	75
	yes	25	27	11	7	6	76
Total		58	52	15	12	14	151

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Phi	.183			.281
	Cramer's V	.183			.281
Interval by Interval	Pearson's R	.067	.082	.820	.414[c]
Ordinal by Ordinal	Spearman Correlation	.105	.081	1.291	.199[c]
N of Valid Cases		151			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Crosstabulation

Willingness to pay more for improved water services * Yerevan, other urban, rural

Count

		Yerevan, other urban, rural			Total
		Yerevan	Other Urban	Rural	
Willingness to pay more for improved water services	no	29	26	20	75
	yes	13	29	34	76
Total		42	55	54	151

Symmetric Measures

		Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Nominal by Nominal	Phi	.256			.007
	Cramer's V	.256			.007
Interval by Interval	Pearson's R	.250	.078	3.148	.002[c]
Ordinal by Ordinal	Spearman Correlation	.248	.078	3.120	.002[c]
N of Valid Cases		151			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.
c. Based on normal approximation.

Annex VI-26 Improved sanitation importance

Crosstabulation

How important are improvement in sewage for you * Water company

			Water company					
			Yerevan Djur	AWSC	Shirak	Lori	Nor Akunq	Total
How important are improvement in sewage for you	very unimportant	Count	3	0	0	0	0	3
		% within How important are improvement in sewage for you	100.0%	0.0%	0.0%	0.0%	0.0%	100.0%
		% within Water company	21.4%	0.0%	0.0%	0.0%	0.0%	5.8%
		% of Total	5.8%	0.0%	0.0%	0.0%	0.0%	5.8%
	unimportant	Count	1	0	1	0	0	2
		% within How important are improvement in sewage for you	50.0%	0.0%	50.0%	0.0%	0.0%	100.0%
		% within Water company	7.1%	0.0%	5.9%	0.0%	0.0%	3.8%
		% of Total	1.9%	0.0%	1.9%	0.0%	0.0%	3.8%
	neither	Count	1	1	1	0	0	3
		% within How important are improvement in sewage for you	33.3%	33.3%	33.3%	0.0%	0.0%	100.0%
		% within Water company	7.1%	7.7%	5.9%	0.0%	0.0%	5.8%
		% of Total	1.9%	1.9%	1.9%	0.0%	0.0%	5.8%
	important	Count	0	4	2	1	2	9
		% within How important are improvement in sewage for you	0.0%	44.4%	22.2%	11.1%	22.2%	100.0%
		% within Water company	0.0%	30.8%	11.8%	25.0%	50.0%	17.3%
		% of Total	0.0%	7.7%	3.8%	1.9%	3.8%	17.3%
	very important	Count	9	8	13	3	2	35
		% within How important are improvement in sewage for you	25.7%	22.9%	37.1%	8.6%	5.7%	100.0%
		% within Water company	64.3%	61.5%	76.5%	75.0%	50.0%	67.3%
		% of Total	17.3%	15.4%	25.0%	5.8%	3.8%	67.3%
Total		Count	14	13	17	4	4	52
		% within How important are improvement in sewage for you	26.9%	25.0%	32.7%	7.7%	7.7%	100.0%
		% within Water company	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	26.9%	25.0%	32.7%	7.7%	7.7%	100.0%