IDARA (INSTITUTING WATER DEMAND MANAGEMENT IN JORDAN)

Task 1.4- Perform End Use Analysis

Deliverable 2 : Residential Water Use Baseline Survey

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EXECUTIVE SUMMARY

Although one of the four poorest countries in terms of water resources, Jordan aspires to raise the quality and standard of living of Jordanians through expanding the commercial, industrial, and tourism sectors. This puts more pressure on the already limited water resources. In the past decades, the Government of Jordan has developed extensive water resources management schemes. In addition, several donor agencies have invested billions of dollars in water related projects aimed at solving or reducing water scarcity in Jordan. Water management utilities used worldwide have been reducing potable water usage by implementing life cycle cost-effective water efficiency programs. Like most countries around the world, the management of freshwater resources to accommodate growing communities has traditionally focused on supply-side projects. But often these large-scale projects have generated negative impacts, additionally, the costs of obtaining and treating new sources of water have steadily risen, making demand-side options economically attractive.

A more efficient and well-planned use of water can result in significant savings in fresh water. In the absence of new water resources in these countries, such savings in water can be considered as new sources. One approach that has been successfully implemented worldwide is on the implementation of strategic water efficiency and educational programs

Within the scope of Activity 1, ***"Institutional Capacity for Water Demand Management"***, IDARA conducted a residential end use survey implemented by the Interdisciplinary Research Consultants (I*d*RC) and Seif International in collaboration with the utilities and the Ministry of Water and Irrigation's Water Demand Management Unit to obtain a more in-depth view of the social make-up of the households in terms of wealth, gender, and age groups, and assess how those factors affect water use and demand. A representative sample of households was defined in the three targeted areas (Amman, Northern Governorates, and Aqaba). The sample was chosen to be statistically representative, stratified according to the actual socioeconomic and living conditions among Jordanian households in different areas, and geographically distributed in a manner that covers the areas under study. Some other criteria were included in the selection process such as history of water consumption in the households in the services areas, review of poverty and socioeconomic factors, and serviceability by the various utilities.

The trends of consumption for the various areas within each of the three service areas indicated the existence of a relation between wealth and water consumption. Wealthier households supplied on an intermittent basis were found to consume more water than poorer houses on a continuous supply basis. Generally, a higher wealth index means larger households, thus more indoor and outdoor use. There are, however, other factors that enter in consideration making it difficult to establish an empirical relationship.

Household type also seemed to be related to water consumption with single houses consuming more water than apartment units. This is an expected result and is mainly attributed to the significant differences in size between houses and apartments, and to the existence of outdoor uses in houses. Only minimal proportions of households use water tankers to supplement their water demand. This was regardless of the wealth level.

Other factors such as gender, age, and education were not found to have any apparent impact on water consumption rates. The majority of households in all three service areas indicated their overall satisfaction with the supplied quantities of water. This is despite the differences in the storage capacities of households in different areas. This finding is confirmed both by the responses given during the surveys and by the fact that only a small minority of households supplement their demand via tankers

The study also revealed that lavatories and faucets account for nearly 50% of the indoor consumption. Again, such finding identifies a key area of where awareness programs should focus on in terms of improving water use efficiency. The promotion of more efficient toilets (either with dual flush mechanisms or with simple volume reducing practices) could have significant results in terms of savings. The same applies to the utilization of water efficient faucets. While not as water consuming as faucets and toilets, showers represent a good portion of household consumption (an average of

12%). This too identifies an area that should be given attention in terms improving household water use efficiency.

The highest outdoor use proportions were found in the northern governorates service area, while the lowest proportion was in the Aqaba area. This is an expected result given the rural nature of the northern governorates and the higher ratios of irrigation use for cropping purposes as opposed to landscaping purposes as in Amman. In general, the breakdown for outdoor uses had higher variations than the indoor uses. Reasons for such variation include the lifestyle, type of residence, wealth indicators, the intended purpose of outdoor use, and the geographic location. Though the survey at hand was not designed to specifically address this, the results of the analysis reveal that there are significant savings potential under this part of household water consumption. Outdoor water conservation areas include maintenance opportunities, irrigation systems opportunities, landscaping opportunities, and management opportunities.

Based on the findings, and using the surveys periodically conducted by the Department of Statistics, it is believed that the utilities could delineate wealthier areas and design awareness programs targeting such group(s). Such programs could result in quick wins in terms of achieving water savings at the household level. This is especially true since such households would be more open and more willing to making simple investments to improve the efficiency of their water fixtures.

The study revealed that there are a number of water use behaviors that need to be further explored. For example, the study has shown that people generally underestimate the extent to which they use water (in terms of frequency and durations). While several studies in Jordan have attempted to better quantify such behaviors, no single comprehensive effort has been undertaken. Therefore, it is very important that a comprehensive study with a sampling approach similar to the one at hand be followed where household members are asked to keep a diary of their water consumption behavior. Such effort is significant and would have to extend over a period of time to take seasonal variations into account. Once established, however, it would provide a powerful tool for the water utilities to more accurately estimate demand, and target their awareness activities.

Outdoor water use remains to be an ambiguous aspect especially in the absence of comprehensive studies that focus on this aspect of household water use. Therefore, it is recommended that detailed studies similar to IDARA's end use studies, yet outdoor oriented, be conducted. Such study would clearly focus on individual homes rather than apartments, but would help develop more accurate outdoor water use based on actual observations and measurements. It is also recommended to target awareness efforts on indoor water uses where such uses have been found to be the highest and to focus awareness related to outdoor user to areas that demonstrate high use. This is demonstrated by the fact that some collection areas still exhibit inefficient outdoor water use (such as using the hose to clean or using potable water to grow crops) despite all national efforts in the past to curtail such practices.

The study revealed that a significant portion of households still have water fixtures with excessive flow rates. It is recommended that the utilities become involved in post-meter services provided they are related to water use efficiency. While the utilities responsibilities are up to the meter, and their revenues improve as a result of selling more water, increasing water use efficiency enables them to serve more people. Therefore, it is recommended that the utilities become more actively engaged in providing such services. This could be one of the mechanisms to promote compliance with the new plumbing codes.

While IDARA has been successful in institutionalizing water demand management at the Ministry of Water, there is still a need to build the capacities of the utilities themselves to implement their respective water use efficiency plans. Specifically, the creation of demand management units within each utility to coordinate with the Ministry and periodically undertake such surveys and studies. Planning for awareness programs would be based on the results of such studies, and should be a joint effort between the Water Demand Management Unit at the Ministry and the three water utilities.

1.0 STUDY BACKGROUND

Jordan is the fourth water poorest country on earth. Demand for water already exceeds Jordan's available water resources. Annual per capita water availability has declined from 3600 cubic meters per year in 1946 to around 145 cubic meters per year in 2008. Water demand is currently estimated at around 1530 MCM versus 870 MCM of water resources. The demand is projected to increase to around 1670 MCM by 2022. The high water shortage has caused a drastic over-abstraction of the groundwater aquifers that are pumped at two folds the safe yield. On the other hand, Jordan's stability, tourism attraction, quality of business and health services make it as a prime regional hub for investment. This challenging situation provides a great opportunity for the introduction of the most effective water demand management tools.

Non-Agricultural water use represents approximately 35% of total fresh water consumption in Jordan. The residential water use accounts for around 87%, 84% and 30% of the non-agricultural billed water respectively in Amman, the Northern Governorates, and Aqaba. Urban Water Demand Management in Jordan started from the bottom of the pyramid concentrating on educating and convincing the public about the need and benefits of water efficiency, then moved up to work with the institutions to develop water demand management policies, institutionalize WDM; develop standards, codes and regulations; and introduce technologies and communicate best management Practices.

Within the scope of Activity 1, "Institutional Capacity for Water Demand Management", IDARA conducted a residential end use survey implemented by the Interdisciplinary Research Consultants (I*d*RC) and Seif International in collaboration with the utilities and the MWI water demand unit to get a more in-depth view of the social make-up of the households in terms of wealth, gender, and age groups, and assess how those factors affect water use and demand.

This report presents the program objectives, methodology, results, and recommendations.

1.1 Study Organization

Figure 1 below presents the project organization structure, management, and the interaction between project's stakeholders.

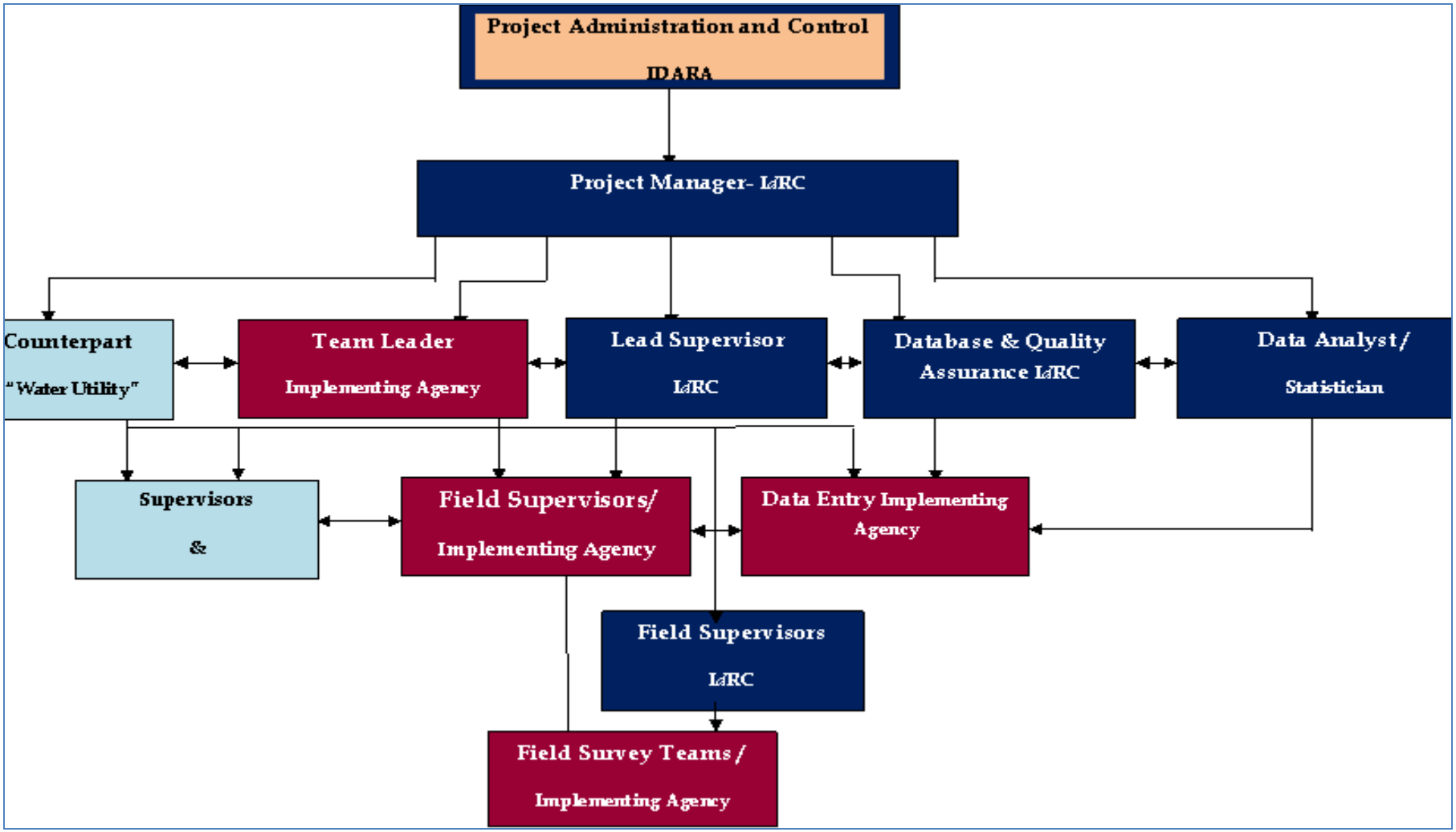


Figure 1: Project Organization Chart

2.0 METHODOLOGY

The overall goal of the study at hand was to conduct a residential water use baseline survey to assess how socioeconomic factors affect water use at the household level in Jordan. Specific steps to achieve this objective are summarized in the following Matrix.

Steps	General Description
Sample Definition and Selection	The main focus of this step was to define a sample of households in the service areas of Jordan Water Company Miyahuna), the Northern Governorates Water Authority (YWC), and Aqaba Water Company (AW)) to be surveyed. The focus was to select a sample that is statistically representative, stratified according to the actual socio-economic and living conditions among Jordanian households in different areas, and geographically distributed in a manner that covers the areas under study.
Survey Tool Finalization	The main theme of this step was to finalize the means of collecting the data needed to establish the desired correlations as part of this study. One of the objectives of the effort at hand was to prepare the survey tool to be used for collecting the necessary data from the study sample as defined above.
Baseline Survey Implementation	Under this step, the aim was to make sure that the data collection, analysis, and interpretation are done according to proper procedures that meet the objective of the survey., is conducted according to .

Figure 2: Steps of the residential water use baseline survey

To meet the objective of the study, the following four stages were used, each with a number of tasks and sub-tasks, as summarized in Figure 2 below.

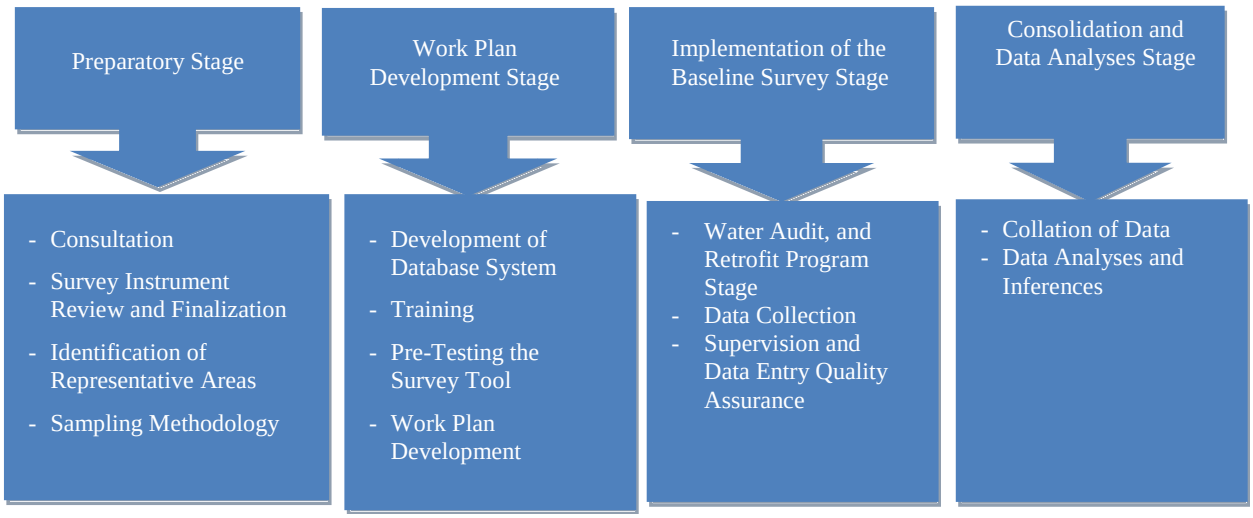


Figure 3: Study Methodology

2.1 Preparatory Stage

This stage focused mainly on the preparatory works needed to achieve and finalize the survey tool and the household survey sample. Under this stage, the following activities were conducted:

1. *Consultation*

Several meetings were held at the Department of Statistics (DoS) to discuss the proper sampling methodology to be used in the study, along with the socio-economic parameters that have to be included in the survey instrument. Furthermore, other meetings were held with the water utilities to identify target areas, sample sizes and the parameters that affect the data collection in the field, as well as to obtain the required data of the subscribers, water consumption, GIS data and maps, and collection areas within the water utilities.

2. *Survey Instrument Preparation*

The baseline survey instrument was prepared in collaboration with the DoS and the water utilities. The survey instrument was designed to capture all technical and socio-economic data and questions needed to meet the baseline survey objective. A final version of the survey instrument was translated into Arabic for data collection facilitation purposes. A copy of the survey tool is included in Appendix A of this report.

3. *Identification of Representative Areas*

The representative areas were selected in collaboration with the water utilities. The selection took into consideration geographical distribution, socioeconomic variations, and water consumption. . Table 1 below includes the list of the selected collection areas in the three study governorates.

Table 1: Selected Collection Areas From the Three Service Areas

Miyahuna Service Area		YWC Service Area		AWC Service Area	
Geographical Location	**Target Collection Area**	**Geographical Location**	**Target Collection Area**	**Geographical Location**	**Target Collection Area**
West	Abdoun Khalda	Irbid	Hay Al Janoubi Hay Al- Jama'a Hay Al-Turkman	Aqaba City	Al-Mahdoud 5th Quarter 8th Quarter
North	Shafa Badran Sweileh (East)	Ramtha	Abu Basal Al- Masra and Turra		
South	Quwaismeh Al-Lubban	Mafraq	Mafraq City Ba'aj		
East	Marka Hashimi Shamali	Ajloun	Ajloon City Kufranja		
Center and Downtown	Al-Waibdeh Ras Al-Ain	Jerash	Jerash City Balilah		

4. *Sampling Methodology*

In order to conduct a survey that is statistically representative of the actual population, a sampling strategy was followed that took into account the relative ease or difficulty in the mechanism of drawing a representative sample whilst ensuring validity and reliability of the data. A ***Probability Sampling Method*** was used for the study at hand; given the need to generalize the results and to eliminate biases. It was recognized that the most appropriate type to be used is the stratified sampling, in which sub-samples are randomly drawn from samples within different strata that are more or less equal on some characteristic. With respect to the requirements of the assignment at hand, the selection of the sample was done based on the total number of residential subscribers in the service area of the three utilities under study.

The appropriate sample size for a population-based survey is determined largely by three factors: (i) the estimated prevalence of the variable of interest, (ii) the desired level of confidence, and (iii) the acceptable margin of error. For a survey design based on a simple random sample, the sample size required can be calculated according to the following formula:

$$n_s \geq \frac{Z^2 pq}{d^2 + pq/N} * Df \qquad (1)$$

The above formula is the most appropriate sample size determination formula to be used, where proportions are being assessed for significance and correlations, which is the case for the survey at hand.

Where:

Z: The number of standard deviations needed for a certain confidence level for the purposes of this study (95% confidence was used i.e. Z =1.96)

p: The proportion of the population (0.5).

q: 1-p

d: Error allowed for the estimate assumed to be not more than 3%.

N: The Total Number of Residential Subscribers at the three water utilities (678,544).

Df: Is the Design Factor, which is the ratio of the actual variance to the variance computed under the assumption of simple random sampling. And it is used to determine how much larger the sample size needs to be. In general, for a well designed study, the design factor usually ranges from 1 to 3, and for the study at hand, it was recommended by the statisticians at DoS to be 2.

Applying the above equation to the entire subscribers in the three utilities resulted in a minimum required sample size of 2,130 households. The sample size for each stratum (i.e., utility's service area) was calculated based on its own weight to the total number of subscribers, as shown in Table 2 below. For example, Miyahuna subscribers account for 65% of all subscribers in all three regions. Therefore, 65% of the overall sample size (i.e., 1,385 out of 2,130) was taken from the Miyahuna service area, and so on.

Table 2: Allocation of Sampling Units by Stratum

Stratum (Service Area)	Number of subscribes	Proportional allocation
Miyahuna	441,255	1,385
YWC	215,793	678
AW	21,496	67
Total	**678,544**	**2,130**

During data collection, the field surveyors encountered several obstacles that affected the response rate. Therefore, and in order to resolve this hurdle, the calculated minimum sample was multiplied by 2 (i.e., a new sample size of $n_s \geq 4260$ was calculated, as shown in Table 3 below).

Table 3:Allocation of Finalized Sample Size and Complete Visits

Stratum (Utility)	Proportional Allocation		Final Sample Size	Min. Number Required For Successful Visits
	Calculated	Modified (to account for Non-Responsiveness)		
Miyahuna	1,385	2,770	2,700	1,400
YWC	678	1,356	1,300	700
AW	67	134[a]	600	300
Total	**2,130**	**4,260**	**4,600**	**2,400**

a: Due to the touristic nature of Aqaba, as well as the continuous supply pattern of water coupled with the high demand, it was decided to increase the number of households in Aqaba City to be 600 instead of 134.

As a second stage of sampling, and for each region in the service areas identified in Table 1, the proportional sub-sample size was calculated based on the actual proportions of subscriptions. The proportional samples for each of the three utilities are shown in Tables 4 through 6 below.

Table 4:The Selected Collection Areas at Miyahuna and the Corresponding Sample Size

Geographical Area	Name	Subscribers	Proportional Sample
West	Abdoun	8,590	262
	Khalda	14,538	444
North	Shafa Badran	11,035	337
	Sweileh (East)	6,264	191
South	Quwaismeh	5,253	160
	Al-Lubban	6,464	197
East	Marka	15,857	484

	Al-Hashimi Al-Shamali	16,382	500
Center and Downtown	Al-Waibdeh	3,658	112
	Ras Al-Ain	436	13
Total		**88,477**	**2,700**

Table 5: The Selected Collection Areas at YWC and the Corresponding Sample Size.

YWC Collection Areas	Name	Subscribers	Proportional Sample
Irbid	Hay Al- Jama'a	8,944	314
	Hay Al Janoubi	2,292	81
	Hay Al-Turkman	2,886	101
Ramtha	Abu Al Basal District, Al Masra and Turra	4,217	148
Mafraq	Mafraq City	7,851	276
	Ba'aj	506	18
Ajloun	Ajloun City	1,494	53
	Kufranja	2,376	84
Jerash	Jerash City	5,876	207
	Balila	536	19
Total		**36,978**	**1,301**

Table 6: The Selected Collection Areas at AW and the Corresponding Sample Size

AW Collection Areas	Name	Subscribers	Proportional Sample
Aqaba City	Al-Mahdoud Area	775	420
	Fifth Residential Area	162	88
	Eighth Residential Area	165	92
Total		**1,102**	**600**

The selected samples for Miyahuna, YWC, and AW are presented in Appendices B, C and D, respectively.

2.2 Work Plan Development Stage

This stage focused on finalizing the data management system to be used for the data collation, training the field staff on the use of the survey instrument, conducting the test-run/pre-test of the survey tool, estimating the needed WSDs for the retrofit activities, and developing a work plan for the field works. To this end, the following activities were conducted:

1. *Development of Database System*

Based on the final version of the survey instrument, a data management system was designed to facilitate the data entry, and minimize any possibility of errors in the process. To do so, the system was designed in a manner that resembles what the actual survey tool looks like in terms of appearance, coding, and sequencing of questions and responses, etc.

2. *Training*

Three training and orientation sessions were held for the implementing agency's surveyors and data operators. The training covered the areas of data collection using the survey tool and appropriate communication protocol, installing the WSDs, and data entry and use of the database system. .

3. *Pre-Testing the Survey Tool*

A test run was conducted on randomly selected households in the Miyahuna, YWC, and AW service areas. The purpose of the test run was to pre-test the survey instrument to identify any shortcomings in the design and/or challenges in the data collection process itself. The test run was also intended to roughly estimate the amount of WSDs needed for the retrofit activity, and to assess the required number of plumbers and meter readers. The test run was supervised by the I*d*RC staff and was coordinated with the water utilities and the implementing agency. The total numbers of the households in the test-run were 99, 43, and 17 in the Miyahuna, YWC, and AW service areas, respectively. Of those, the accessed households were 34, 36 and 11, respectively. Of the accessed households, the questionnaires were completed for 21, 28, and 11 households, which were translated into response rates of 62%, 78%, and 100% for the three areas, respectively. Details of the statistics gathered from the test run are presented in Appendix B.

4. *Work Plan Development and Finalization*

The work plan was based on the results obtained from the test run that was conducted in the three target areas of the study. Key activities included modification of the survey instrument according to the findings of the pre-testing, and modification of the database and solving all bugs raised during the data entry. An implementation schedule of the daily visits of the field staff was also developed

2.3 Implementation of the Baseline Survey Stage

The implementation of the baseline survey was conducted for the selected sample of households in the Miyahuna, YWC and AW service areas, respectively, during the period of June to August, 2010. The implementing agency (Sief Int.) assigned 8 survey teams (1 male and 1 female for each team), 2 field supervisors, and 1 project manager. All the staff was supported by 3 vehicles to facilitate their movement during the interviews between the households. The implementation, however, was supervised by the I*d*RC staff and was coordinated by the water utilities to provide the survey teams with meter readers who facilitated the access to the selected households.

1. *Implementation, Water Audit, and Retrofit Program*

One of the major problems that faced the field staff was to meet the target of the selected households within a certain collection area. After a thorough discussion, it was decided to make replacements to households directly in the field; provided that the replacement did not exceed the 20% of the target number of selected households in any given collection area. Tables 7, 8 and 9 summarize some statistics on the implementation of the baseline survey in the Miyahuna, YWC, and AW service areas.

Table 7:Statistics on the Field Visits in the MIYAHUNA Service Area

Location in Amman	Collection Area	Proportional Sample	Target	Successful[1] Visits %
West	Abdoon	262	136	100
	Khalda	444	231	100
North	Shafa Badran	337	175	100
	Suweilh_East	191+	101	100
South	Quweismeh	160	83	100
	Al-Lubban	197	102	***101***
East	Marka	484*	253	***108***
	Hashimi Shamali	500	260	92
Center and Down Town	Al Weibdeh	112	58	100
	Ras Al-Ein	13	7	***114***
Total		**2700**	**1406**	**100**

[1] **Percentages more than 100% mean that the numbers of successful visits exceeded the targeted numbers**

Table 8: Statistics On The Field Visits In The YWC Service Area

Governorate	Collection Area	Proportional Sample	Target	Successful[1] Visits %
Irbid	Eastern District	314	170	101
	Northern District	81	43	102
	Turkman District	101	55	102
	Ramtha	148	80	101
Mafraq	City	276	149	100
	Ba'aj	18	10	110
Ajloun	City	53	28	104
	Kufranja	84	46	96
Jerash	City	207	111	100
	Balilah	19	10	110
Total		**1,301**	**702**	**101**

Table 9: Statistics on the Field Visits in the AW Service Area

Governorate	Collection Area	Proportional Sample	Target	Successful[1] Visits %
Aqaba	Eighth Area	92	43	98
	Fifth Residential Area	88	49	98
	Al-Mahdoud Area	442	208	87
	Third Residential Area (as a replacement area)		51	159
Total			**351**	**100**

2. ***Supervision and Quality Assurance***

I*d*RC implemented an effective system for fieldwork supervision. The fieldwork plan was organized so that the supervisors accompanied the interviewers during their visits in a given collection area to observe them and ensure clear delivery of questions to the respondent, accurate data logging, adherence to proper procedures as per the interviewers training, and completeness of filled survey; such that there is no missing data. This also entailed checking the completed survey forms on a daily basis. In case the survey contained any errors, it is returned to the implementing agency either to check the data or to complete it again.

2.4 Consolidation and Data Analyses Stage

The main focus of the data analyses was to test the correlations related to socioeconomic parameters versus water consumption behavior. Key relations that were investigated to meet this objective are:

a. Households, Social-Economic and Demographic Indicators (e.g, wealth index, income levels, gender, age group, education levels, household types, and plumbing fittings and fixtures versus water use behavior) and Households General Information data (e.g., consumption per capita, tanker water use versus the total water consumption, extent of water meters accuracy, willingness to participate in the end use analysis study, and the eligibility to conduct this study accordingly).

b. Indoor Water Use related data (e.g., indoor water consumption per water use type, availability of certain appliances, extents of leaks in all fixtures)

c. Outdoor Water Use data (e.g., Percentage of outdoor water use of total water consumption, outdoor usage behaviors related to cleaning, irrigation, etc.)

3.0 DATA ANALYSES AND RESULTS

3.1 Main Steps in the Data Analyses

The IDARA Team analyzed all the collected data through the conduct of frequency analysis, calculations of means, and statistical ratios for the various variables collected through the survey. All such analyses were conducted using the SPSS software to provide descriptive statistics for all indicators and parameters of the surveyed households. These parameters included socioeconomic data, demographic indicators, households' general information, indoor water use and outdoor water use, just to name a few. These analyses were the first step towards meeting the main objective of the study in terms of establishing correlations between those various household characteristics against water consumption.

As a second step, it was necessary to obtain the actual water consumptions for each of the surveyed households. To do so, a computer code was developed to read the household subscription number/name in each of the completed and digitized questionnaires. This same code then extracted the actual billed water from the water utilities' complete lists that had been obtained by the IDARA Team. In cases where the records of a household(s) were missing, the billed water consumption was taken as the average of the water consumption within that collection area. It was those consumptions that were analyzed against the various variables in order to examine the correlations set out in the beginning of the study.

In addition to the analyses above, there were two key "calculations" that the IDARA Team undertook. Those were the calculation of a *Wealth Index* that takes into account the various demographic and socioeconomic variables in a household. It was this variable that was analyzed against water consumption and water usage behavior to examine the correlations of interest. The other calculation was that of water consumption (both indoor and outdoor). As will be seen in a later section, this was calculated using a model that had been developed by the IDARA project activities and based on a number of field observations that had been done at the household level. Although the actual billed water consumption was obtained for the various households, it was necessary to undertake this calculation in order to separate the indoor and outdoor uses. The data collected through the household survey was used to test the model that had been originally developed by IDARA. The following two sub-sections describe how those two calculations were conducted, while the remainder of this section presents the overall results of the entire analyses.

3.1.1 Wealth Index

As a measure of economic status, the household wealth has several advantages. It represents a more permanent status than income or expenditures. In the form that it is used, wealth is more easily measured (with only a single respondent needed in most cases) and requires far fewer questions than expenditures or income. Also, wealth is a theoretically measurable quantity and it can be measured by making a list of all assets and properties (including physical and monetary assets), assigning them a value, and ranking the sum of these values.

In light of the above, it was decided to use the household Wealth Index as the measure of economic status. To calculate it, one must utilize a composite measure of the cumulative living standard of a household. The wealth index is calculated using easy-to-collect data on a household's ownership of selected assets. It is generated using a statistical procedure known as the *Principal Components Analysis*, which places individual households on a continuous scale of relative wealth. Based on the data collected in a household questionnaire, the wealth index is constructed using household assets. This includes type of housing, housing ownership status, employment status of the head of household, number of employed members, drinking water source, source of hot water, number of cars, availability of garden/grass, availability of swimming pool, availability of dishwasher, washing machine and jacuzzi at household, as well as household income and expenditures. Table 10 below presents the complete list of all variables that were used in the wealth index calculation in this study.

Table 10: . List of Variables Included in Calculating the Wealth Index

Variable Name			
1	Household Type (Apartment, Villa, Single House)	**11**	Swimming Pool
2	Household Tenure (Owned /Rented)	**12**	Dishwasher
3	Family Head Employment Status (Public, Private, Self Employed)	**13**	Washing Machine type
4	Household Monthly Spending	**14**	Source of Hot Water (Boiler, Electric Heater, Solar Heater, Gas)
5	Household Monthly Income	**15**	Air Condition Type
6	Water Supply Source (Public, Well, Tankers, Harvesting)	**16**	Household Age
7	Drinking Water Source (Public, Bottled , RO)	**17**	Jacuzzi
8	Garden Type (Grass, Planted Trees, …etc)	**18**	Household Area
9	Garden Irrigation (Drip, Sprinklers, Bucket, Hose)	**19**	No. of Employed Family Members at Household.
10	No. of Cars at Household		

Afterwards, each asset was assigned a weight (Factor Score) generated through the *Principal Components Analysis*. The resulting asset scores were then standardized in relation to a standard normal distribution. Each household was then assigned a score for each asset; and the scores were summed for each household. The standardized scores were then used to create the break points that defined wealth triplets; **Poor, Middle, and Rich.** Based on the information gathered for the various households in the study at hand, households were distributed amongst those three categories of wealth.

3.1.2 Water Use Calculation

Using the results and findings of an End Use Analysis conducted by IDARA's team in different households in Amman, the indoor water use of all fixtures and the outdoor water use can be estimated, with a reasonable level of accuracy. This is done using a number of formulas and equations built upon a number of variables related to water use behavior. Variables that were used in calculating the indoor and outdoor water included Frequency of use per day, number of family members in the HH, Average flow rate of a fixture, Duration of use, number of showers per week, and number of cars per HH.

The End Use Analysis conducted by IDARA entailed detailed observations of the values of the above variables for a number of households. Using those data, and the measured water consumptions, a number of equations were developed for calculating the indoor and outdoor water use. Those equations were mainly based on the variables listed above, and were calibrated using the actual data collected in the End Use Analysis Study conducted by IDARA. The IDARA Team based its analysis on the actual billed data obtained from the three water utilities. However, additional analyses were conducted to compare the actual billed consumption against the calculated consumptions using the values of the above variables collected as part of the survey. This helped both test the reliability of the equations developed by IDARA and further calibrate them, and to estimate the indoor/outdoor consumption breakdown.

3.2 Results and Discussion

The survey tool was divided into eight main sections. Each section addressed various aspects of a household in order to cover all the indicators and parameters to be investigated. The main eight sections were as follows:

1) Household general information and socioeconomics
2) Household members demographics including gender, age, and education level
3) Household type and ownership
4) Water sources and storage

5) Outdoor water use

6) Indoor water use

7) Awareness on WSDs

8) Water audits

In total, 2,467 households were surveyed broken down as follows:

- 1,408 in the Miyahuna service area,
- 706 in the YWC service area, and
- 353 in the AW service area.

The following sub-sections summarize the results that were revealed by the survey, based on the trend and frequency analyses undertaken.

3.2.1 Households' Socio-economic and Demographic Indicators versus Water Consumption

Thorough analyses were made to measure the relationship between the various socioeconomic indicators (living standards, age, education, etc) against water consumption in the three targeted areas. A wealth index was calculated and analyzed to measure the cumulative living status of each household surveyed. Figure 4 below presents the calculated wealth indices for the three target areas. Looking at the Figure, the following observations can be made:

- The distribution of the calculated wealth indices coincides with the actual general living conditions in the various districts and neighborhoods included in the survey. For example, the highest wealth indices in the Miyahuna service area were obtained in the Western and Northern parts of the Amman Governorate. Those included the Abdoun, Khalda, and Shafa Badran collection areas, which are generally known to be on the higher end of wealth. The analysis revealed that nearly two-thirds of the households surveyed in those areas fall under the ***Rich*** category as earlier defined by the Wealth Index. Results of the wealth indices analyses obtained for the Eastern and Central parts of the Governorate show lower standards of livings. Nearly 65% of the total households surveyed withhin those areas can be categorized under the ***Poor*** category. This finding is also consistent with the overall living conditions in those areas. Finally, other areas in Amman such as Sweileh, Weibdeh, and Hashmi showed an almost equal split between the ***Middle*** and ***Poor*** categories, with a minority of households being in the ***Rich*** category.
- Looking at the collection areas of YWC, the results showed some variations between, and within, each Governorate. Generally, and at the governorate level, Irbid was found to have the highest proportion of ***Rich*** households followed by Ajloun, Jerash, and Mafraq. One explanation could be that while outside the capital, Irbid and Ajloun have a lesser rural setting when compared to the two other governorates. Within each governorate, there were also some variations in the distribution of wealth. For example, nearly half the households in the Turkman collection area fall under the ***Poor*** category. On the other hand, Al-Hay Al-Janoubi and Ramtha collection areas showed more households falling under the ***Rich*** category. The same trend can be seen for Ajloun and Jerash with households in the governorate's capital being more on the higher end compared to those in the surrounding villages. Both types of environment in the Mafraq governorate showed a dominance of households under the ***Poor*** category.
- The distribution of the wealth indices in the AW service area indicated a concentration of households that fall under the ***Poor*** category in the Al Mahdoud area. Close to 60% of the surveyed households under the ***Rich*** category were found in the Fifth Residential Area, followed by the Eighth and Third Residential Areas, which are considered as middle class areas, respectively.

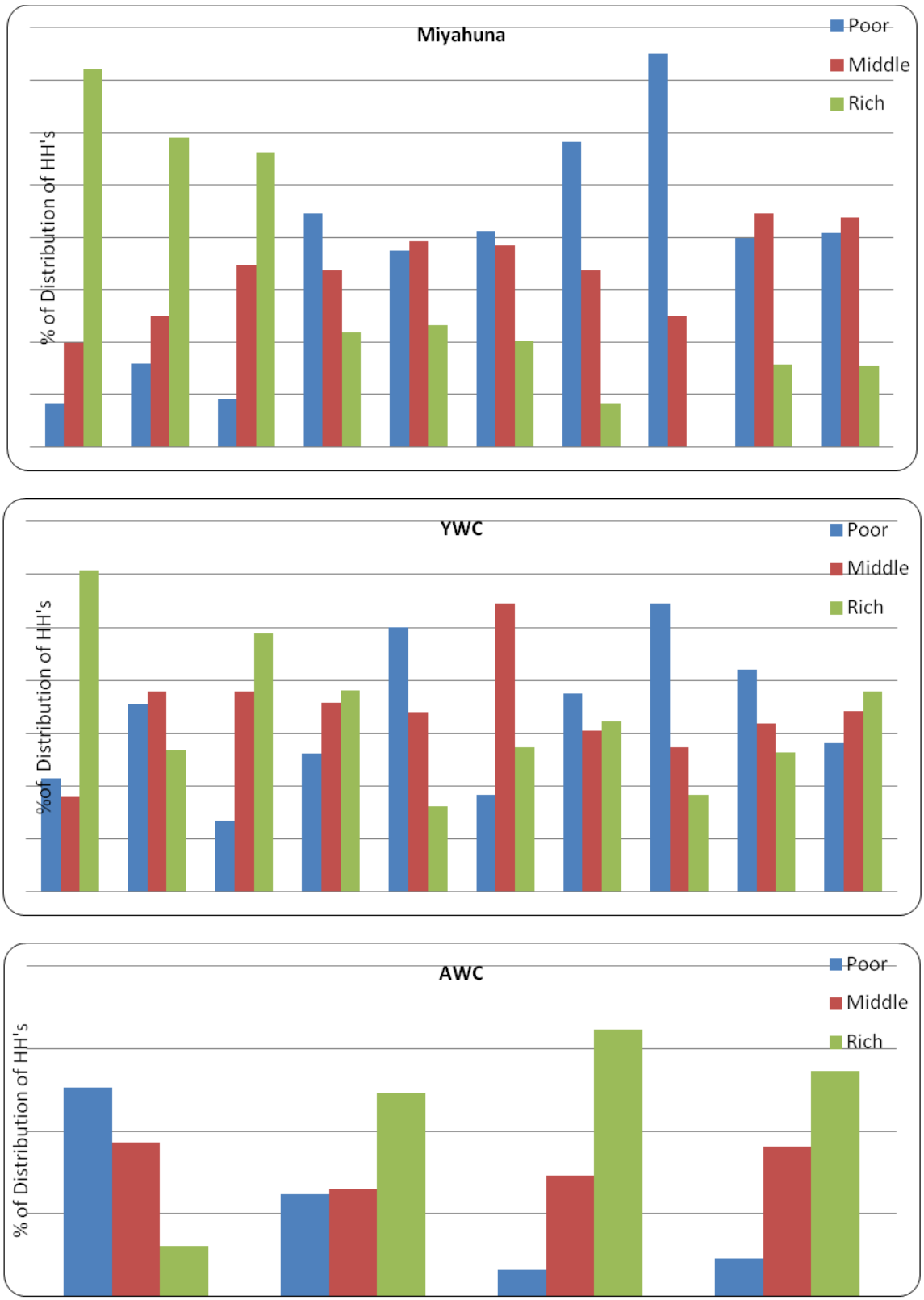


Figure 4:Percentage Of Distribution Of Wealth Index For The Three Service Areas

To examine the relationship between wealth and water consumption, the billed consumptions for all households in a given service area were sorted in ascending order. The IDARA then summed the billed consumption for all households in a service area and calculated the cut-off points for five consumption categories according to five percentile limits (20%, 40%, 60%, 80%, and 100% of the total

consumption in the service area, respectively). Using the sorted list of households, the cumulative consumptions corresponding to the five percentiles were identified, and the households categorized into those five consumption categories. The five categories were lowest consumption, second lowest consumption, middle consumption, fourth, and highest consumption.

Figure 5 summarizes the approach that was used for this categorization, while Figure 6 shows the distribution of households in the five consumption categories for each of the three service areas.

As can be seen in the Figure, with the exception of the highest consumption category, the five categories are well represented in the three service areas. Generally, the lowest consumption category is the largest single category in all three service areas. The

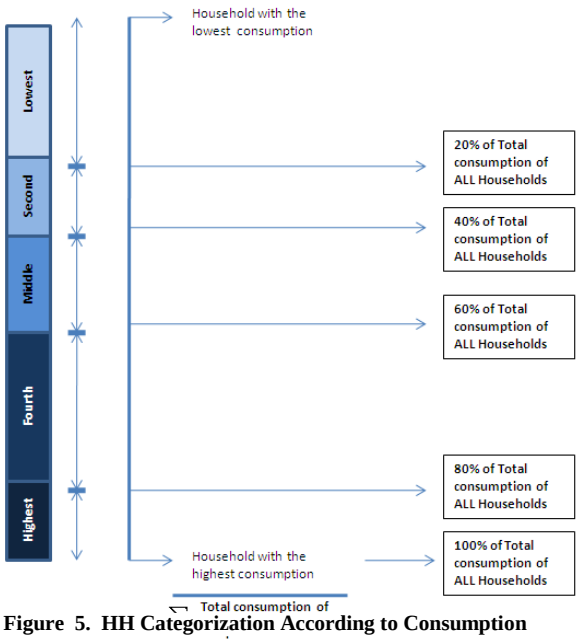


Figure 5. HH Categorization According to Consumption

Proportional size of this category in the Miyahuna and YWC service areas are comparable in size, however, it is smaller in the AW area. This could be attributed to the pattern of consumption in Aqaba due to its climate and touristic nature. The same trend (but in an inverse pattern) can be seen for the highest consumption category. No significant differences between the proportional sizes of the other three categories could be detected between the three service areas.

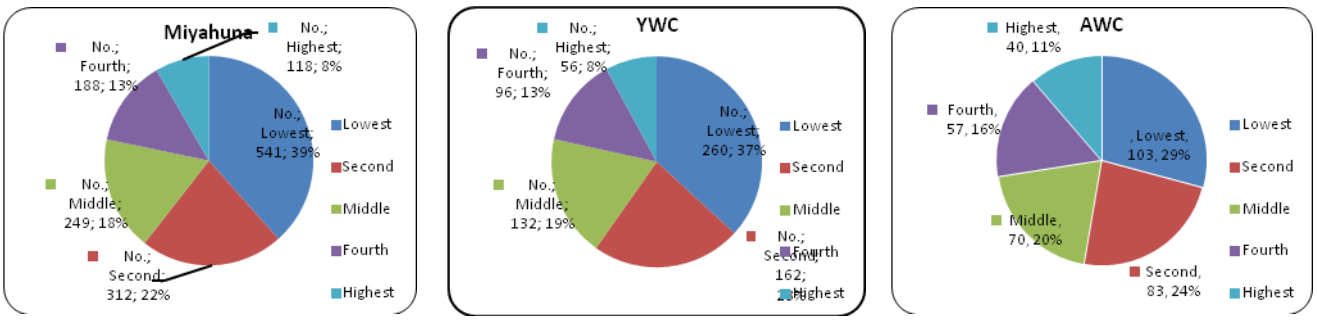


Figure 6: Percent Distribution of Subscribers by Billed Water Consumption Quintile

Figure 7 below shows the distributions of the households in the various collection areas within each utility's service area. Those are broken down by the five water consumption categories, and shown for each utility separately. While the Figures do not represent much on their own, it is interesting to compare the geographic distributions of households in the lowest and highest consumption categories in light of the Wealth Index distribution presented earlier.

Examining the Figure for the Miyahuna service area, one could see that the trend of the geographic distribution of households in the lowest consumption category somewhat corresponds to the geographic distribution of households in the ***Poor*** category. For instance, the collection areas with the highest concentration of low consumption households are almost the same as those with the highest concentration of ***Poor*** households. The same applies to the collection areas with the highest concentration of high consumption households being almost the same as those with a higher concentration of ***Rich*** households. Although not as explicit, a similar trend can be seen in the Figures for the YWC and AW areas, respectively.

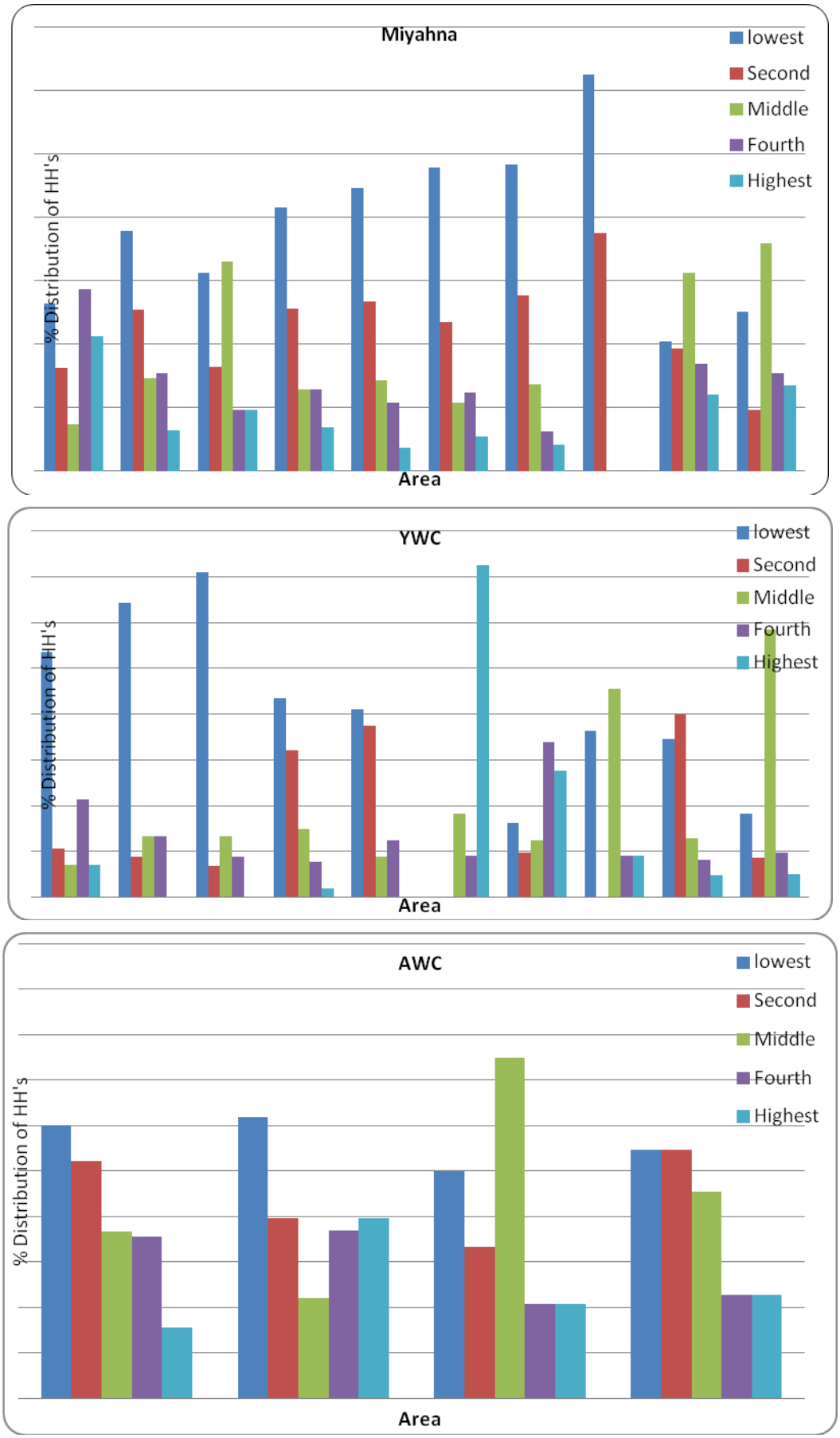
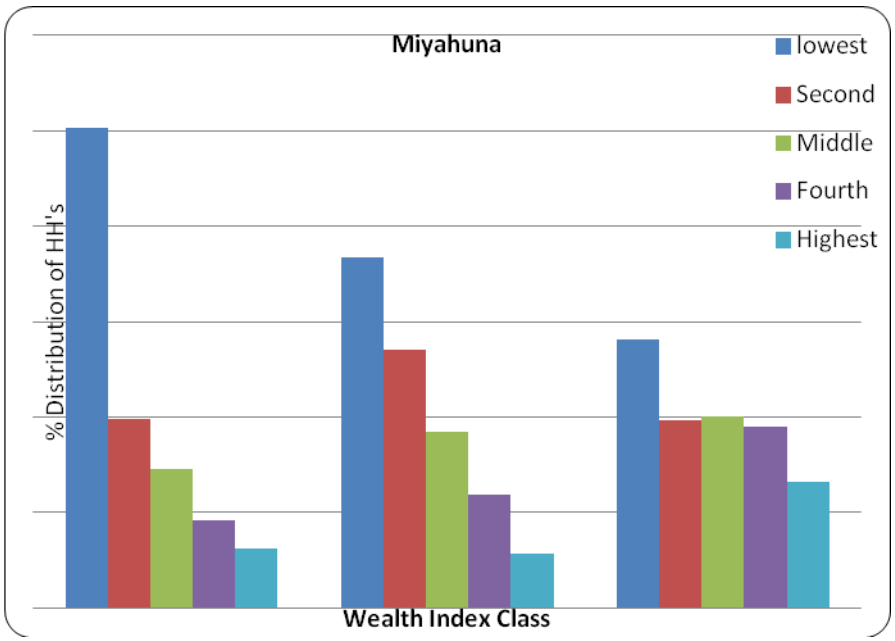
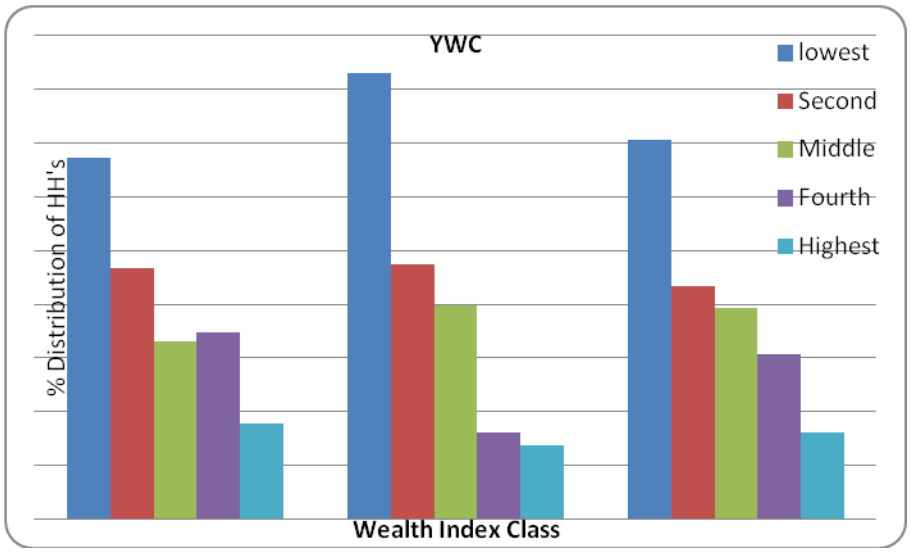


Figure 7: Percent Distribution of Subscribers by Billed Water Consumption Quintiles and Area

To further examine the above trends, the IDARA team directly compared the households' distribution among the consumption categories against the Wealth Indices for the three service areas. The results of those comparisons are shown in Figure 8 below**.** Examining the part of the Figure representing the Miyahuna service area data, one could clearly see a trend between household consumption and wealth in the sense that the ***Poor*** households group has the highest percentage (nearly 50%) of low consumption households, followed by the ***Middle*** and ***Rich*** households groups with percentages of 37% and 28%, respectively. The part of the Figure representing the AW data shows a similar trend but not as significant. Again, this could be attributed to the nature of Aqaba's climate and the continuous supply scheme. The trend in the YWC was completely different in the sense that it was the ***Middle*** wealth category that had the highest concentration of low consuming households, followed by the ***Rich*** and ***Poor*** categories that were almost identical. Furthermore, the difference between the three wealth categories was not that significant as can be seen in the Figure. One explanation for such results could be the dominantly rural nature of the northern governorates, where the various types of households lead similar lifestyles regardless of their wealth status.





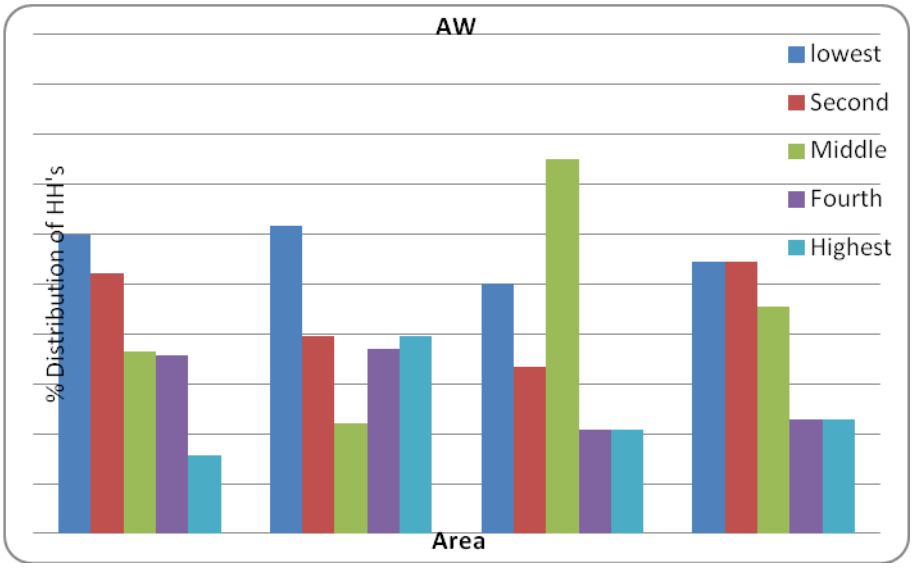
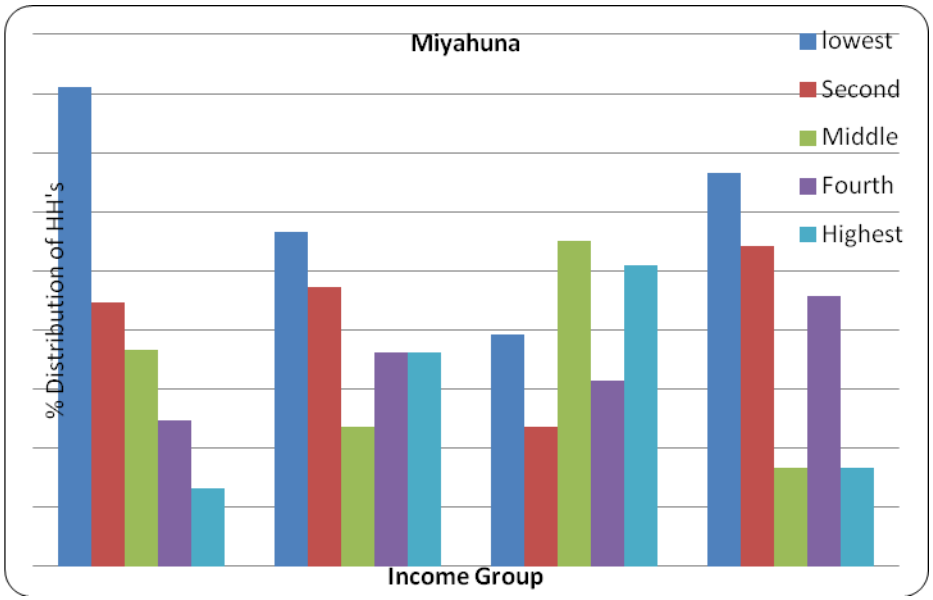
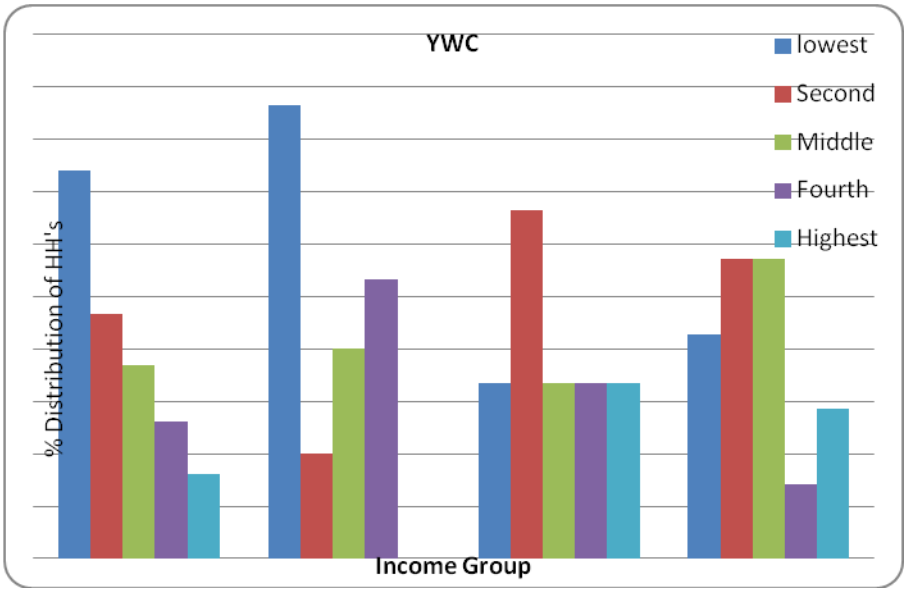


Figure 8: Percent Distribution of Subscribers by Water Consumption Group (Liter/Day/Capita) and Wealth Index



The wealth/consumption relationship was also examined through graphically comparing the distributions of households' consumption categories to the household income data. The results of those comparisons are shown in **Figure 9 below.** The trends in the Figure are consistent with the previously presented trends in that, in general, the lower the income category, the higher the concentration of households with the lowest consumption. There are some abnormalities, which in addition to the justifications given above, could be attributed to the lack of income data for some households; a shortcoming of using income data to establish household wealth status as earlier described in sub-section 3.1.1.



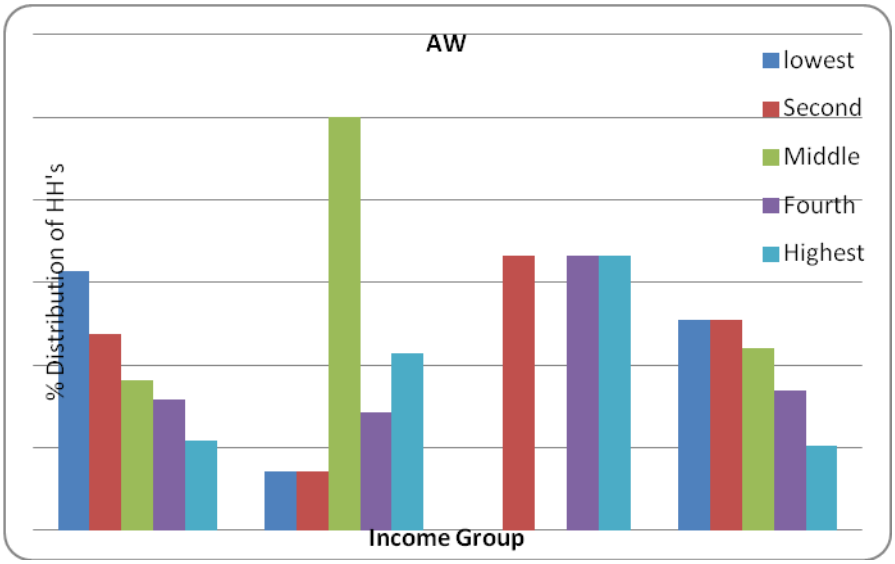


Figure 9: Distribution of Households Incomes Against Consumption Categories in the Service Areas

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Table 11:Average Income And Water Consumption For Collection Areas Of Miyahuna Service Area

MIYAHUNA			YWC			AWC		
Collectic Area	Average Income (JOD)	Water Consumption (L/C/D)	Collection Area	Average Income (JOD)	Water Consumption (L/C/D)	Collection Area	Average Income (JOD)	Water Consum ption (L/C/D)
Abdoun	1318	159.8	Jerash-Balilah	591	159.8	Third Area	875	153.3
Hashmi	680	86	Jerash-City	771	153.9	Fifth Area	1184	147.7
Marka	568	87.5	Ajloun - City	991	133.2	Mahdoud	838	145.4
Weibdet	795	123.2	Ramtha	775	98.9	Eighth Area	1321	136.4
Quweis meh	658	101.5	Irbid-Sharki	683	95.9			
Lubban	619	103	Mafraq-City	613	90.7			
S. Badran	1013	111.8	Irbid-Turkman	589	85.9			
Khalda	1160	107.5	Irbid-Janobi	867	83.9			
Suweile h	847	99.7	Mafraq-Baej	295	75.2			
Ras Al Ain	594	49.3	Kofranja	689	73.7			

To further examine all the above trends, a mathematical examination of the relationship between water consumption and the wealth index/income of the household was conducted at the collection area level for each of the three service areas. To do so, the average income levels and water consumptions of households in each collection area were calculated. The results are presented in Table 11 below. The relations between those two variables for the households in the various collection areas are graphically presented in the following **Figures.**

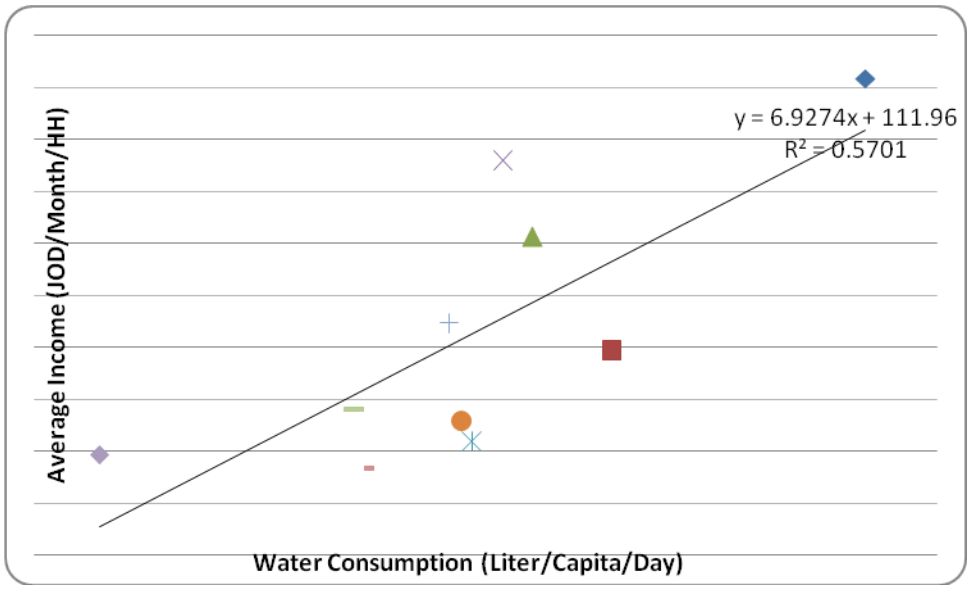


Figure 10: Average Income versus Water Consumption (l/c/d), Miyahuna Service Area

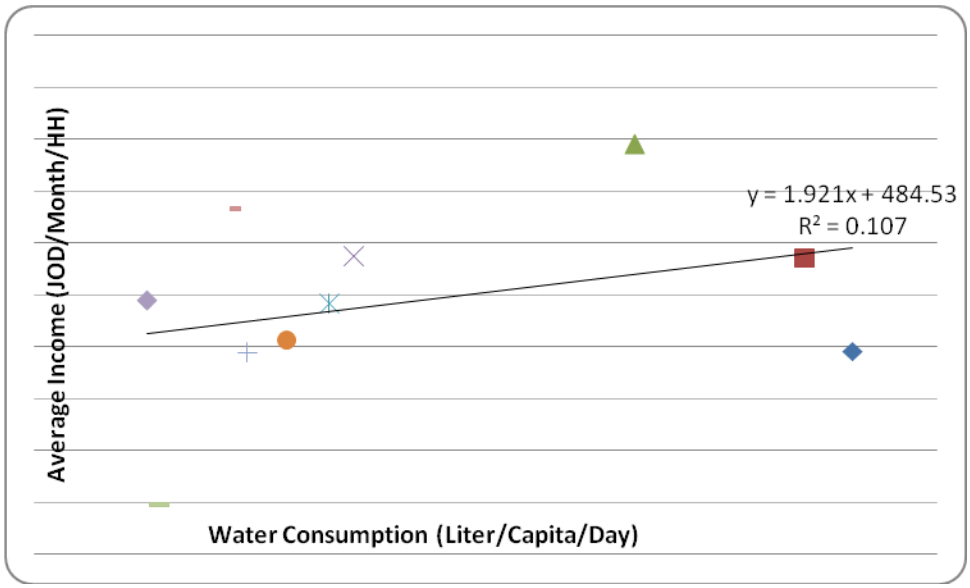


Figure 11: Average Income Versus Water Consumption (l/c/d), YWC Service Area

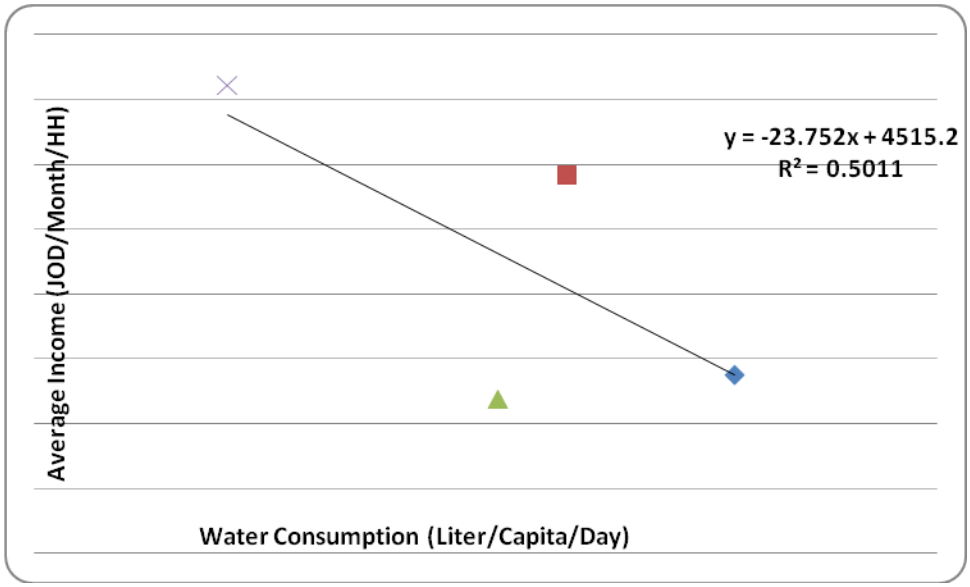


Figure 12: Average Income versus Water Consumption (l/c/d), AW Service Area

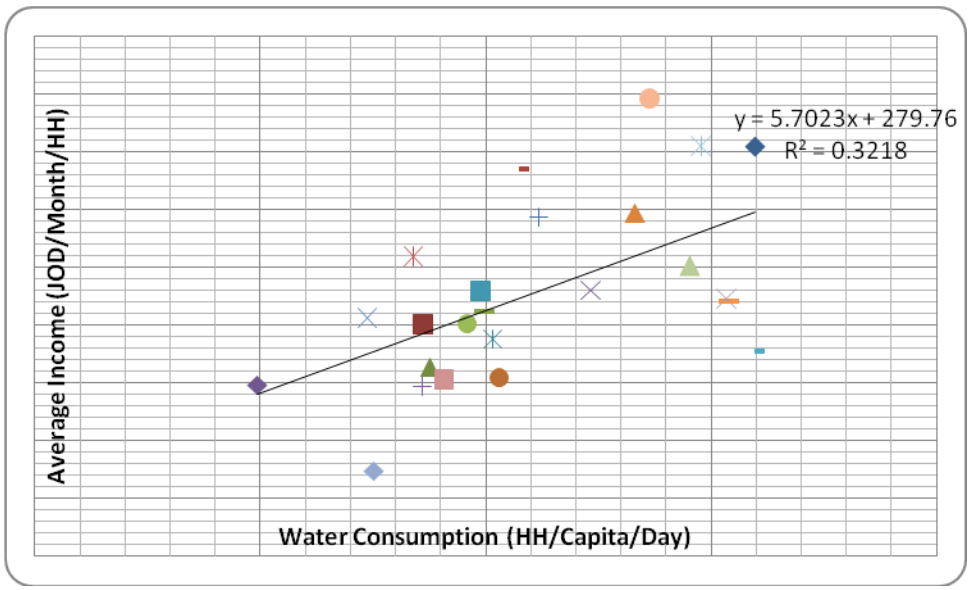


Figure 13: Average Income versus Water Consumption (l/c/d), All Service Areas

It is clear from the above Figures that the results for Miyahuna and YWC show that there is a positive relationship between water consumption expressed in (l/c/d) and the household average monthly income. The results shown in Figure 12 for the AW collections areas, however, show a negative trend. Here no conclusion can be drawn, due to the fact that the averages of four collection areas were used to establish the relationship. Another factor contributing to such finding could be the climate conditions in Aqaba which are predominantly hot. It is known that the lower income households in Aqaba rely more on fans and desert coolers as compared to higher income families that relay on air conditioning. The ineffectiveness of fans and desert coolers could be a factor that contributes to higher water consumption. This trend is worth further investigating in a larger sample as presented in the recommendations section of this report.

There are additional factors that could also affect the nature of the relationships examined above. Those include the supply period, social and economical behaviors, and storage patterns. For instance, the scheduled water supply pattern followed in Miyahuna and YWC service areas does affect some behaviors related to water use.

In conclusion, the above analyses indicate that there is a positive relationship between consumption and wealth status. While the statistical significance of the relationship is not high, such trend it is worth noting, and should be taken into consideration in the design of targeted water conservation campaigns and programs in the future.

3.2.2 Gender, Age Group, Education Level, and Household Type versus Water Use

The following group of Tables presents the analyses of gender, education level, and household type against water consumption in the three service areas. The surveyed sample was almost equally split in terms of gender with 50.2% of the interviewed respondents being males, and 49.8% of them being females. Tables 12 through 14 present the sample's general descriptive statistics related to household type, gender distribution, and the educational levels in the three service areas under study.

Table 12:Type of Housing Distribution

Household Type	Miyahuna		YWC		AW		Overall Sample	
	No.	%	No.	%	No.	%	No.	%
Apartment	1243	88.3	494	70.4	310	87.8	2047	83.1
Villa/Dar	165	11.7	208	29.6	43	12.2	416	16.9
Total	**1408**	**100**	**702**	**100**	**353**	**100**	**2463**	**100**

Table 13: Gender Distribution

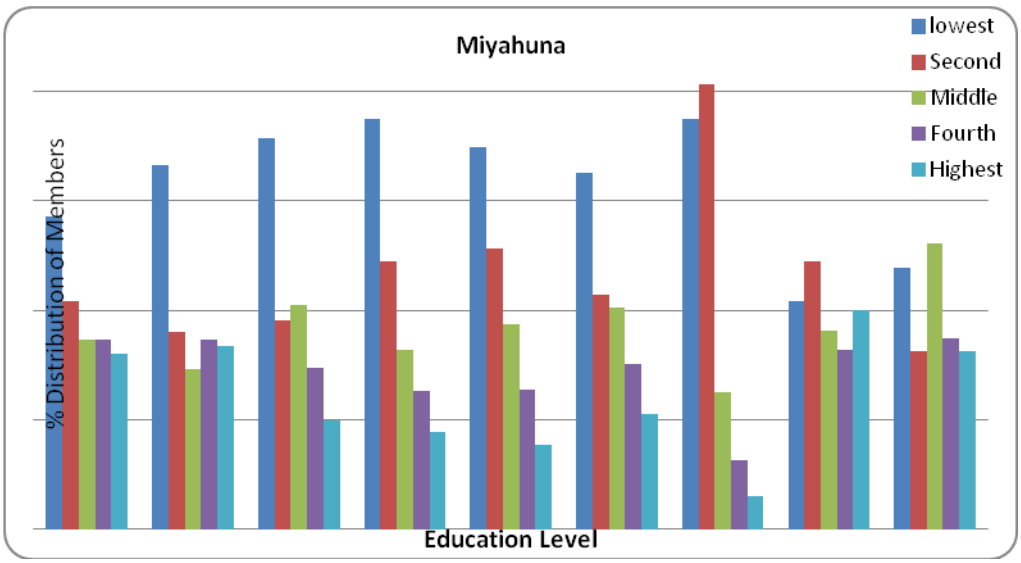
Gender of respondent	Miyahuna		YWC		AW		Overall Sample	
	No.	%	No.	%	No.	%	No.	%
Male	657	46.7	382	54.3	198	56.1	1237	50.2
Female	751	53.3	321	45.7	155	43.9	1227	49.8
Total	**1408**	**100**	**703**	**100**	**353**	**100**	**2464**	**100**

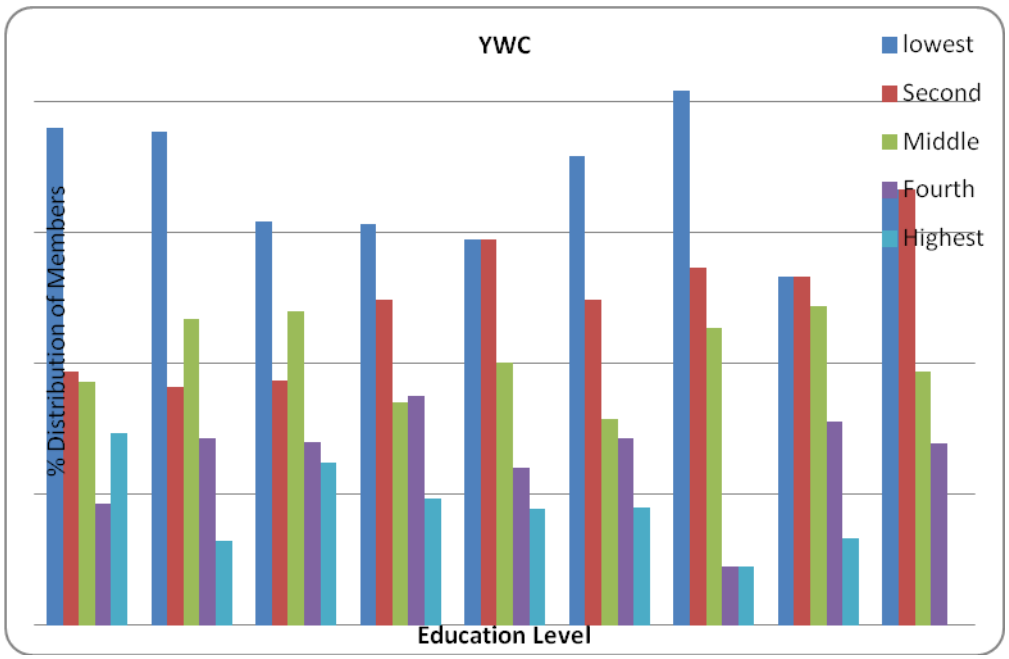
Table 14: Education Distribution

Education Level of members	Miyahuna		YWC		AW		Overall Sample	
	No.	%	No.	%	No.	%	No.	%
Illiterate	231	4.8	129	5.1	53	4.3	413	4.8
Read/write	150	3.1	77	3.0	45	3.7	272	3.2
Elementary	771	16.1	379	15.0	218	17.8	1368	16.0
Secondary	1375	28.7	823	32.5	471	38.5	2669	31.2
Diploma	478	10.0	224	8.9	150	12.3	852	10.0
Bachelor's	1554	32.4	796	31.5	272	22.2	2622	30.7
High Diploma	32	0.7	22	0.9	1	0.1	55	0.6
Master's	110	2.3	45	1.8	10	0.8	165	1.9
Ph. D.	92	1.9	36	1.4	4	0.3	132	1.5
Total	**4793**	**100**	**2531**	**100**	**1224**	**100**	**8548**	**100**

Figure 14 shows the comparison between the various levels of education in the households against water consumption. The later was presented in the same manner as in the previous section (i.e., distribution amongst the five consumption categories). The education levels in the table represent the general profile of education in a particular household. In other words, an "Illiterate" household is defined as one that has at least one illiterate person in the household regardless of the education levels of other household members. The same applies to the other education levels. As can be seen in the table, there does not seem to be any apparent relation between the two variables. It was expected that with higher education levels, household members would be more aware of the water shortage problems in Jordan, thus, demonstrate more efficient water use behaviors. The Figure below, however, does not portray this with the exception that there seems to be a decreasing proportion of

households with high consumption as the education levels improve. This same, but inversed, trend can be seen for the lower consumption category. However, both trends are very mild, and do not seem to hold after the "Higher Diploma" levels of education. Differences between the three service areas were not detectable.





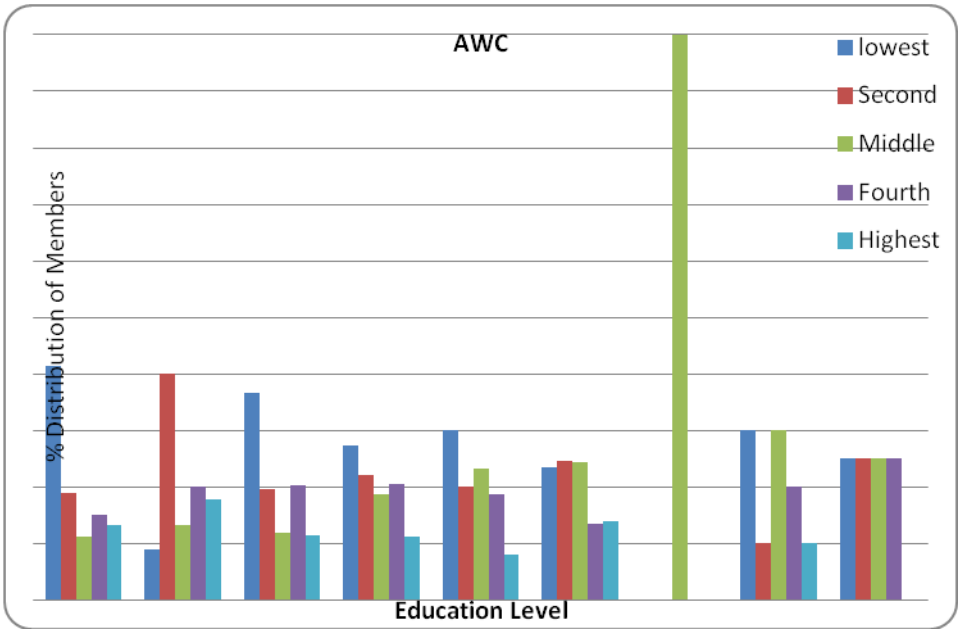
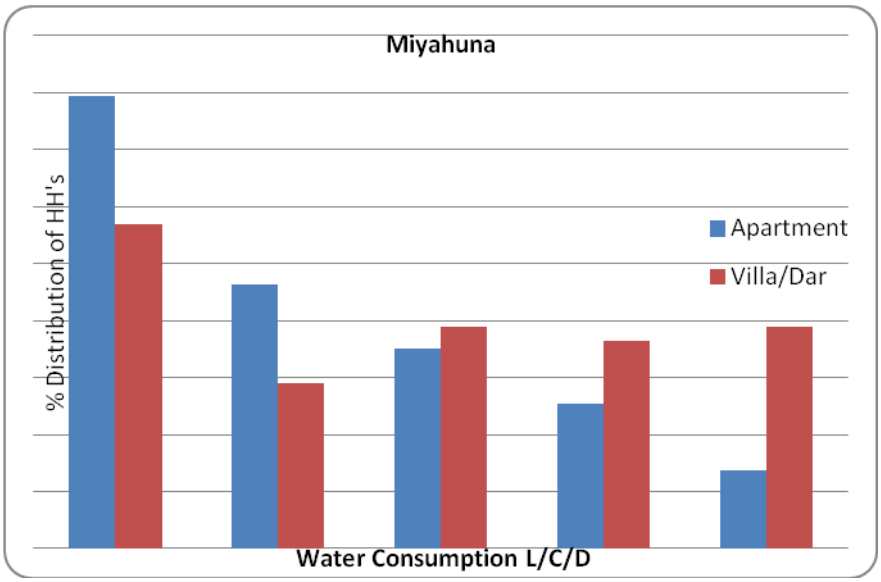


Figure 14: Distribution of Household Education Profile against Consumption Categories in the Service Areas

Figure 15 shows the comparison between the household type against water consumption. Two household types were defined; Apartment and Villa or dar. As can be seen in the Figure, the higher consumption categories are dominated by single housing units (i.e., villas or dars), while the lower consumption categories are dominated by apartments. Based on this, it is evident that villas consume more water than apartment dwellings. This is an expected result and is attributed to the fact that villas usually have larger irrigated areas compared to apartments (even ground floor ones), and larger outdoor areas (i.e., garages, pathways, etc.). As shown in the previous section, although not extremely significant, wealth is correlated with water consumption. The majority of wealthy households reside in villas as opposed to apartments. An additional significance of this finding is that while there are several commonalities between individual users of any household type, any awareness and conservation campaigns should take into consideration the specifics of the various uses in a villa/dar, which lead to higher consumption rates. The trends were similar for the Miyahuna and AW service areas, but not as clear for the YWC service area.



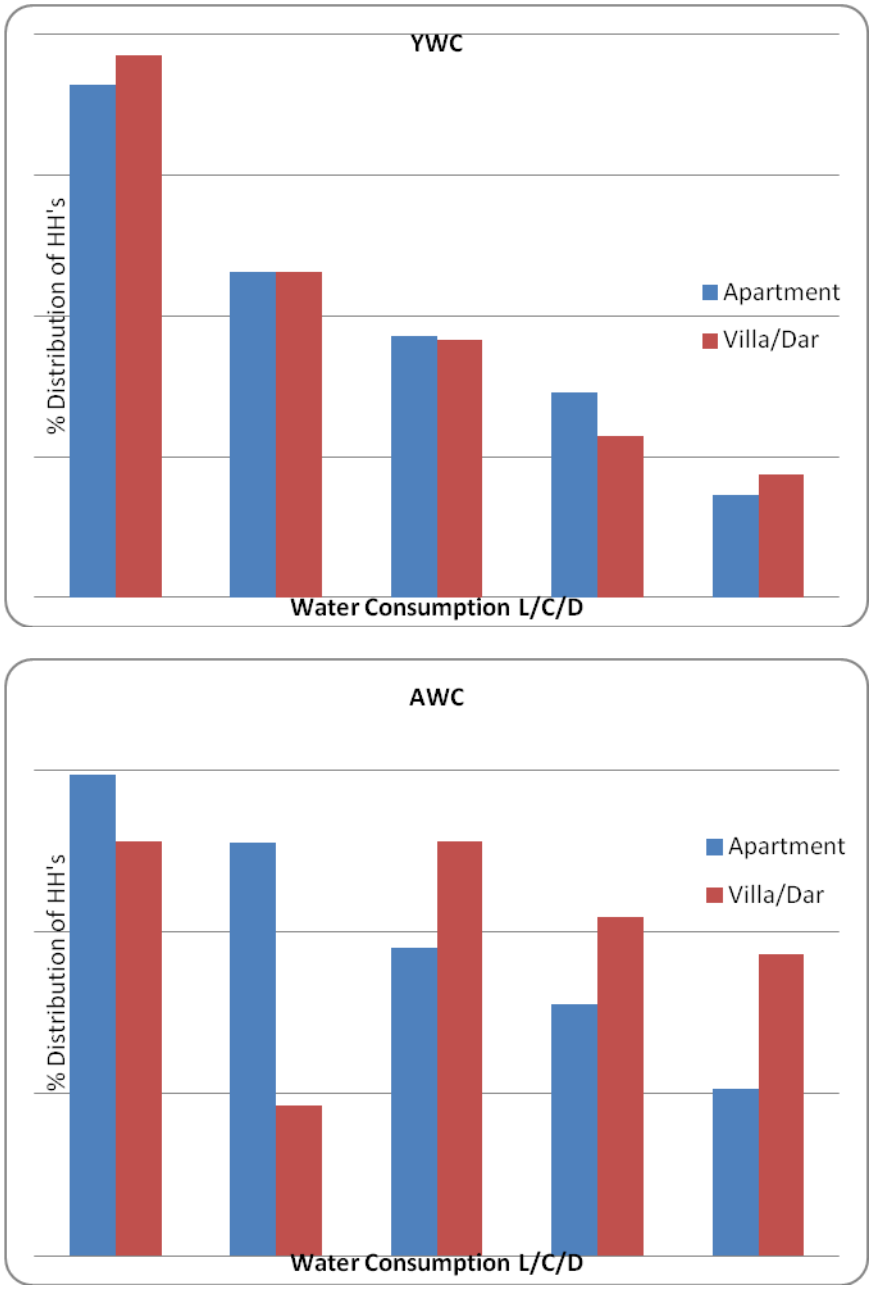


Figure 15: Distribution of Household Type Against Consumption Categories

The relation between the gender composition and household consumption is shown in Figure 16. Prior to the conduct of the analysis, it was expected that households with predominantly female household members would consume more water. This is attributed to a number of reasons such as the common belief that females take longer showers and use water for longer periods of time. The results in the Figure below show that there are no significant differences between the two genders regardless of the household water consumption category. One explanation could be that while females use water for longer periods of time (e.g., longer showers), males tend to use water more frequently, which somewhat balances out the overall consumption. It would take a more detailed study that solely focus on differences on water consumption behavior between the two genders to more conclusively decide whether there are any significant relations between gender and water consumption patterns and behaviors. The same conclusion applies to the relationship between age and water consumption, and the need to further study it in detail to establish a relationship, if any. The trend for both gender and age was generally the same in all three service areas.

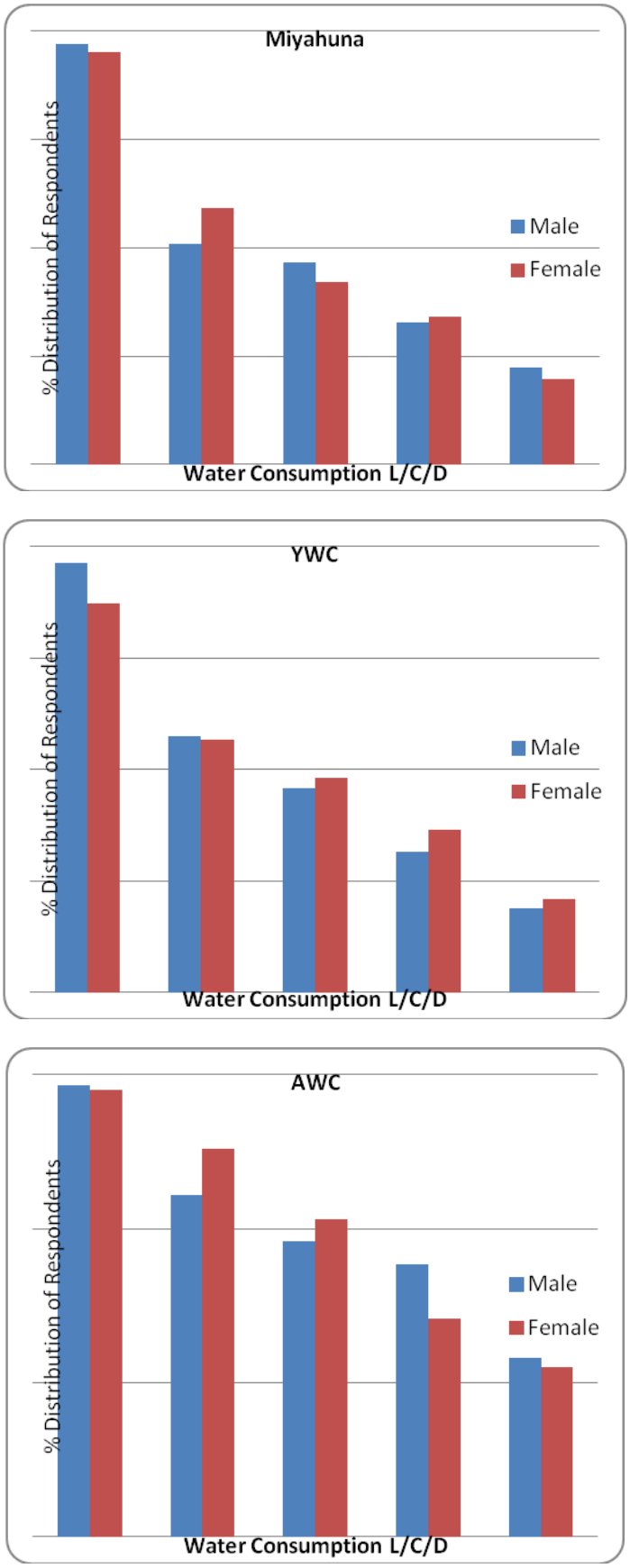


Figure 16: Distribution of Households Gender Composition Against Consumption Categories

3.2.3 *Household General Information*

Part two of the survey tool addressed information regarding the household general information, water resources and storage utilities, and indoor and outdoor water uses patterns.

Overall, the entire sample of surveyed households indicated that they are connected to the municipal water supply system in the three service areas. Data analysis revealed that nearly 84% of the surveyed sample in the Miyahuna service was satisfied with the amounts of supplied water, while nearly two thirds of YWC sample indicated such satisfaction. This is despite the intermittent water supply scheme in both service areas. On the other hand, almost 100% of the households surveyed in the AW service area stated that they receive sufficient amounts of water. This complete satisfaction in Aqaba can be attributed to the continuous water supply scheme in the AW service area.

As a result of the intermittent supply, most surveyed households in the Miyahuna and YWC service areas tend to increase their storage capacity. This is achieved through using roof and/or ground tanks. Furthermore, it was found that nearly 23% of the total sample in the YWC area, and 4.2% of those surveyed in the Miyahuna area use water tankers as a second source of water supply. However, this is considered a minor portion and gives a general indication of the sufficiency of the supplied amounts of water supply in those service areas. As will be seen in following sections, the higher need in the YWC area could be attributed to the relatively higher outdoor consumption.

In terms of meter accuracy, it was found that almost the entire sample of the surveyed households in all three service areas are satisfied with the accuracy of their water meter, which reflects on the accuracy of the actual water bill consumption. The proportions of households with malfunctioning meters were as follows:

- MIYAHUNA 1376 (97.7%)
- YWC 684 (96.9%)
- AWC 351 (99.4%)

With regards to the households' sources of drinking water, Figure 17 below indicates that nearly 80% of the surveyed sample in the Miyahuna service area uses the filtered water (both bottled and treated RO water) as the main source for drinking. More than two thirds of the sample in the YWC service area use filtered water for drinking. Considering the lower level of income in some of the collection areas in the Northern Governorates, around 32% of the sample surveyed use tap water as a main source for drinking. Nearly 90% of the sample surveyed in the AW service area indicated that they use tap water as the main source for drinking. This result is attributed to the high quality of the water supplied to the Governorate from the Disi Aquifer, in the Southern part of the country.

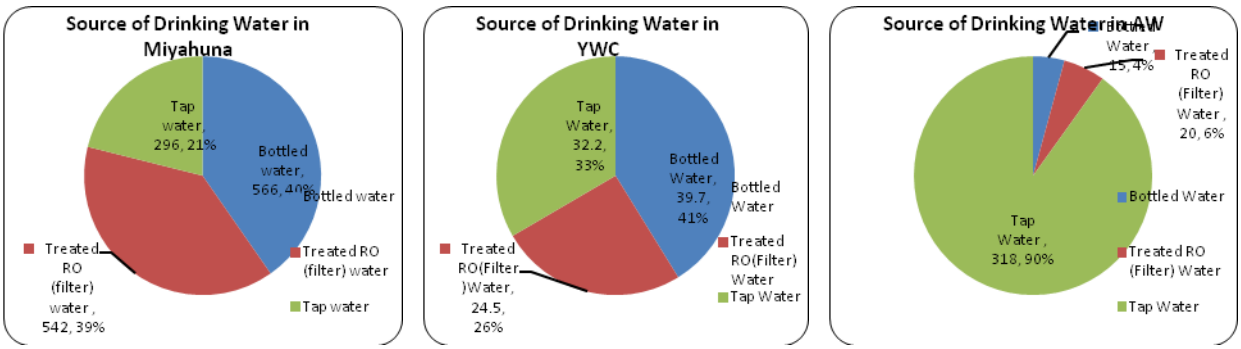


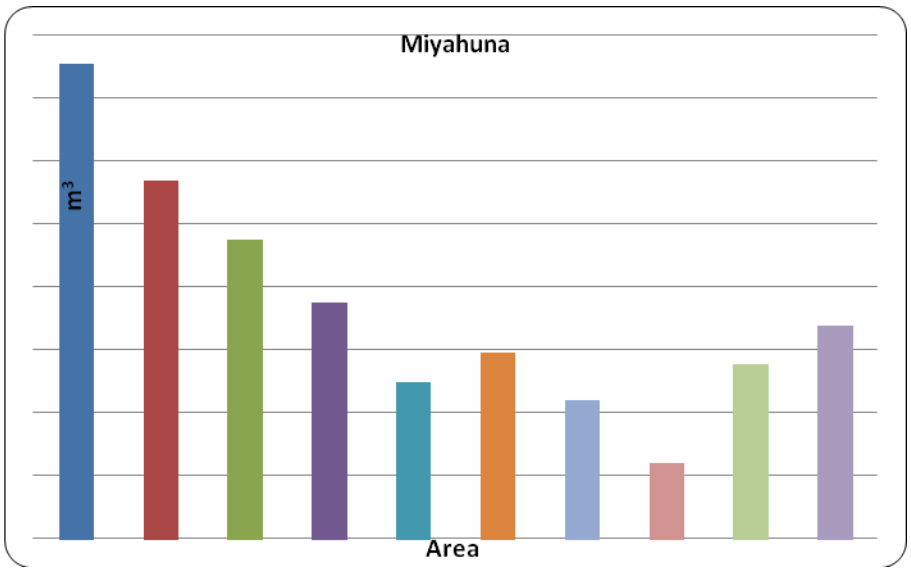
Figure 17: Source of Drinking Water in the Three Service Areas

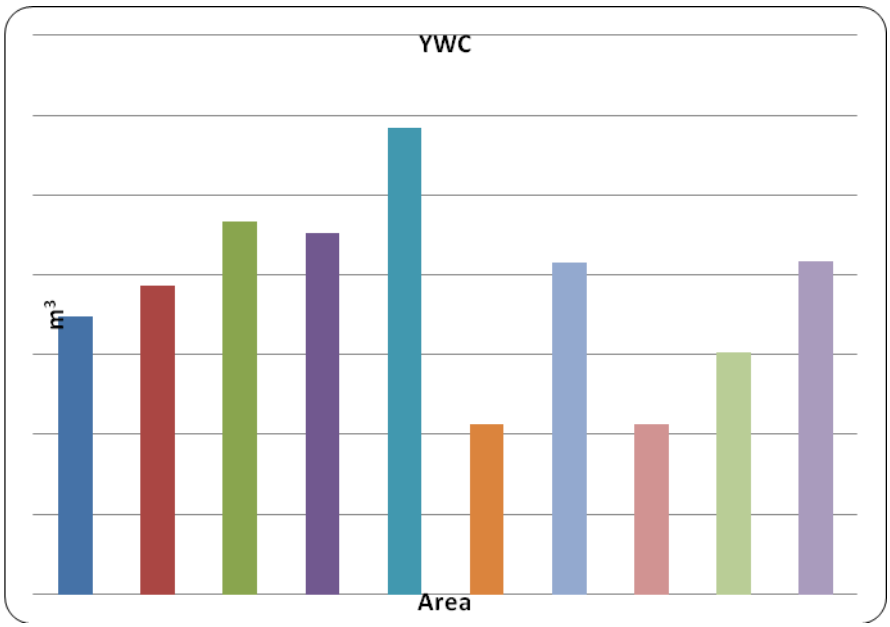
3.2.3.1 Water Storage and Home Appliances

The proportions of houses that indicated that they have a well were as follows:

Area	Has water well
• MIYAHUNA	19.60%
• YWC	30.80%
• AWC	0.30%

Figure 18 below presents the average tank capacities used in the households as the main means of water storage. As can be seen in the Figure, the average storage tank capacity used in the Miyahuna service areas was found to be 8m^3/HH (the same volume was reported for the YWC service area). This is split between both roof top tanks and ground tanks. In the Figure, one could see that the higher storage capacities are concentrated in the collection areas with the higher levels of income. This supports the findings presented earlier on the relation between water consumption and the wealth levels of households. The storage capacity of tanks in the AW service area (mainly roof top tanks) was found to be much less with an average capacity of 2m^3/HH. Such difference is attributed to the continuous water supply scheme in the AW service area.





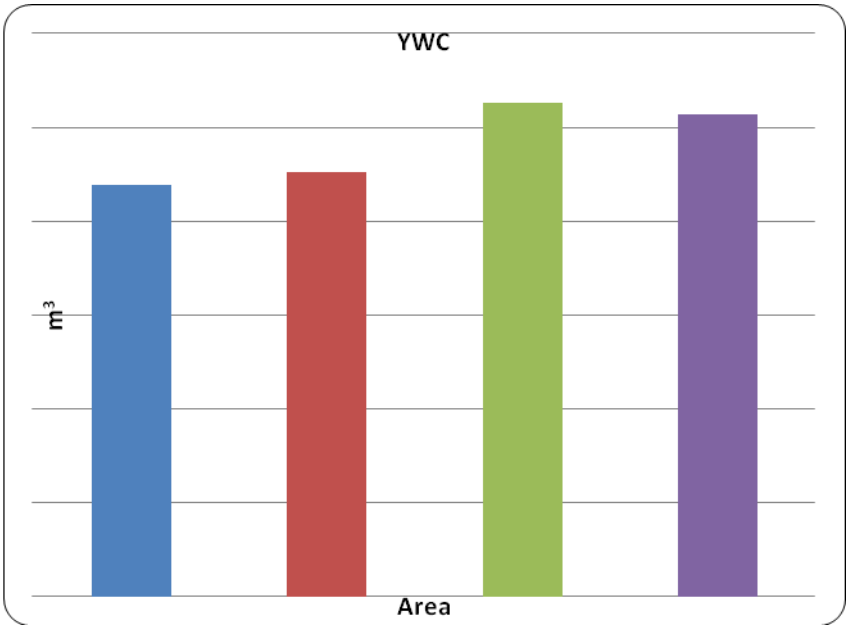


Figure 18: Storage Capacity Distribution

The analysis also revealed that the majority of respondents surveyed in the Miyahuna service area stated that their roof tanks are considered to be in good condition. Only 3% of the tanks were reported to have leaks. Of those, 4% of them were reported to have problems with the tank floaters. While a small percentage, faulty tank floaters could result in excessive leaks and waste. The fact that some households, although a minority, admitted to having tank leaks, and have not remedied those is an alarming one. Surprisingly, the entire sample of the respondents in the AW service area stated that no water leaks appear in their roof tanks.

As mentioned in an earlier section, many socio-economic indicators were used to calculate the Wealth Index. One of those indicators was the ownership of appliances. Table 15 below presents the percentages of appliances in the households in the three service areas. Some of the statistics reported below are useful in justifying some of the inferences made in the previous sections.

Table 15: Ratios for Appliances in Households

Utility	Dishwasher	Washing Machine		Air Conditioner		
		Automatic	Semi Automatic	Split	Desert (Water type)	Central
Miyhuna	4.5	52.0	43.0	23.7	0.1	0.5
AWC	0.3	41.0	59.0	60.6	37.1	0.0
YWC	1.1	41.0	54.0	14.3	0.7	0.0

As can be seen from the table above, nearly 43% of surveyed households in the Miyahuna service area depend on semi automatic washers. This is despite their inefficiency in terms of water and energy savings. Furthermore, a high percentage of the sample surveyed in the AW service area (98%) use air conditioners. Of those, 40% of the households use the Desert (water type) air conditioner, which consumes a great amount of water to operate. This is mainly used by the lower income families, which supports the justification given earlier on the trend between wealth and water consumption in the AW service area.

3.2.4 Water Consumption Calculations

As previously noted, the survey tool collected information related to water use behavior in a household. This included the daily frequencies of water fixture use and the durations of such use. For example, the numbers of times a household member uses the toilet, and the number of times a household member uses a faucet and the duration of such use. It should be emphasized that such data were based on the respondents' perceptions on their frequency of use of such water outlets.

They were not based on actual observations. Furthermore, the survey team collected data related to the water flow rates in such water outlets. This included the capacity of the toilet tanks, the flow rates in the various faucets in a household, etc. In addition, similar data were collected related to outdoor water use such as the frequency and means of irrigation, the frequency and means of car washing, and so on.

Those data were then used to calculate the water consumption at the household level using the formulas that had been previously developed by the IDARA Project as a result of the End Use Analysis. The purpose was to examine the reliability of the formulas, and identify the proper factors for calibrating those formulas. The adjustment factors were mainly intended to account for the personal behaviors in the use of water fixtures (e.g., the degree to which a user open the tap, the degree to which a person opens the shower tap, etc.), and to account for specific uses of water fixtures such as ablution versus the other regular use of a water fixture. To do so, the IDARA Team calculated the average household water consumption on a collection area basis for each of the three service areas. Those calculated consumptions were then compared to the actual average billed consumption rates that had been obtained from the three water utilities. The results of those comparisons are presented in Tables 16 through 18.

As can be seen in the Tables, the billed water consumptions are close to the calculated water consumptions in almost all of collection areas of Miyahuna service area. At the collection area level, those differences range from as little as 5%, to as high as 15%. The collection area with the highest difference was Al Lubban. This could be mainly attributed to the dense and low income status of that area.

Table 16: Water Calculations in Amman

Collection Area	No. of HHs	Size of HH	Consumption				Difference (%)[2]
			liter/day/area		liter/capita/day*		
			Billed	Calculated	Billed	Calculated	
Abdoun	136	637	101,777	108,936.22	159.8	171.02	7.03%
Khalda	232	1,136	122,141	128,339.73	107.5	112.98	5.08%
Shafa-	176	860	96,154	88,463.28	111.8	102.87	8.00%
Sweileh	101	515	51,335	44,998.51	99.7	87.38	12.34%
Al-Waibdeh	56	212	26,125	27,532.06	123.2	129.87	5.39%
Hashimi	242	1,289	110,792	101,798.61	86	78.98	8.12%
North-	271	1,351	118,186	125,136.02	87.5	92.63	5.88%
Ras-Al-Ain	8	53	2,613	2,358.84	49.3	44.51	9.73%
Quwaismeh	83	486	49,310	52,119.93	101.5	107.25	5.70%
Al-Lubban	103	600	61,814	52,538.53	103	87.57	15.01%
Total	1,408	7,139	740,247	732,221.70			

[2] **Absolute Value of the difference**

Table 17: Water Calculations in the Northern Governorates

Collection Area	No. of HHs	Size of HH	Consumption				Difference (%)
			liter/day/area		liter/capita/day*		
			Billed	Calculated	Billed	Calculated	
Ajloun-City	28	153	20,373	18,571.78	133.2	121.39	8.84%
Ajloun-	45	286	21,078	19,046.32	73.7	66.6	9.64%
Al-Janoubi	45	200	16,784	19,889.17	83.9	99.45	18.50%
Eastern	168	839	80,448	97,880.77	95.9	116.67	21.67%
Irbid-	56	325	27,918	24,102.07	85.9	74.17	13.67%
Jerash-	11	74	11,822	3,480.07	159.8	47.03	70.56%
Jerash-City	111	639	98,369	63,562.50	153.9	99.48	35.38%
Mafraq-Ba'aj	11	82	6,166	2,060.84	75.2	25.14	66.58%
Mafraq-City	148	897	81,390	118,397.20	90.7	132	45.47%
Ramtha	82	506	50,022	43,528.82	98.9	86.03	12.98%
Total	705	4,001	414,370	410,519.56			

Table 18: Water Calculations in Aaqba

Collection Area	No. of HHs	Size of HH	Consumption				Difference (%)
			liter/day/area		liter/capita/day*		
			Billed	Calculated	Billed	Calculated	
Mahdoud Area	180	1,016	147,831	135,842.39	145.5	133.71	8.11%
Third Area	81	490	75,110	68,985.70	153.3	140.79	8.15%
Fifth Area	48	276	40,758	43,283.49	147.7	156.83	6.20%
Eighth Area	44	254	34,646	36,737.50	136.4	144.64	6.04%
Total	353	2,036	298,345	284,849.09			

The main shortcoming of the formulas used to calculate the consumption is the fact that the used frequencies and durations of water use were completely based on the respondents' perceptions. Furthermore, with the lack of information on the specifics of the households that were used to develop those formulas, it is difficult to make an opinion on the effectiveness of IDARA's formulas. At the service area level, the overall difference between the calculated and billed consumptions very low. Such difference would be acceptable for estimation purposes had the variance of the differences been less severe at the collection area level.

In the YWC services area, the trend was similar. The individual differences at the collection area level were higher than that in the Miyahuna service area. Given that outdoor water use in YWC constitutes a larger percentage (10%) of overall water use compared to Miyahuna's (4%) and AWC's (3%), this increment in difference is quite expected. Outdoor water use calculation is more prone to respondents' accuracy, estimate of planted area and irrigation patterns. Thus; a detailed End Use Analysis study would have to be conducted in the Northern Governorates in order to arrive at formulas that give results with a more reasonable level of accuracy. The results for the AW collection area were similar in terms of the differences, with the overall difference in consumption being similar to that of Miyahuna.

Although the calculated water consumptions using the formulas were only relatively accurate, the IDARA Team used the water consumption behavioral data collected during the survey to estimate the proportional water consumption for the various uses within a household. This was done as a portion of the calculated consumption since the individual uses were also calculated. This guaranteed consistency in the calculations of the proportions.

Tables 19 through 21 below present the detailed breakdown for the values and percentages of the indoor and outdoor water uses in the three service areas. Generally, the indoor water consumption rates were much higher than outdoor consumption in the three service areas. Indoor water use accounted for the majority of the total household use in the Miyahuna, YWC, and AW service areas, respectively. Within the household, the toilets and the kitchen faucets accounted for the highest consumption. Bidets, toilet faucets, showers, and other uses accounted for the remainder of the consumption. One observation worthy of noting is that the results for YWC indicated that the indoor water use, while generally higher than the outdoor use, was less than that in the Miyahuna and the AW service areas. This is mainly attributed to the high percentages of the planted areas and gardens around the households in those areas as will be discussed in more detail in a following sub-section.

Examining the proportional consumptions of the various indoor uses within households at the collection area level, one could see that the ratios are generally consistent and with minimal variance. This applies to all three service areas.

Table 19: Percentages of Indoor Water Use per Type and Outdoor Water Use for Households in the Miyahuna Service Area

Area	Total Use (liter/day)	Outdoor Use		Indoor Water Use		Toilets		Faucets		Showers		Other		Leaks		Clothes Washing	
		L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%
Abdoon	108,936.22	7159.215578	6.57%	101,777.00	93.43%	17214.51	15.80%	56100.07	51.50%	9555	8.77%	554.19	0.51%	7971.975508	7.32%	10381.254	9.53%
Khalda	128,339.73	6198.72422	4.83%	122,141.01	95.17%	25065.42	19.53%	61713.52	48.09%	12496	9.74%	840.64	0.66%	9567.04423	7.45%	12458.382	9.71%
S-Badran	88,463.28	5770.833674	6.52%	82,692.44	93.48%	19295.91	21.81%	37554.18	42.45%	10320	11.67%	610.6	0.69%	6477.122595	7.32%	8434.62888	9.53%
Sweleh	44,998.51	1363.758296	3.03%	43,634.75	96.97%	10301.47	22.89%	20510.42	45.58%	4635	10.30%	319.3	0.71%	3417.816975	7.60%	4450.7445	9.89%
Weibdeh	27,532.06	1145.81	4.16%	26,386.25	95.84%	5863.82	21.30%	11969.45	43.47%	3604	13.09%	190.8	0.69%	2066.778729	7.51%	2691.3975	9.78%
N. Hashmi	101,798.61	977.8825974	0.96%	100,820.73	99.04%	28070.24	27.57%	39733.31	39.03%	14179	13.93%	657.39	0.65%	7897.072134	7.76%	10283.71344	10.10%
N-Marka	125,136.02	1040.716704	0.83%	124,095.30	99.17%	23142.26	18.49%	64349.17	51.42%	13510	10.80%	716.03	0.57%	9720.120384	7.77%	12657.7206	10.12%
Ras-El-Ein	2,358.84	7.14	0.30%	2,351.70	99.70%	826.81	35.05%	381.07	16.15%	689	29.21%	30.74	1.30%	184.2036491	7.81%	239.8733999	10.17%
Qwesmeh	52,119.93	344.4311008	0.66%	51,775.50	99.34%	10090.5	19.36%	29150.55	55.93%	2916	5.59%	281.88	0.54%	4055.464574	7.78%	5281.101	10.13%
Lubban	52,538.53	1851.041065	3.52%	50,687.49	96.48%	11267.07	21.45%	25120.05	47.81%	4800	9.14%	360	0.69%	3970.242286	7.56%	5170.12296	9.84%
Total	***732,221.70***	***25859.5532***	***3.53%***	***706362.1493***	***96.47%***	***151138***	***20.64%***	***346581.8***	***47.33%***	***76704***	***10.48%***	***4561.57***	***0.62%***	***55327.841***	***7.56%***	***72048.94***	***9.84%***

Table 20: Percentages of Indoor Water Use per Type and Outdoor Water Use for Households in the YWC Service Area

Area	Total Use (liter/day)	Outdoor Use		Indoor Water Use		Toilets		Faucets		Showers		Other		Leaks		Clothes Washing	
		L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%
Ajloun-city	18,571.78	2202.823712	11.86%	16,368.96	88.14%	1,939.14	10.44%	10,246.39	55.17%	1,071.00	5.77%	160.65	0.87%	2218.11	11.94%	733.6639548	3.95%
Kofranja	19,046.32	3717.140356	19.52%	15,329.18	80.48%	926.08	4.86%	9,307.92	48.87%	2,002.00	10.51%	328.9	1.73%	1957.65	10.28%	806.6305999	4.24%
Irbid-Janobi	19,889.17	2364.421865	11.89%	17,524.75	88.11%	4,369.37	21.97%	7,143.18	35.91%	2,600.00	13.07%	252	1.27%	2525.77	12.70%	634.4352	3.19%
Irbid-Sharki	97,880.77	11439.91735	11.69%	86,440.85	88.31%	22,515.06	23.00%	36,919.31	37.72%	10,068.00	10.29%	1,350.79	1.38%	12745.57	13.02%	2842.122748	2.90%
Turkman	24,102.07	1555.518051	6.45%	22,546.55	93.55%	6,166.73	25.59%	9,496.30	39.40%	2,275.00	9.44%	542.75	2.25%	3026.94	12.56%	1038.834906	4.31%
Balilah	3,480.07	7.429917157	0.21%	3,472.64	99.79%	1,406.00	40.40%	1,128.15	32.42%	296	8.51%	16.28	0.47%	392.47	11.28%	233.7444447	6.72%
Jerash-city	63,562.50	3771.3042	5.93%	59,791.20	94.07%	21,246.75	33.43%	21,500.23	33.83%	5,112.00	8.04%	1,150.20	1.81%	7518.03	11.83%	3263.991149	5.14%
Mafraq-Baej	2,060.84	61.75190217	3.00%	1,999.09	97.00%	908.8	44.10%	373.92	18.14%	246	11.94%	109.88	5.33%	128.06	6.21%	232.428	11.28%
Mafraq-city	118,397.20	13801.62218	11.66%	104,595.58	88.34%	19,740.56	16.67%	57,866.70	48.88%	7,176.00	6.06%	950.82	0.80%	15675.92	13.24%	3185.58064	2.69%
Ramtha	43,528.82	1345.13745	3.09%	42,183.68	96.91%	11,496.73	26.41%	18,849.90	43.30%	3,542.00	8.14%	688.16	1.58%	5792.36	13.31%	1814.527528	4.17%
Total	***410,519.56***	***40,267.07***	***9.81%***	***370,252.49***	***90.19%***	***90,715.22***	***22.10%***	***172,832.00***	***42.10%***	***34,388.00***	***8.38%***	***5,550.43***	***1.35%***	***51,980.88***	***12.66%***	***14,785.96***	***3.60%***

Table 21: Percentages of Indoor Water Use per Type and Outdoor Water Use for Households in the AW Service Area

Area	Total Use (liter/day)	Outdoor Use		Indoor Water Use		Toilets		Faucets		Showers		Other		Leaks		Clothes Washing	
		L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%	L/Day	%
Almahdoud	135,842.39	2794.48503	2.06%	133,047.90	97.94%	29,529.85	21.74%	61,217.49	45.07%	18,288.00	13.46%	20.32	0.01%	10953.55006	8.06%	13038.6942	9.60%
Third Area	68,985.70	1386.699803	2.01%	67,599.00	97.99%	16,783.81	24.33%	30,785.21	44.63%	7,840.00	11.36%	0	0.00%	5565.281607	8.07%	6624.702	9.60%
Fifth Area	43,283.49	2525.489991	5.83%	40,758.00	94.17%	8,364.19	19.32%	20,581.09	47.55%	4,416.00	10.20%	46.92	0.11%	3355.519279	7.75%	3994.284	9.23%
Eighth Area	36,737.50	359.2	0.98%	36,378.30	99.02%	8,164.93	22.23%	18,318.33	49.86%	3,302.00	8.99%	33.02	0.09%	2994.947911	8.15%	3565.0734	9.70%
Total	***284,849.09***	***7,065.87***	***2.48%***	***277,783.21***	***97.52%***	***62,842.78***	***22.06%***	***130,902.12***	***45.95%***	***33,846.00***	***11.88%***	***100.26***	***0.04%***	***22,869.30***	***8.03%***	***27,222.75***	***9.56%***

3.2.4.1 *Outdoor Water Consumption Calculations*

The overall proportions of outdoor water use were 3.5%, 10% and 2.5% for the Miyahuna, YWC and AW service areas, respectively. As shown in Figure 19 below, the YWC service area showed the highest proportion of outdoor water use compared to the other service areas. The highest proportion in the Miyahuna service area was nearly 7% in Abdoon, while in Aqaba it was 5% of the total consumption. The reason for the high outdoor consumption proportions in some YWC collection areas is attributed to the fact that most households in those areas have large irrigated areas, coupled with the rural nature of most collection areas.

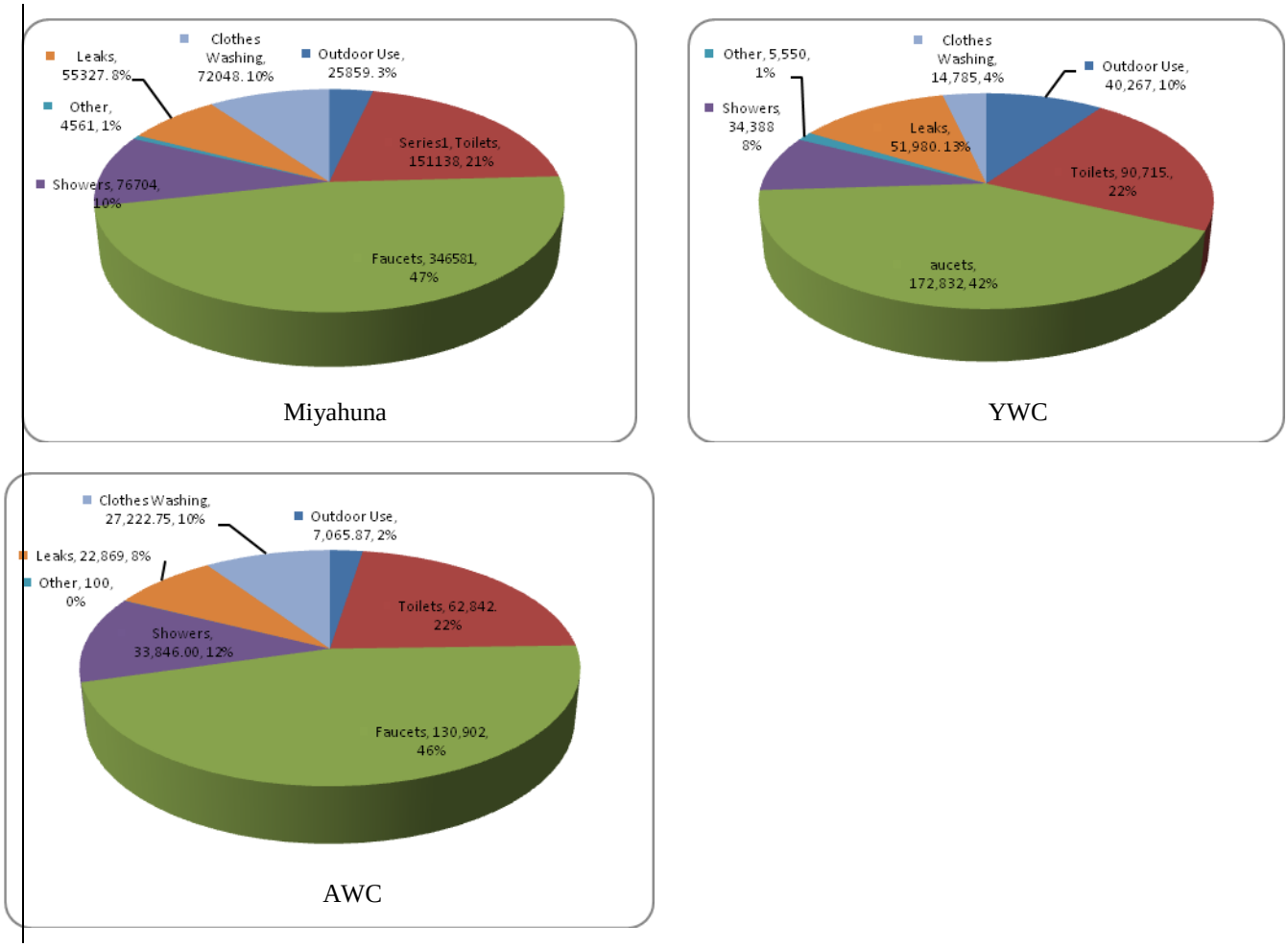


Figure 19: Percentages of Outdoor Water Use in the three Collection Areas

Table 22 summarizes the proportions of households in the three service areas with irrigated gardens. As can bee seen, between 20% to 30% of surveyed households have irrigated gardens. However, only minimal proportions of those households have areas that are planted with grass.

Table 22: Statistics on Gardens in the Service Areas and the Proportions of Households with Grass

Service Area	Has Garden	Does not have a Garden	Has Grass	Does not have Grass
MIYAHUNA	385 27.30%	1023 72.70%	23 1.60%	362 25.70%
YWC	230	476	4	226

	32.60%	67.40%	0.60%	32.00%
AWC	80	273	2	78
	22.70%	77.30%	0.60%	22.10%

Among the surveyed households, nearly 73%, 65%, and in the Miyahuna, YWC, and AW service areas respectively indicated that they own at least one car. Nearly 30% of respondents in all three areas indicated that they wash their cars at home. The majority of the households indicated that they wash their car using a bucket instead of a hose, especially in the Miyahuna and YWC service areas. Ratios of hose to bucket washed cars were, 29%, 56.5%, and 25.5%, in the Miyahuna, AW and YWC service areas, respectively. Obviously, the high percentage in the AW service area is attributed to the continuous water supply as well as the easiness of washing the car using a hose. The equivalent ratios related to yard and sidewalk cleaning methods were as follows:

Table 23: Yard and sidewalk cleaning methods

Area	Bucket	Hose	No side walk or front yard	Do not wash them	Missing
MIYAHUNA	109	206	399	688	6
	7.70%	14.60%	28.30%	48.90%	0.50%
YWC	73	115	218	296	4
	10.30%	16.30%	41.90%	30.90%	0.60%
AWC	9	68	147	129	0
	2.50%	19.30%	41.60%	36.50%	0.00%

In terms of swimming pools, nearly 1.2% of the surveyed sample indicated that they own a swimming pool. This was only reported in the Miyahuna service area. The overall percentage of water use of these swimming pools was around 3.15%, and it represents the amount of water used to fill the pool. Finally, it should be mentioned that nearly 50% of the entire sample in the three service areas were aware of WSD's and their benefits in improving water use efficiency.

4.0 DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

4.1 Brief Discussion of the Results

This section of the report provides a discussion of the key results provided in the previous section. The discussion focuses on three key areas related to household water use. Those are (1) household water consumption rates, consumption trends and their relationship with socio-economic and demographic indicators, (2) indoor water use behaviors and patterns, and (3) outdoor water use and patterns.

Household General Water Consumption and Effect of Socioeconomics

It is safe to assume that most households solely rely on water supplied by the water utilities as only 0.05% of the sample in Amman, and 1% of sample in the northern governorates indicated that they use water tankers as a second source of water supply. That said, there is room for improving water efficiency in Jordanian homes. This, however, has to be targeted and should focus on areas where there is excessive consumption.

Establishing a consumption threshold would help identify geographic areas where efforts should be concentrated in promoting water use efficiency and demand management concepts at the household level. Such focused and targeted approach can help achieve faster results following the "***low hanging fruit***" concept to identify where the biggest potential for savings is. One interesting note to make on this is that the areas with the highest exceedance of consumption were characterized by higher flow rates that by far exceed the recommendations of the Jordanian code as revealed by the results of the conducted water audits.

Another interesting comparison to make is that of the water supply schemes to some of the daily water consumption rates. For instance, the North Hashimi collection area (a lower income area) is supplied on a continuous basis, while Abdoun (a higher income area) is supplied intermittently. Yet, the daily consumption in North Hashimi was 86 liters, while that of Abdoun's was 159 liters. This is indicative of the existence of a relation between wealth and water consumption. Despite the intermittent supply, wealthier households tend to consume more water than poorer houses on a continuous supply basis. This was confirmed by several of the results presented in the previous section. Looking at the sorted consumption and wealth data for Amman, one could clearly see that as the proportion of poor household increases, the consumption decreases.

Table 24: Proportion of Households' Wealth Classification

Collection Area	Proportion of Households' Wealth Classification (%)			Billed Consumption l/c/d
	Poor	Middle	Rich	
Abdoon	8.1	19.9	72.1	159.8
Khalda	15.9	25	59.1	107.5
Shafa-Badran	9.1	34.7	56.3	111.8
Weibdeh	37.5	39.3	23.2	123.2
Sweleh-East	44.6	33.7	21.8	99.7
North-Hashmi	41.3	38.4	20.2	86
Qwesmeh	39.8	44.6	15.7	101.5
Lubban	40.8	43.7	15.5	103
North-Marka	58.3	33.6	8.1	87.5
Ras-El-Ein	75	25	0	49.3

Generally, a higher wealth index means larger households, thus more indoor and outdoor use. There are, however, other factors that affect such relationship that make it difficult to establish an empirical relationship. For example a wealthier household means a higher ability to store more water (a household

in Abdoon has a 15.1 m^3 mean volume of storage, while Ras el-Ein had only 2.38 m^3). Comparing Weibdeh to North Hashimi, one can notice that the wealth structure is comparable. Yet, the billed water consumption was higher in Weibdeh by 44%. The survey results indicated that the planted area per HH in Weibdeh was higher than that in North Hashimi by 70%. Analysis for outdoor use confirm this remark where outdoor use in Weibdeh was 18.3% out of total calculated water consumption, while outdoor water use in North Hashimi was only 5.2%. So, there is a tendency for consumption to increase with wealth, but given the complexity and inter-dependence of a variety of factors, it is hard to establish a clear cut relationship to describe such trend. The results for YWC and AWC were not as conclusive as those for Amman.

Other factors such as gender, age, and education were not found to have any apparent impact on water consumption rates. House type was found to have an effect with houses consuming more water than apartments. This can be attributed with the size of houses being usually larger than apartments, in addition to the higher outdoor uses that are associated with owning a house. This includes irrigation and other outdoor uses.

The above must be also taken into consideration in designing any targeted water efficiency and demand management awareness programs at the household level. While such programs should target all types of population and households, the biggest potential could probably be found in the wealthier households. Therefore, the quickest gains could be achieved by focusing on such areas.

The majority of households in all three service areas indicated their overall satisfaction with the supplied quantities of water. This is despite the differences in the storage capacities of households in different areas. This finding is confirmed both by the responses given during the surveys and by the fact that only a small minority of households supplement their demand via tankers, the proportions of which are shown below.

Area	Buys Tanker Water
• MIYAHUNA	4.2%
• YWC	23%
• AWC	0%

A combination of this finding and that of higher consumption rates in some areas emphasize that there is a potential for improving efficiency in some collection areas. As stated before, the threshold concept can help identify geographic areas where awareness should be focused to achieve the best results. This concept is not only applicable to areas where the overall consumption is high, it could be applied to areas with the highest average faucet flow rate, or the highest showers' flow rates as the results of the survey at hand indicate.

Indoor Water Use

An important aspect of the calculations that were conducted under this activity is that while the used formulas had been based on end use analysis and actual observations, the frequencies of use for the various water outlets in a home were based on those reported by the interviewees. In other words, they represented the interviewees "perceptions" on how frequently and for how long they use the different water outlets such as faucets, showers, etc. Generally, the calculated consumptions were higher than billed ones in the three service areas. Given that those calculations were based on responses given by interviewees, it can be concluded that people usually over-estimate the extent to which they use water outlets both in terms of frequency and duration. Several studies related to human behavior have shown that consciousness of a certain non preferred behavior could lead to curtailing it. Given that the respondents think they use water less than they actually do, making such users aware of their water use habits could promote more efficiency use at the household level. While an ideal result of the study at hand would have been to develop a model that could accurately predict water consumption in a

household, it is impossible to do so without detailed observations at the household level that focus on water use behavior. This would include observations on the numbers of time each household member uses a water outlet and the duration of such use. A preferred approach for achieving such results would be to design a sample in a manner similar to what was done for this study, but to work with such families on keeping diaries related to their water consumption behavior. This would be the most accurate way to develop a model. On suggested method for achieving this is to select a number of households where each member is asked to keep a diary on water consumption behavior. This would be daily records of the frequency and duration of water use behavior for each family member to keep on a pre-designed log. The logs for all participants would be then collected and further analyzed to more accurately capture the water use behaviors of the different family members.

Another interesting finding of the calculations conducted under this activity is the breakdown of indoor use in a household. While the exact quantities calculated may not be accurate, the proportional analysis of where the concentration of water use is, gives acceptable findings on where the biggest potential for savings could be. For instance, the study revealed that lavatories and faucets account for nearly 50% of the indoor consumption. Again, such finding identifies a key area of where awareness programs should focus on in terms of improving water use efficiency. The promotion of more efficient toilets (either with dual flush mechanisms or with simple volume reducing practices) could have significant results in terms of savings. The same applies to the utilization of water efficient faucets. While other water outlets in a home are not less important, the achieved savings may not be as significant as those related to toilet and faucet use.

To form a more quantitative understanding of the above, one could look at the average flow rates measured for those outlets for the sample under study. For instance, the average toilet tank capacity in Amman households was found to be 8.5 liters with an average reported frequency of daily use of 4.5 times per household member. Conforming to the new Jordan building codes of a 4 liter toilet tank capacity leads to a 4.0 liter savings per use. With an average household size of 5 people, the average daily savings per household are 2.7 cubic meters per month. Similar calculations for the northern governorates and Aqaba yield potential toilet savings of 3.1 and 3.4 cubic meters per months, respectively.

While not as water consuming as faucets and toilets, showers represent a good portion of household consumption (an average of 12%). This too identifies an area that should be given attention in terms improving household water use efficiency. The utilization of efficient shower heads is could be expected to save significant amounts of water. One aspect that was noted during the preparatory stage of the study was the abundance of the old shower heads in areas of east Amman. Such mechanisms cannot be fitted with water saving devices, thus, despite any awareness programs, it is difficult to achieve savings. Demonstrating the cost effectiveness in investing in a new shower mechanism and the return on the investment in terms of water savings could be an effective tool to promote shower head efficiency in the Kingdom.

The newly developed plumbing codes will be a very effective tool in addressing this issue, however, until it is finalized, approved, and implemented, any awareness programs should take this fact into consideration. Having identified the most consuming fixtures and appliances in a household will facilitate the design of targeted programs to help better control consumption.

Outdoor Water Use

The highest outdoor use proportions were found in the YWC service area, while the lowest proportion was in the AW area. This is an expected result given the rural nature of the northern governorates and the higher ratios of irrigation use for cropping purposes as opposed to landscaping purposes as in Amman.

In general, the breakdown for outdoor uses had higher variations than the indoor uses. This is when comparing between and within service areas. Reasons for such variation include the lifestyle, type of residence, wealth indicators, the intended purpose of outdoor use, and the geographic location. With the

lack of a national reference value on average or "typical" outdoor water uses, it is hard to judge on the obtained results. The problem is further complicated by the fact that the current metering system in Jordan does not separate between outdoor and indoor consumption.

The outdoor water use estimation was based on evapo-transpiration and rainfall data obtained from FAO Database for climate stations in Amman, Irbid, and Aqaba, vegetation type (grass, shrubs, trees), and planted area.

Though the survey at hand was not designed to specifically address this, the results of the analysis reveal that there are significant savings potential under this part of household water consumption. Outdoor water conservation areas include maintenance opportunities, irrigation systems opportunities, landscaping opportunities, and management opportunities. The findings of the study help identify another area where awareness and conservation programs for households should focus on.

4.2 Main Conclusions

As one of the activities of the Instituting Water Demand Management in Jordan (IDARA) Project, a detailed household survey was undertaken in Amman, the Northern Governorates, and Aqaba. A key objective was to understand how socioeconomic factors affect water use. The study aimed to examine the existence of relations between some socioeconomic parameters, such as wealth, gender, education, and water use in a household.

A representative sample of households was defined in the three targeted areas. The sample was chosen to be statistically representative, stratified according to the actual socioeconomic and living conditions among Jordanian households in different areas, and geographically distributed in a manner that covers the areas under study. Some other criteria were included in the selection process such as history of water consumption in the households in the services areas, review of poverty and socioeconomic factors, and serviceability by the various utilities. Based on the results of the survey, the following conclusions can be drawn:

- Five socioeconomic and demographic parameters were examined against water consumption rates and behaviors. In general, the results showed that while not statistically significant for the sample at hand, there is a detectable trend between wealth (as measured by the wealth index) and water use. Generally, there is an increase in household water consumption as the wealth status increases. This was more obvious in Amman that in the other regions mainly due to the completely urban setting of Amman. Living conditions in the governorates is a little bit different, where even in an urban setting there is a resemblance to the rural lifestyle.
- Household type also seemed to be related to water consumption with single houses consuming more water than apartment units. This is an expected result and is mainly attributed to the significant differences in size between houses and apartments, and to the existence of outdoor uses in houses.
- The other factors (gender, age group, and education) did not seem to have an impact on water consumption and no single trend could be detected for the analyzed data.
- There was an overall satisfaction with the quantities of water supplied by the three utilities. The satisfaction in the AW service area was full (i.e., a 100% level of satisfaction), which is mainly attributed to the fact that water is supplied on a continuous basis.
- Only minimal proportions of households use water tankers to supplement their water demand. This was regardless of the wealth level. There is, however, reliance on storage tanks in the Miyahuna and YWC service areas to enable households to meet their demands through the utility supply. The storage capacities of the various household were found to be related to the wealth index with wealthier household having larger storage capacities.

- In general, indoor water use was found to account for the bulk of a household's consumption. This averaged about 96%, 90%, and 97% of the total consumption in Miyahuna, YMC, and AW service areas, respectively. Within an average Jordanian household, the biggest indoor consumption was found to come from toilets and kitchen faucets. Those two outlets account for over 60% of indoor consumption, and examining the average flow rates of such outlets, there seems to be a significant potential for savings in all categories of homes.
- Showers follow the above two plumbing fixtures in terms of indoor consumption, and could also be subject to significant savings shall water saving technology be implemented in a more comprehensive manner.
- Almost every home has a washing machine with significant portions in all three service areas utilizing the inefficienct semi-automatic washing machines. While this was the dominant washing appliance in the YWC and AW service areas, there are significant portions of such technology in Amman households.
- Evaporative air conditioners using water for cooling are used in parts of the AW service areas (nearly 40%).
- Outdoor water use was found to account for 3.5%, 10%, and 2.5% of total residential water consumption in Miyahuna, YWC, and AW respectively. The high outdoor water in YWC is attributed to larger planted areas mainly concentrated in rural areas where households use domestic water supply to irrigate crops intended for their own use. This was mostly evident in Jerash and Ajloun, but coincides with the findings of previous socioeconomic surveys that have identified those two areas as the most self sufficient in terms of the values of food items that are self grown.
- Other outdoor uses include swimming pools, car washing, and cleaning. The proportions of households that have a swimming pool were found to be minimal. However, higher ratios were reported for the other uses (i.e., cleaning and car washing), with worrisome results on the use of hoses, rather than buckets, for such activities.

4.3 Recommendations

Based on the results of the analyses and the conclusions made above, the following recommendations are presented:

-
- The study has also revealed that the wealth status has a relative impact on consumption. Based on the surveys periodically conducted by the DoS, the utilities could delineate wealthier areas and design awareness programs targeting such group(s). Such programs could result in quick wins in terms of achieving water savings at the household level. This is especially true since such households would be more open and more willing to making simple investments to improve the efficiency of their water fixtures.
- The study revealed that there are a number of water use behaviors that need to be further explored. While the IDARA Project has undertaken several activities related to end-use analyses and field observations of water consumption patterns, there is a need for several more studies to help better understand such behaviors. For example, the study has shown that people generally underestimate the extent to which they use water (in terms of frequency and durations). While several studies in Jordan have attempted to better quantify such behaviors, no single comprehensive effort has been undertaken. Therefore, it is very important that a comprehensive study with a sampling approach similar to the one at hand be followed where household members are asked to keep a diary of their water consumption behavior. Such effort is significant and would have to extend over a period of time to take seasonal variations into

account. Once established, however, it would provide a powerful tool for the water utilities to more accurately estimate demand, and target their awareness activities.

- Contrary to common belief, the study did not reveal any differences in water consumption behavior between males and females, but it failed to identify why no such differences exist. A better understanding of the differences between the two genders in terms of water use, if any, would be useful in designing targeted awareness program. Therefore, it is recommended that if a comprehensive survey is conducted to better quantify household water use behavior in terms of frequency and duration, that it also attempt to differentiate between the two genders . This would be similar to the "diary" approach recommended above for capturing water use behavior in more detail.
- Outdoor water use remains to be an ambiguous aspect especially in the absence of comprehensive studies that focus on this aspect of household water use. Therefore, it is recommended that detailed studies similar to IDARA's end use studies, yet outdoor oriented, be conducted. Such study would clearly focus on individual homes rather than apartments, but would help develop more accurate outdoor water use based on actual observations and measurements. Such study should also explore options that the water utilities could impose on households sub-metering of outdoor water or providing outdoor characteristics when applying for water service. Developing a better understanding of outdoor water use behaviors in Jordanian homes would also be helpful for utilities to design and implement awareness programs targeting outdoor use. Sub-metering would help identify households with excessive use.
- It is also recommended that any awareness campaigns be tied to the findings of surveys such as the one at hand. In other words, to target awareness efforts on indoor water uses where such uses have been found to be the highest and to focus awareness related to outdoor user to areas that demonstrate high use. This is demonstrated by the fact that some collection areas still exhibit inefficient outdoor water use (such as using the hose to clean or using potable water to grow crops) despite all national efforts in the past to curtail such practices.
- While IDARA has been very successful in developing new plumbing codes and there is a need to develop a mechanism to enforce it. This process will take some time, however, the Government of Jordan needs to develop a mechanism where they could monitor the progress achieved towards compliance with the new codes. The study revealed that toilets and kitchen faucets are the biggest consumers of water within a household. Therefore, any developed mechanisms for enforcement and monitoring should place an emphasis on those two water outlets.
- The study revealed that a significant portion of households still have water fixtures with excessive flow rates. In addition to the recommendation related to code enforcement above, it is recommended that the utilities become involved in post-meter services provided they are related to water use efficiency. While the utilities responsibilities are up to the meter, and their revenues improve as a result of selling more water, increasing water use efficiency enables them to serve more people. Therefore, in addition to the forecasting tools recommended above, it is recommended that the utilities become more actively engaged in providing such services. This could be one of the mechanisms to promote compliance with the new plumbing codes. To do so, there is a need to build the capacities of the utilities to help them provide such services through their meter readers or plumbing crews. It is also recommended that such services be under the umbrella of the Water Demand Management Unit, which has managed to build its capacity since the beginning of the IDARA project, yet, it still lacks the human resources to undertake such a nationwide endeavor
- Efforts to increase awareness on water saving technology and the importance of their use should be promoted as concepts that would help save water at home, but more importantly, to be promoted as part of a national collaborative effort to combat water shortage in the Kingdom as illustrated in the utilities water use efficiency plans developed with the support of IDARA.

- Although to a lesser extent in terms of consumption, more utilization of efficient shower heads could result in indoor savings. One issue with showers in the abundance of old shower mechanisms in the less wealthy areas of the service areas. Similar to the programs of WSD distribution, utilities should consider programs where such old shower mechanisms are replaced with newer mechanisms that could be fitted with water saving technology.
- While IDARA has been successful in institutionalizing water demand management at the Ministry of Water, there is still a need to build the capacities of the utilities themselves to implement their respective water use efficiency plans. Specifically, the creation of demand management units within each utility to coordinate with the Ministry and periodically undertake such surveys and studies. Planning for awareness programs would be based on the results of such studies, and should be a joint effort between the Water Demand Management Unit at the Ministry and the three water utilities.

Appendix

Appendix A: Survey Tool

المسح الميداني لاستخدامات المياه في المنازل

1. البيـــــانات التعـــــريفية

101	**رقم الاستمارة:**	|__|__|__|__|	109	**رقم المبنى:**	|__|__|__|
102	**المحافظــة:**	|__|__|	110	**رقم المسكن:**	|__|__|__|
103	**اللـــواء :**	|__|__|	111	**أسم رب الأسرة:**	
104	**القضـــاء:**	|__|	112	**أسم الفرد المدلي بالبيانات:**	
105	**التجمع السكاني:**	|__|__|__|	113	**جنس المدلي بالبيانات 1. ذكر 2. أنثى**	|__|
106	**المنطقة:**	|__|__|	114	**رقم الهاتف الأرضي:**	|__|__|__|__|__|__|__|__|__|__|
107	**الحي:**	|__|__|	115	**رقم الهاتف الخلوي:**	|__|__|__|__|__|__|__|__|__|__|
108	**رقم البلوك:**	|__|__|__|	116	**نتيجة الزيارة النهائية:**	|__|
117	**اسم المشترك:**_____		118	**رقم المشترك:**	|_____|
119	**منطقة التحصيل:-** _____		120	**اسم الشارع:-** _____	
121	**GIS route:-** _____		122	**رقم عداد المياه:-** _____	

زيارات الباحثة		
	1	**2**
التاريـــــخ:	_____	_____
اسم الباحثة:	_____	_____
النتيجـــــة* :	_____	_____
الزيارة التالية: التاريخ **الوقـت**	_____ _____	_____ _____
*** نتيجة الزيارة :** |___|	1. تمت 2. لا يوجد أحد/لا يوجد عضو مؤهل في المنزل 3. الأسرة غير موجودة لفترة طويلة 6. المسكن خالٍ/تغيرت صفة الإشغال 7. المسكن هدم 8. لم يتم الوصول للمسكن	**118 العدد الكلي للزيارات** |__|__| **119 عدد سكان المنزل الكلي** |__|

4. أرجئت 5. رفضت	9. أخرى(حددي)_____

المراقب	المدقق	مدخلة البيانات
الاسم _____ التاريخ _____ **120**|__|__|	الاسم _____ **121**|__|__|	الاسم _____ **122**|__|__|

مرحبا، اسمي .....اعمل في _____، ونحن نقوم الآن بتنفيذ دراسة حول في محافظة المملكة، ونحن نقدر كثيراً مشاركتكم في هذه الدراسة. وسوف آخذ من وقتكم من 20 – 30 دقيقة لتعبئة الاستمارة، وكل المعلومات التي تدلون بها ستعامل بسرية تامة ولن يطلع عليها أشخاص آخرون.

للباحثة: إذا استخدمت استمارة مكملة ضعي إشارة × في المربع |__|

2. بيانات سكان المنزل

201	203		204		206	207
رقم الفرد المتسلسل	**العلاقة برب الأسرة**		**الجنس**		**العمر**	**المستوى التعليمي**
	1.زوج/ زوجة 2.ابن / ابنه 3.أب / أم 4.حفيد/ حفيده 5.أخ / أخت 6.أقارب آخرون 7.خادم /خادمه 8.آخرون		هل (الاسم) ذكر أم أنثى؟ ذكر أنثى		كم عمر (الاسم) بالسنوات الكاملة؟ إذا كان العمر اقل من سنة سجلي 00 وإذا كان 97 فأكثر سجلي .97	1.أمي 2.يقرأ ويكتب 3.ابتدائي أو إعدادي 4.ثانوي 5.دبلوم متوسط 6.بكالوريوس 7. دبلوم عالي 8.ماجستير 9. دكتوراه 10. لاينطبق
××		×	×	×	××	×
01	**رب الأسرة**	|_0_|	1	2	|__|__|	|__|
02		|__|	1	2	|__|__|	|__|
03		|__|	1	2	|__|__|	|__|
04		|__|	1	2	|__|__|	|__|
05		|__|	1	2	|__|__|	|__|
06		|__|	1	2	|__|__|	|__|
07		|__|	1	2	|__|__|	|__|
08		|__|	1	2	|__|__|	|__|
09		|__|	1	2	|__|__|	|__|

10		|__|	1	2	|__|__|	|__|
11		|__|	1	2	|__|__|	|__|
12		|__|	1	2	|__|__|	|__|
13		|__|	1	2	|__|__|	|__|
14		|__|	1	2	|__|__|	|__|
15		|__|	1	2	|__|__|	|__|
16		|__|	1	2	|__|__|	|__|
17		|__|	1	2	|__|__|	|__|
18		|__|	1	2	|__|__|	|__|
19		|__|	1	2	|__|__|	|__|
20		|__|	1	2	|__|__|	|__|

3. بيانات المسكن والأسرة

301	نوع المسكن. **الباحث:** سجلي الإجابة من خلال المشاهدة	شقة ..... 1 دار \ فيلا..... 2 براكية ..... 3 أخرى (حددي) _____ 4	**304**
302	عدد الطوابق في العمارة	العدد _____	|__|__|
303	ما هو رقم الطابق الذي يقع فيه المسكن؟	العدد _____	|__|__|
304	ما هي سنة بناء المسكن (عمر المسكن)؟	أقل من سنة ..... 1 1-4 سنوات ..... 2 5-10 سنوات ..... 3 11 – 20 سنة ..... 4 أكثر من 20 سنة ..... 5 لا أعرف 8	|__|
305	مساحة المسكن بالمتر المربع؟	أقل من 100 م^2 ..... 1 100- 150 م^2..... 2 151- 200 م^2..... 3 201 - 300 م^2..... 4 أكثر من 300 م^2..... 5 لا أعرف 8	|__|
306	نوع حيازة المسكن؟	ملك للأسرة أو أحد أفرادها ..... 1 مستأجر .....…… 2 دون مقابل ..... 3 مقابل عمل ..... 4 أخرى (حددي) _____ 5	|__|

307	ما هي الحالة العملية لرب الأسرة (نوع العمل)؟	موظف قطاع عام ..... موظف قطاع خاص ..... صاحب عمل ..... لا أعرف ..... أخرى (حدد) _____	1 2 3 4 5	|__|
308	ماهو عدد أفراد الأسرة الذين يعملون حالياً؟	العدد _____ لا أعرف	 98	|__|__|
309	ما هو معدل انفاق الأسرة الشهري؟	أقل من 250 دينار ..... 251- 500 دينار ..... 501 – 1000 دينار ..... 1001 – 2000 دينار ..... أكثر من 2001 دينار ..... لا أعرف	1 2 3 4 5 8	|__|
310	ما هو معدل دخل الأسرة الشهري؟	أقل من 250 دينار ..... 251- 500 دينار ..... 501 – 1000 دينار ..... 1001 – 2000 دينار ..... أكثر من 2001 دينار ..... لا أعرف	1 2 3 4 5 8	|__|

الآن سوف أسأل عن مصادر المياه للمنزل:

4. مصادر المياه (Water Sources)			
401	ما هي مصادر المياه المستخدمة في المنزل؟		
401a	شبكة المياه العامة (البلدية)	1 0	نعم لا
401b	بئر تجميع مياه امطار	1 0	نعم لا
401c	بئر مياه جوفية	1 0	نعم لا
401d	صهريج مياه (تنكات)	1 0	نعم لا
401e	غير ذلك، حدد:_____		
402	ما هو معدل استهلاك منزلك من المياه في كل فاتورة؟	|___|___| م3/الدورة	
403		|___|___| دينار/الدورة	
404	هل تكفيك كميّة المياه التي تصل الى منزلك في فصل الصيف ؟	1 2 3	كافية بالكاد تكفي لا تكفي

إذا كنت تحصل على المياه من الشبكة العامّة (البلدية)

5. مياه الشبكة العامة (البلدية) (Utility Water)

501	هل لديك عداد مياه اضافي (خدمات)؟	1 0	نعم لا	
502	هل عداد المياه الخاص بك مستقل أم مشترك مع اخرين	1 2	مستقل مشترك مع آخرين (العدد_____)	
503	الكمية المستهلكة فى آخر فاتورة		|__|__|__|__|	متر مكعب
504	القيمة المدفوعة فى آخر فاتورة		|__|__|__|__|	دينار
505	قراءة العداد الحالية		_____	
506	هل عداد المياه صالح؟	1 0	نعم لا	
507	عدد ساعات دور تزويد المياه الخاص بمنطقتك؟	99	|__|__| ساعة لا أعلم	
508	في أي يوم من الاسبوع تحصل على دورك من المياه؟	99	|__|__| لا أعلم	
509	ما هو مصدر ماء الشرب في المنزل؟	1 2 3 4	من الخزان جهاز فلترة أو (RO) مياه معبأة (عبوات بلاستيكية) بئر تجميع مياه المطر	

إذا كنت تحصل على المياه من الصهاريج (في حال عدم استخدام صهاريج (تنكات) مياه انتقل الى السؤال التالي):

6. صهاريج المياه (Water Tankers)			
601	عدد المرات التي تستخدم فيها صهريج مياه في الصيف؟	|__|__|	
		99 لا أعلم	
602	عدد المرات التي تستخدم فيها صهريج مياه في الشتاء؟	|__|__|	
		99 لا أعلم	
603	ما هي سعة الصهريج؟	|__|__|	متر مكعب
604	كم تدفع عن كل صهريج؟	|__|__|__|__|	دينار

إذا كنت تشتري المياه المعبأة (في حال عدم استخدام المياه المعباة انتقل الى السؤال التالي):

7. المياه المعبأة (Bottled Water)			
701	كم عبوة يستهلك المنزل في الاسبوع؟	|__|__|	
		99 لا أعلم	
702	ما هي سعة العبوة؟	|__|__|	ليتر
		99 لا أعلم	
703	كم تدفع عن كل عبوة؟	|__|__|	دينار
		99 لا أعلم	

الآن سوف أسأل عن تخزين المياه في منزلك:

8. تخزين المياه (Water Storage)			
801	عدد الخزانات العلوية؟	|__|__|	
		99 لا أعلم	
802	سعة الخزانات العلوية؟	|__|__|	متر مكعب
		99 لا أعلم	
803	عدد الخزانات السفلية؟	|__|__|	
		99 لا أعلم	
804	سعة الخزانات السفلية؟	|__|__|	متر مكعب
		99 لا أعلم	
805	ما نوع الخزان؟	1 خزان معدني فوق المنزل	
		2 خزان بلاستيكي فوق المنزل	
		3 خزان ارضي معدني	
		4 خزان ارضي بلاستيكي	
		5 خزان ارضي إسمنتي أو بئر.	
		6 برميل	
	(يمكن اختيار أكثر من بند)	99 لا أعلم	

الآن سوف أسأل عن استخدامات المياه خارج المنزل:

	9. معلومات حول الإستخدامات الخارجية للمياه (Outdoor Uses)		
901	هل يوجد حديقة في المنزل؟	1 0	نعم لا
902	مساحة الحديقة بالمتر المربع؟	 99	|___|___| لا اعلم
903	نسبة الزراعة (الغطاء النباتي) في الحديقة؟	1 2 3 4	%25 %50 %75 %100
904	هل الحديقة مزروعة بالنجيل(الحشيش)؟	1 0	نعم لا
905	مساحة النجيل (الحشيش)؟	 99	|___|___| لا اعلم
906	ما هو مصدر ري الحديقة؟	1 2 3 4 99	مياه الشبكة العامة (خزان المنزل) صهاريج (تنكات) بئر تجميع مياه الأمطار مياه معاد استخدامها (رمادية) لا يتم ري الحديقة
907	ما هو أسلوب الري المتبع؟	1 2 3 4 99	ري بنظام التنقيط ري بنظام رشاشات مياه ري بدلو السقاية ري بخرطوم المياه (البربيش) لا اعلم
908	كم مرة تروى الحديقة في الاسبوع؟	 99	|___|___| لا اعلم
909	المدة الزمنية التي تروى فيها الحديقة؟	 99	|___|___| دقيقة لا اعلم
910	ما هو عدد السيارات في المنزل؟	1 99	|___|___| لا اعلم
911	كم مرة يتكررغسيل السيارات ؟	 99	|___|___| في الاسبوع لا اعلم
912	كيف يتم غسيل السيارات الخاصة بك؟	1 2 99	الدلو 3 عامل يقوم بغسلها البربيش 4 محطة غسيل سيارات لا أعلم
913	كيف يتم غسل الرصيف أمام منزلك؟	1 2	بالدلو بالبربيش

		3 4	لا يتم غسل الرصيف لا يوجد رصيف
914	هل يوجد بركة سباحة؟	1 0	نعم لا
915	ما هو حجم بركة السباحة بالمتر المكعب؟ (إذا لم يتوفر الحجم مباشره، يمكن حسابه من خلال ابعاد البركة إذا أمكن)	99	|___|___| لا اعلم
916	ما هو مصدر المياه لتعبئة البركة؟	1 2 3 99	مياه الشبكة العامة (خزان المنزل) صهاريج (تنكات) بئر تجميع مياه الأمطار لا اعلم
917	عدد مرات غسيل فلاتر بركة السباحة؟	99	|___|___| لا اعلم
918	هل يوجد تسرب ظاهري في الحديقة الخارجية	1 0 99	نعم لا لا اعلم

10. معلومات خاصة باستخدامات المياه في المنزل والتمديدات الصحية (Indoor Water Uses)			
1001	عدد مرات استخدام الفرد للحمام (المرحاض) في اليوم؟		|___|___| استخدام/ اليوم
1002	هل تقوم بشطف المرحاض (فتح السيفون) عند كل استخدام؟	1 2 0 4 98	نعم (في كل الحالات) أحيانا لا لا يوجد سيفون (نستخدم دلو لأنه حمام عربي) لا جواب
1003	عدد مرات الاستحمام للفرد في الاسبوع؟		|___|___| /الاسبوع
1004	معدل الفترة الزمنية لكل استحمام؟		|___|___| دقيقة
1005	هل تقوم بتعبئة حوض الاستحمام أم تستخدم الدوش عند كل استحمام؟	1 2 3	اقوم بتعبئة حوض الاستحمام اقوم باستخدام الدوش غير ذلك، حدد _____
1006	هل تغلقي الحنفية عند الجلي؟	1 0	نعم لا
1007	هل لديك جلاية صحون؟	1 0	نعم لا
1008	هل تستخدم جلاية الصحون؟	1 0	نعم لا
1009	هل تشطف الصحون قبل وضعها في الجلاية؟	1 0	نعم لا

1010	عدد مرات استخدام الجلاية/الأسبوع	99	|___|___| / الاسبوع لا أعلم
1011	هل تقوم بالجلي مباشرة بعد كل وجبة طعام؟	1 0 99	نعم لا لا أعلم
1012	عدد مرات استخدام حنفية المطبخ في اليوم؟	99	|___|___| / اليوم لا أعلم
1013	معدل الفترة الزمنية لكل استخدام لحنفية المطبخ؟	99	|___|___| دقيقة لا أعلم
1014	هل لديك غسالة؟	1 2 3 4 5 6	لايوجد غسالة لدي غسالة اوتوماتيك تعبأ من الامام لدي غسالة اوتوماتيك تعبأ من الاعلى لدي غسالة ذات حوضين لدي غسالة حوض واحد غير ذلك، حدد _____
1015	ما عمر الغسالة؟	99	|___|___| سنة لا اعلم
1016	عدد مرات الغسيل في الاسبوع؟	99	|___|___| / الاسبوع لا اعلم
1017	عدد وجبات (زوم) الغسيل في الغسلة الواحدة؟	99	|___|___| لا اعلم
1018	هل لديك جاكوزي؟	1 0	نعم لا
1019	عدد مرات استخدام الجاكوزي؟	99	|___|___| مرة في الاسبوع لا اعلم
1020	نوع التمديدات الصحية داخل المنزل؟	1 2 3	مواسير حديد مجلفنة ثيرمو بايب (بلاستيك) لا أعلم
1021	ما هو مصدر المياه الساخنة في المنزل؟ (ممكن اختيار أكثر من بند)	1 2 3 4	بويلر تدفئة غيزر كهرباء أو غاز سخان شمسي(عامل) غير ذلك_____
1022	كم عدد مداخل (مواسير) المياه إلى المنزل؟	1 2 3 99	مدخل واحد. مدخلين اثنين. أكثر من ذلك حدد: _____ لا اعلم
1023	هل خزانات المياه مهترئة وتسرب المياه؟	1	نعم

		0	لا
1024	هل العوامة غير صالحة وتسرب المياه؟	1 0 99	نعم لا لا اعلم
1025	مدى صعوبة تركيب جهاز تسجيل بيانات التدفق؟ (تعبأ من قبل معبئ الاستبيان)	1 2 3 99	ممكن (سهل) ممكن، لكن بحاجة إلى قطع إضافية لا يمكن تركيبه لا اعلم
1026	هل هناك مضخة بالقرب من المكان المقترح لتركيب جهاز تسجيل البيانات؟ (تعبأ من قبل معبىء الاستبيان)	1 0 99	نعم لا لا اعلم
1027	كم ضغط المضخة؟	 99	|___|___| بار لا اعلم
1028	هل يتم اعادة استخدام المياه في المنزل؟ مثلا: مياه غسيل الصحون لري الحديقة	1 0	نعم لا
1029	ما عمر الحمامات؟	1 2 3 5 99	1– 5 سنوات 6 – 10 سنوات 11– 20 سنة اكثر من 20 سنة لا اعلم
1030	هل يوجد لديكم نظام تكييف؟	1 2	نعم لا
1031	ما هو نظام التكييف لديكم؟	1 2 3	مكيف عادي مكييف صحراوي تكييف مركزي

قياس مدى الوعي والرغبة في تركيب قطع توفير المياه:			
AW1	هل سمعت عن قطع توفير المياه؟	1 2	نعم لا
AW6	إذا كان الجواب نعم، هل عملت على تركيب قطع توفير المياه سابقا؟	1 2	نعم لا
AW2	اذا كان جوابك للسؤال السابق نعم، حدد من أين سمعت ؟		_____
AW3	هل ترغب في تركيب قطع توفير المياه؟	1 2	نعم لا
AW4	هل ترغب في إجراء دراسة نمط استخدام المياه في منزلك؟	1	نعم

		2	لا
AW5	طبيعة التمديدات داخل المنزل	1	يوجد صندوق توزيع داخلي
		2	نظام توزيع قديم

معلومات التدقيق المائي في المنازل (Water Audits)					
الحمام الرابع	الحمام الثالث	الحمام الثاني	الحمام الأول	حنفيات الحمام 1.	
				عدد الحنفيات في كل حمام	WAF1
				نوع التسنين (خارجي، داخلي)	WAF2
				التدفق (لتر/دقيقة) قبل تركيب قطع توفير المياه	WAF3
				التدفق (لتر/دقيقة) بعد تركيب قطع توفير المياه	WAF4
				هل يوجد تسرب حاليا؟	WAF5
				هل هناك قطع توفير المياه؟	WAF6

الحمام الرابع	الحمام الثالث	الحمام الثاني	الحمام الأول	المراحيض 2.	
				عدد المراحيض في كل حمام	WAT1
				نوع المرحاض(افرنجي، عربي)	WAT2
				هل الخزان ثنائي ام أحادي التدفق (في الحمام الافرنجي)	WAT3
				هل تعمل نياجرا المرحاض؟	WAT4
				في حال استخدام الدلو لعملية شطف المرحاض، كم سعة الدلو باللتر؟	WAT5
				سعة خزان المرحاض (لتر)	WAT6
				هل يوجد تسرب يستوجب التصليح حاليا؟	WAT7

الحمام الرابع	الحمام الثالث	الحمام الثاني	الحمام الأول	البيديه 3.	
				هل يوجد بيديه في الحمام؟	WAb1
				هل يوجد مرش (بربيش) في الحمام؟	WAb2
				نوع حنفية البيديه (حنفية جانبية ام رشاش أرضي)	WAb3
				التدفق (لتر/دقيقة) قبل تركيب قطع توفير المياه	WAb4
				هل يوجد تسرب يستوجب التصليح حاليا؟	WAb5

	دوشات الاستحمام 4.	الحمام الأول	الحمام الثاني	الحمام الثالث	الحمام الرابع
WAS1	عدد الدوشات				
WAS2	نوع الدوش (ثابت/ متحرك)				
WAS3	التدفق (لتر/دقيقة) قبل تركيب قطع توفير المياه				
WAS4	التدفق (لتر/دقيقة) بعد تركيب قطع توفير المياه				
WAS5	هل يوجد سخان كهربائي (Speed او غاز موصول مباشرة مع Heat الدوش؟				
WAS6	هل يوجد تسرب يستوجب التصليح حاليا؟				

	5-حنفيات المطبخ	المطبخ الأول	المطبخ الثاني
WAK1	عدد الحنفيات في كل مطبخ		
WAK2	نوع التسنين (خارجي، داخلي،لا ينطبق)		
WAK3	التدفق (لتر/دقيقة) قبل تركيب قطع توفير المياه		
WAK4	التدفق (لتر/دقيقة) بعد تركيب قطع توفير المياه		
WAK5	هل يوجد تسرب يستوجب التصليح حاليا؟		
WAK6	هل هناك قطع توفير المياه؟		

ملاحظـــــــات:-

Appendix B: Test Run Statistics

The data of the 60 filled questionnaires collected at the three service areas; (21 at MIYAHUNA, 28 at NGWA and 11 at AW) were extracted from the Database and summarized below in tables (1-40).

Table (1), Test Run time table, number of HH visited and number of filled questionnaires

Utility	Region and Date	Number of Households		Total Visits	Filled Questionnaire	
		Reached	Accessed		No	%
MIYAHUNA	Khalda (west), February, 20th	65	11	34	21	61.8
	Ras Al-Ain (center), February, 21st	13	13			
	Al-lubban (south), February, 23rd	21	10			
NGWA	Irbid, February, 22nd	14	14	36	28	77.8
	Ramtha, February, 24th	17	14			
	Mafraq, February, 25th	12	8			
AW	Aqaba, March, 2nd	17	11	11	11	100

Table (2), Number of bathrooms available in household (MIYAHNA)

Availability of Bathrooms	Number of HH	Percentage (%)
1 only	7	33.33
2	9	42.86
3	4	19.05
4	1	4.76
Total	21	100%

Table (3), Number and type of faucets in kitchens and bathrooms (MIYAHNA)

Utility	Number of Faucets		Threading		
	One faucet	Two faucets	External	Internal	Not Available
Kitchen	18	3	12		9
Bathroom	21		10	3	8

Table (4), Number and type of showers (MIYAHNA)

Utility	Type			
	Moveable	Fixed	Moveable and Fixed	Shower not available
Shower	11	7	1	2

Table (5), Number of bathrooms available in household (NGWA)

Availability of Bathrooms	Number of HH	Percentage (%)
1 only	11	39.28
2	14	50.00
3	3	10.71

Total	28	100

Table (6), Number and type of faucets in kitchens and bathrooms (NGWA)

Utility	No. of Faucets		Threading		
	One faucet	Two faucets	External	Internal	Not Available/Does not Fit
Kitchen	28		3	21	4
Bathroom	24	4	17	4	7

Table (7), Number and type of showers (NGWA)

Utility	Type		
	Moveable	Fixed	Moveable and Fixed
Shower	10	17	1

Table (8), No. of bathrooms available in household (AW)

Availability of Bathrooms	Number of HH	Percentage (%)
1 only	0	0
2	10	90.9
3	1	9.1
Total	11	100

Table (9), Number and type of faucets in kitchens and bathrooms (AW)

Utility	Number of Faucets		Threading		
	One faucet	Two faucets	External	Internal	Not Available
Kitchen	8	3	5	3	3
Bathroom	9	2	4	3	4

Table (10), Number and type of showers (AW)

Utility	Type		
	Moveable	Fixed	Moveable and Fixed
Shower	7	4	0

Table (11), Number of Households and family size

Area	**HH**	**Family Member(size)**			
		1 to 3	**4 to 6**	**7 to 10**	**more than 11**
MIYAHUNA	21	7	8	4	2
NGWA	28	4	7	11	1
AW	11	3	2	6	0

Table (12), Inhabitants, Gender, and Age groups

Area	Gender %		Age (years)					
	M	F	1 to 10	11 to 18	19 to 25	26 to 40	41 to 50	>51
MIYAHUNA	52.73	47.27	17	14	23	27	10	20
NGWA	54.10	45.90	23	45	24	27	29	22
AW	49.23	50.77	10	16	14	13	9	8

Table (13), Household Type

Area	HH	HH type			
		Apartment	Dar	Vila	Barracks
MIYAHUNA	21	15	6	0	0
NGWA	28	13	14	0	1
AW	11	9	1	0	1

Table (14), Household Age

Area	HH years of construction					
	<1	1-4	5-10	11-20	>20	Don't know
MIYAHUNA	0	0	8	6	7	0
NGWA	0	3	3	6	14	2
AW	0	3	2	1	4	1

Table (15), Household Area

Area	HH Area m^2					
	<100	100-150	151-200	201-300	> 300	Don't know
MIYAHUNA	0	7	11	2	0	1
NGWA	0	9	9	4	1	5
AW	1	7	2	0	0	1

Table (16), Type of Tenure

Area	HH	HH tenure				
		Owned	Rented	Free	For Work	Other
MIYAHUNA	21	14	5	1	0	1
NGWA	28	26	2	0	0	0
AW	11	6	5	0	0	0

Table (17), Education level

Area	Education								
	Unlettered	Read & write	Primary or Preparatory	Secondary	Diploma	B.Sc.	High Diploma	M. Sc.	Ph.D.
MIYAHUNA	7	1	22	32	11	23	0	0	0
NGWA	7	5	62	30	8	31	1	1	0
AW	1	2	23	16	3	18	0	1	0

Table (18), Families Income

Area	Income Level (JD/month)					
	<250	251-500	501-1000	1001-2000	> 2000	Don't Know
MIYAHUNA	2	7	5	2	0	5
NGWA	6	12	2	3	0	5
AW	0	1	4	5	0	0

Table (19), Families Expenditures

Area	Expenditure (JD/month)					
	<250	251-500	501-1000	1001-2000	> 2000	Don't Know
MIYAHUNA	2	8	6	1	0	2
NGWA	5	15	5	1	0	2
AW	0	2	5	2	0	2

Table (20), Families Employment Type

Area	Employment Type				
	Private Sector	Public Sector	Self Employed	Don't Know	Other/Retired
MIYAHUNA	0	15	1	1	4
NGWA	4	12	1	0	11
AW	3	5	0	0	3

Table (21), Number of Employees at each HH

Area	HH	No of Employees				
		1	2	3	4	Do not know
MIYAHUNA	21	11	5	2	2	0

NGWA	28	16	4	1	1	5
AW	11	3	3	4	0	0

Table (22), Households Water Supply

Area	Water Source				Quantity of Water			Availability of Extra meter	Water Bill (JD), Average
	Public water	Rain water	Artesian well	Tanker	Enough	Barely enough	Don't enough		
MIYAHUNA	20	0	1	0	17	3	1	1	28
NGWA	26	3	0	2	12	3	13	2	29
AW	11	0	0	0	11	0	0	0	91

Table (23), Water meters and Water Pumping

Area	HH	Water Meter			Water Pumping (hrs)					Water Tankers(Average)			
		Single	Joint	Status (works or not ?)	12	24	48	72	>72	Summer	Winter	m^3	Price
MIYAHUNA	21	17	3	20	1	9	10	1	0	N/A	N/A	N/A	N/A
NGWA	28	22	6	27	11	10	3	0	3	3.2	2.0	6.0	13.0
AW	11	10	0	11	0	0	0	0	11	N/A	N/A	N/A	N/A

Table (24), Drinking Water and Availability of Roof Tanks

Area	HH	Drinking Water (5 Gal)		Number of Roof Tanks					Roof Tank Capacity m^3				
		Number	Price (JD)	1	2	3	> 3	Don't Know	1 - 2	3 - 4	5 - 6	> 6	Do not know
MIYAHUNA	21	2.6	1.2	7	8	3	2	1	15	4	1	0	1
NGWA	28	2.3	0.7	6	15	4	2	1	21	6	0	0	1
AW	11	N/A	N/A	6	4	1	0	0	7	3	1	0	0

Table (25), Ground Water Tanks

Area	HH	Number	Ground Tank Capacity m^3

		of Tanks			
		1	2	Up to 6 m^3	> 6
MIYAHUNA	21	8	1	7	2
NGWA	28	11	1	8	4
AW	11	0	0	0	0

Table (26), Availability of Garden

Area	HH	Availability of garden	Avg. area m^2	Garden with Grass	Percentage of planted area				
					25%	50%	75%	100%	Do not know
MIYAHUNA	21	6	97	0	1	3	2	0	0
NGWA	28	11	850	0	2	4	2	3	0
AW	11	2	22	1	0	1	0	0	1

Table (27), Garden's Source of Irrigation

Area	Source of Irrigation				
	Public network	Tankers	Water Harvesting	Gray Water	Not Irrigate it
MIYAHUNA	5	0	0	0	1
NGWA	2	2	2	0	5
AW	1	0	0	0	1

Table (28), Garden's Irrigation Method

Area	Irrigation Method				Avg. Irrigation times (Time/week)	Avg. time spent in garden irrigation (Min.)
	Drip	Bucket	Hose	Don't Know		
MIYAHUNA	0	1	3	1	1	44
NGWA	1	0	3	6	3	53
AW	0	1	0	1	2	15

Table (29), Car Wash and Swimming Pool

Area	Number of Cars				Times of Car Wash / Week				Availability of Swimming pool
	1	2		Do not know	1	2	3	Do not know	
MIYAHUNA	10	4	0	6	9	4	0	2	0
NGWA	18	2	0	5	14	0	0	9	0
AW	7	0	0	4	4	1	1	1	0

Table (30), Behavioral use of Toilet

Area	Average Use of Toilet / Day	Flushing the toilet at every use?			
		Yes	Sometimes	No	Turkish type
MIYAHUNA	3.1	15	0	0	6
NGWA	3.8	17	3	1	6
AW	3.4	8	0	0	3

Table (31), Behavioral use of Shower

Area	Average Number of Showers / week	Time of Shower (min.)	Showering method		
			Bathtub	Shower	Bucket
MIYAHUNA	3.6	13.1	0	15	6
NGWA	3.1	14.6	0	17	11
AW	5.1	16.4	0	6	4

Table (32), Water use in Dish Washing

Area	Closing of water Tap during dish washing?	Availability of dishwasher	Dish Washing after meals	Avg. Number of times using kitchen's faucet per day	Avg. time spent in using kitchen tap(min.)
MIYAHUNA	18	1	15	4.5	12.0
NGWA	26	0	22	4.8	10.4
AW	10	0	10	4.7	10.7

Table (33), Water use in Washing Machine

Area	Availability of Washing Machine and Type				How old the machine is (years)	Avg. No of using Washing Machine / week	Avg. number of batches per each washing process
	Front loading Automatic	Top loading Automatic	Two Basin	Single Basin			
MIYAHUNA	6	0	13	2	9.0	1.5	3.1
NGWA	8	1	15	5	6.1	1.9	3.6
AW	6	0	5	0	3.5	2.4	3.3

Table (34), Pluming Status at HH

Area	Availability of Jacuzzi	Type of plumbing at HH			Connection Type	
		Galvanized Iron Pipes	Thermo Pipe (plastic)	Don't know	Distribution Box	Classical system
MIYAHUNA	0	16	3	2	5	14

NGWA	0	15	12	1	6	22
AW	0	4	6	1	2	9

Table (35), Water Heating Method

Area	Heating Method			
	Boiler (Diesel)	Electrical / Gas heater	Solar heater	Others
MIYAHUNA	3	13	7	2
NGWA	1	15	12	1
AW	0	11	1	0

Table (36), Water Inlets, Water Tanks and Floaters for Households

Area	HH	Number of water inlets		Deteriorated water tank or leak ?	Out of function floater
		1	2		
MIYAHUNA	21	15	6	2	1
NGWA	28	14	14	3	2
AW	11	7	2	10	9

Table (37), Willingness to participate in End Use Analysis

Area	HH	Possibility to install a flow recording data device?				Existence of pump near the proposed location for the data logger?	Pump Pressure
		Possible	Need some plumping work	impossible	Don't know		
MIYAHUNA	21	1	0	4	16		
NGWA	28	2	0	4	22		
AW	11	0	0	5	6		

Table (38), Use of Grey Water and Toilets years of installation

Area	HH	gray water use	Years of Toils Installation				
			1 - 2	3 - 5	6 – 10	>11	Do not know
MIYAHUNA	21	0	8	8	0	0	5
NGWA	28	5	14	13	0	0	1
AW	11	0	6	4	0	0	1

Table (39), Air Conditioning Availability

Area	Availability of AC	AC type		
		Split Unit	Water type	Central unit
MIYAHUNA	4	4	0	0
NGWA	3	3	0	0
AW	11	9	0	2

Table (40), Awareness and Willingness to install WSDs

Area	Awareness of the availability of WSD's	Source of Information						Willingness	
		Water Authority	TV	Hardware Stores	Plumper	Sales man	Friends	To Install WSDs	To Participate in End Use Analysis
MIYAHUNA	10	0	14	2	1	0	0	14	10
NGWA	16	0	26	0	1	1	2	26	9
AW	5	2	11	0	0	0	0	11	3

Figures of the Raw Data

MIYAHUNA	NGWA	AW

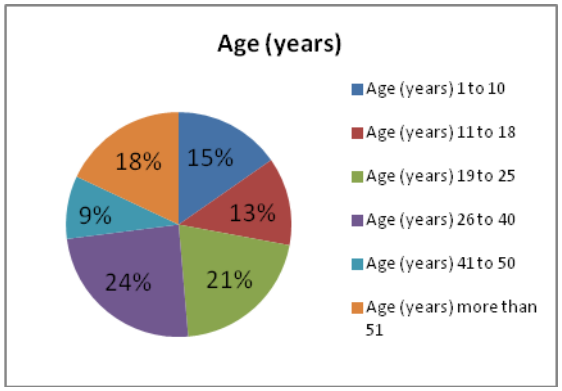
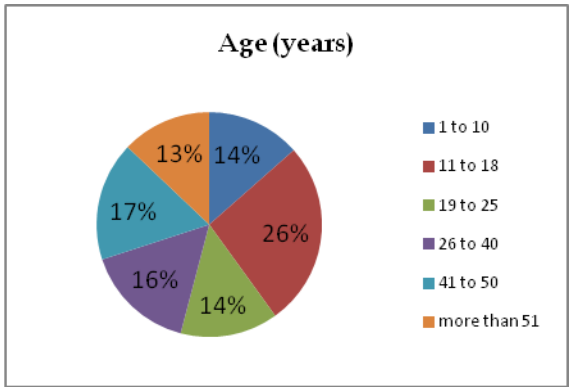
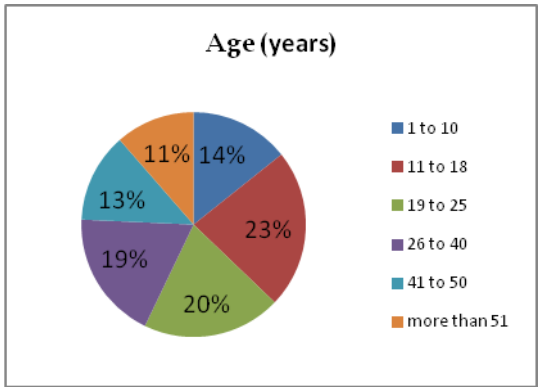
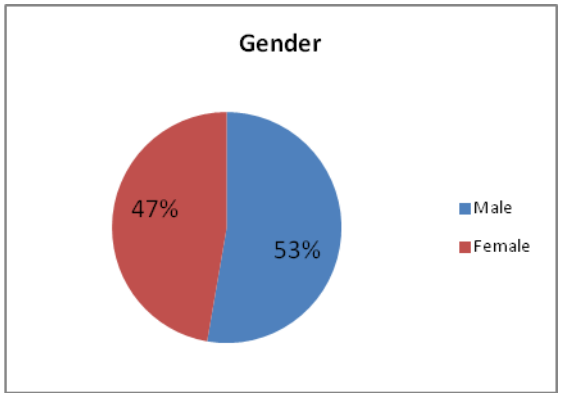
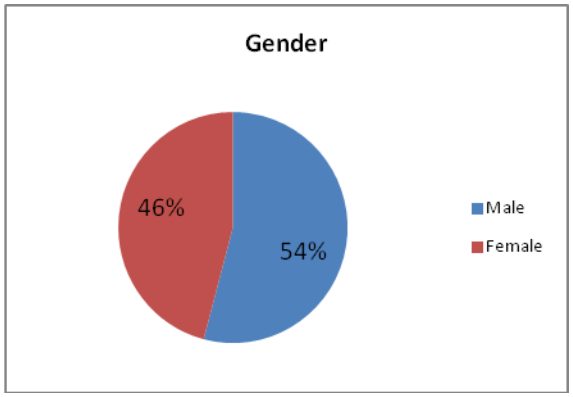
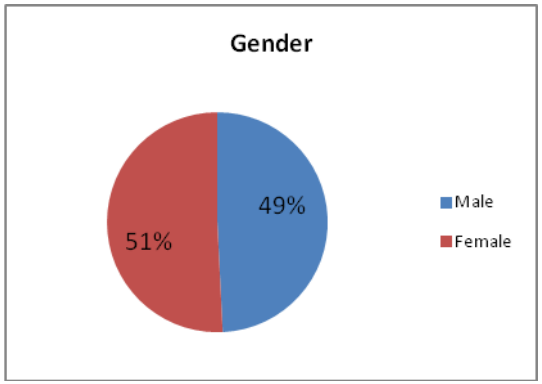

		
		

Figure 1. Gender and Age Groups at MIYAHUNA	**Figure 2. Gender and Age Groups at NGWA**	**Figure 3. Gender and Age Groups at AW**

MIYAHUNA	NGWA	AW

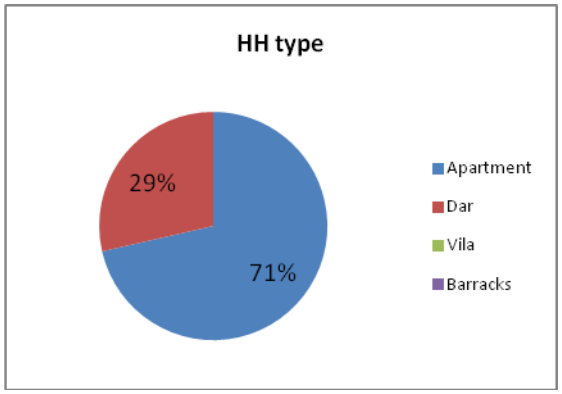
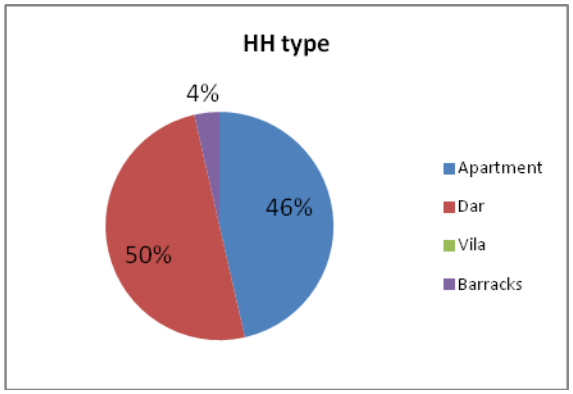
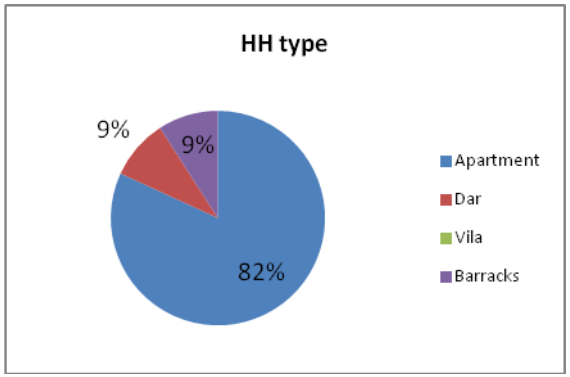
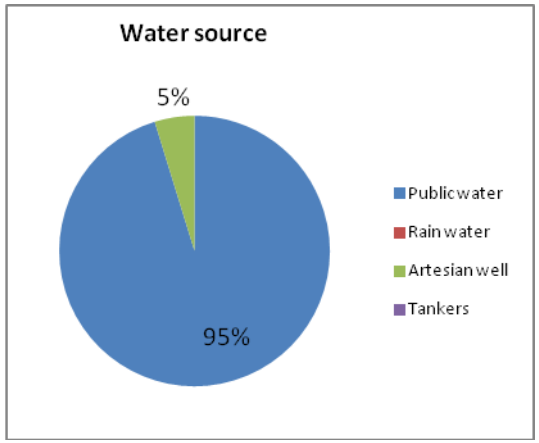
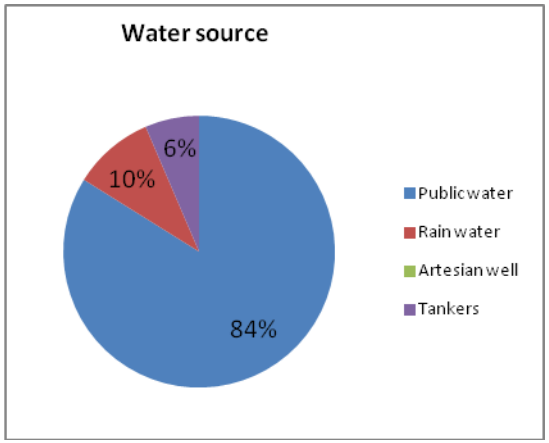
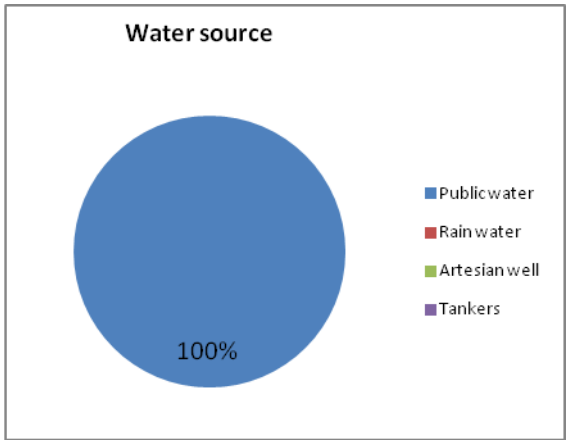

		
		

Figure 4. Household Type and Source of Water at MIYAHUNA	**Figure 5. Household Type and Source of Water at NGWA**	**Figure 6. Household Type and Source of Water at AW**

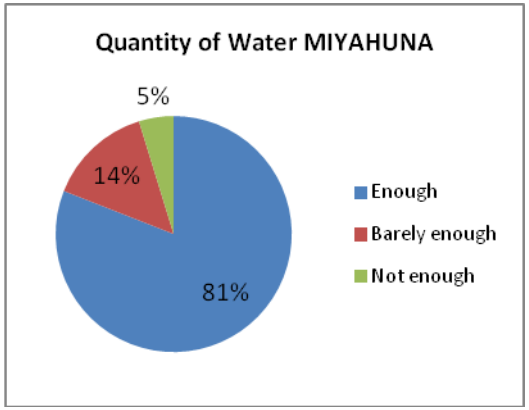


Figure 7. Quantity of Water at MIYAHUNA

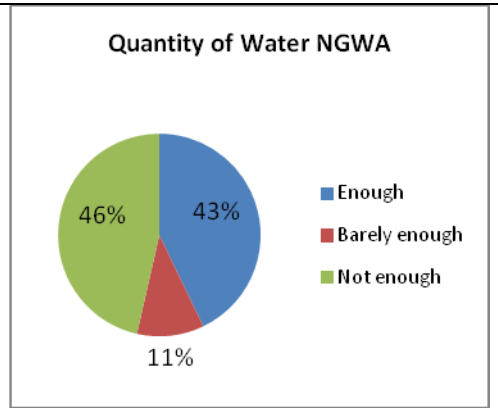


Figure 8. Quantity of Water at NGWA

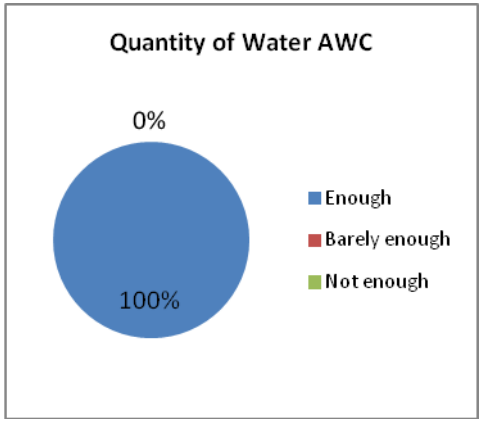


Figure 9. Quantity of Water at AW

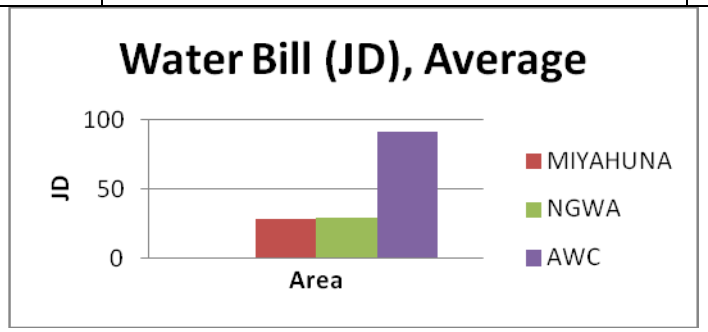


Figure 10. Comparison of water Bill

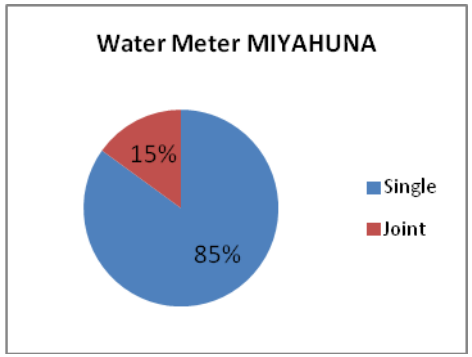


Figure 11 Type of Water Meter at MIYAHUNA

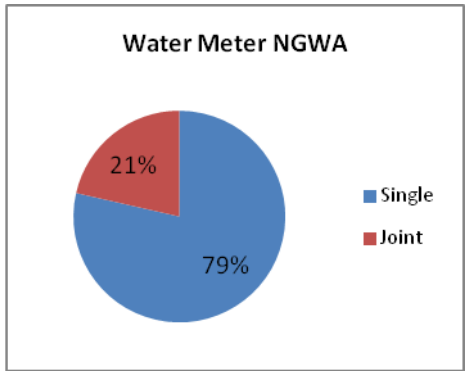


Figure 12 Type of Water Meter at NGWA

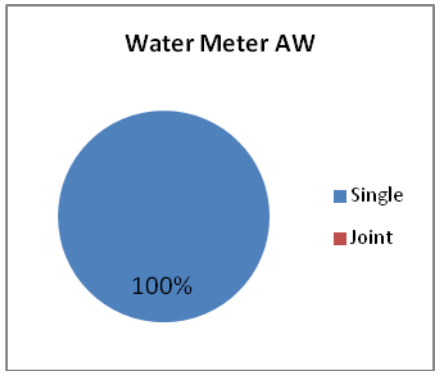


Figure 13. Type of Water Meter at AW

MIYAHUNA	NGWA	AW

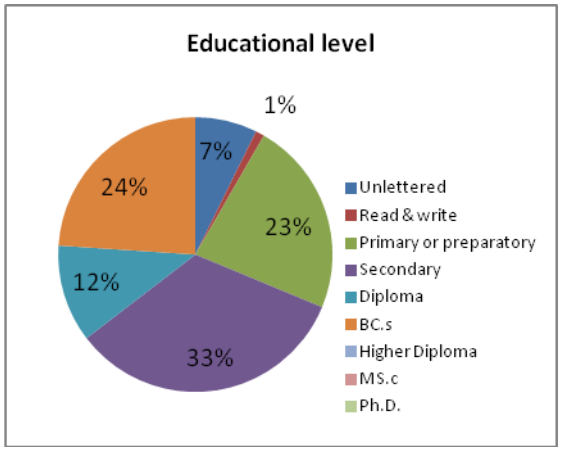
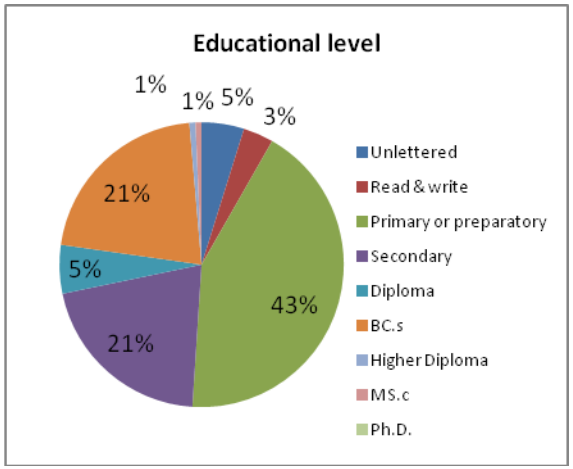
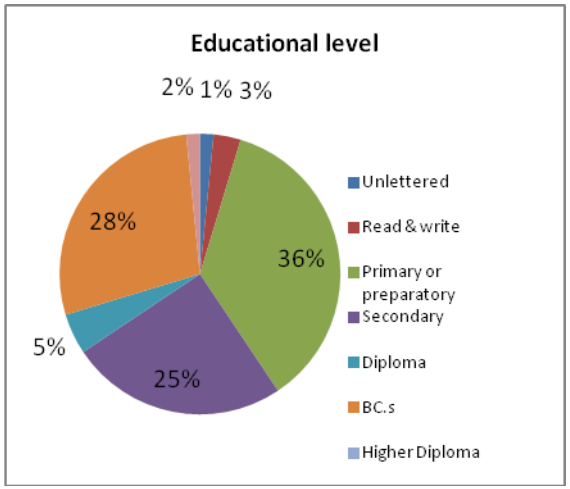

		

Figure 14 Education Level at MIYAHUNA	Figure 15 Education Level at NGWA	Figure 16. Education Level at AW

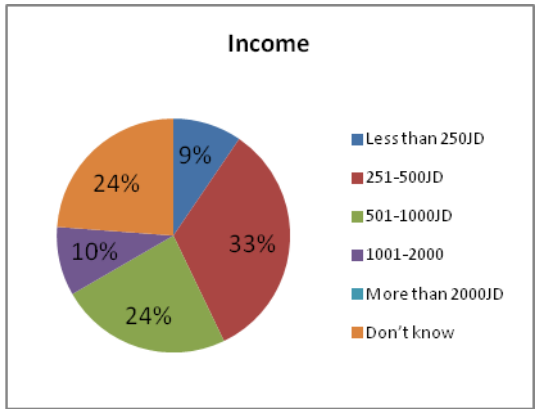


Figure 17 Family Income at MIYAHUNA

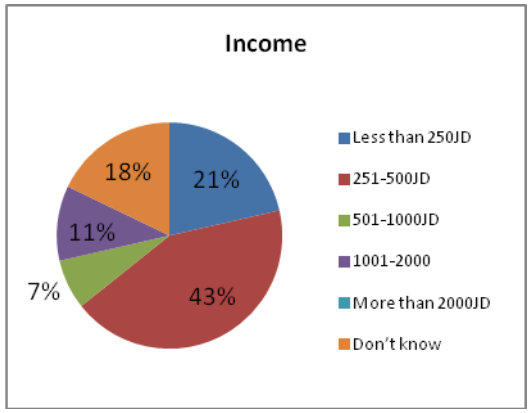


Figure 18 Family Income at NGWA

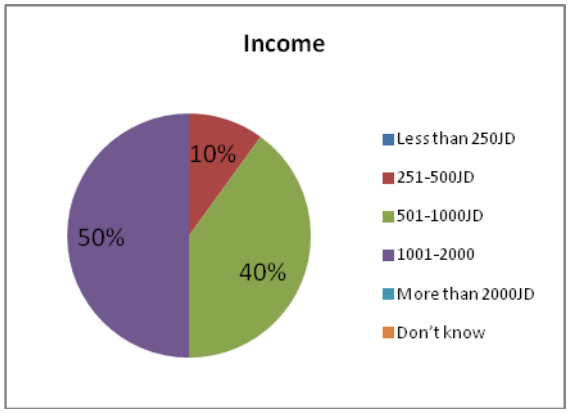
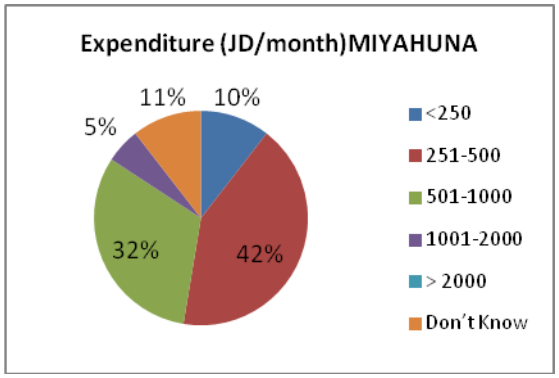
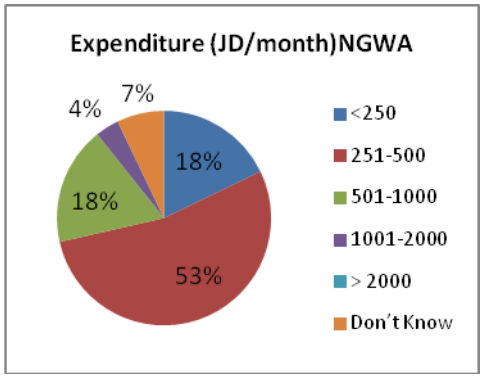
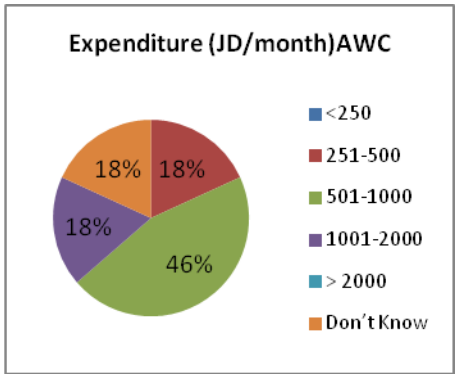
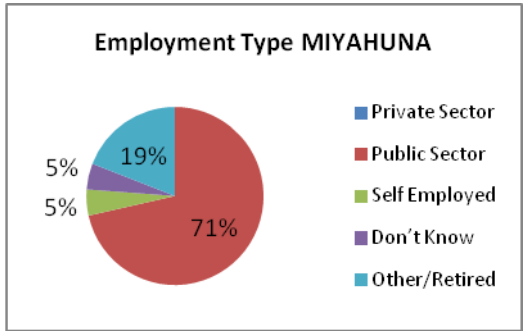


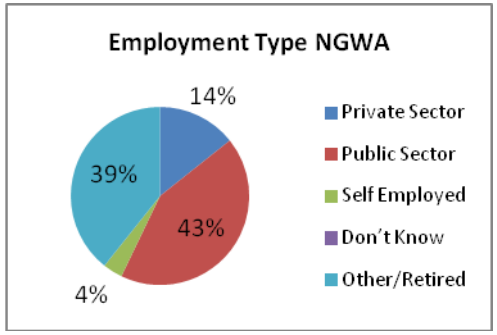
Figure 19. Family Income at AW

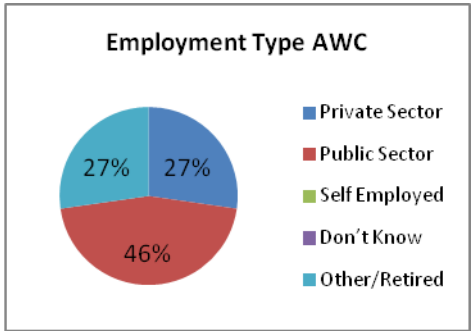


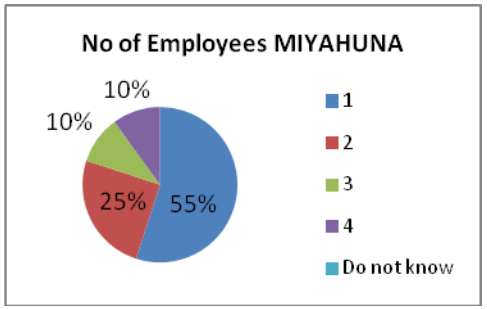


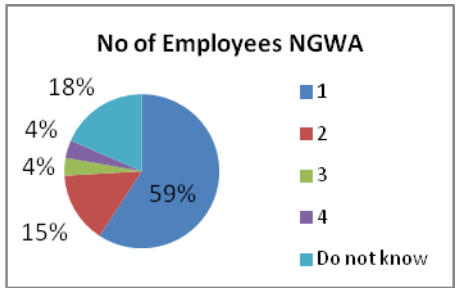












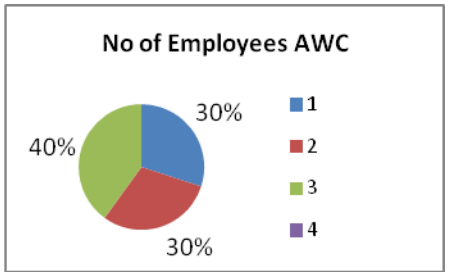
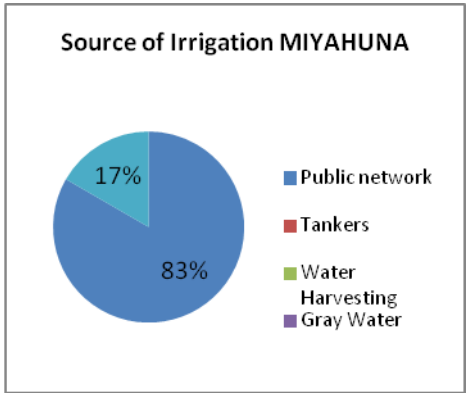


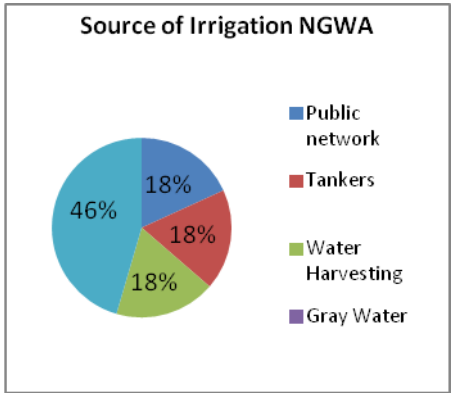
Figure 20 Employment and Expenditures at

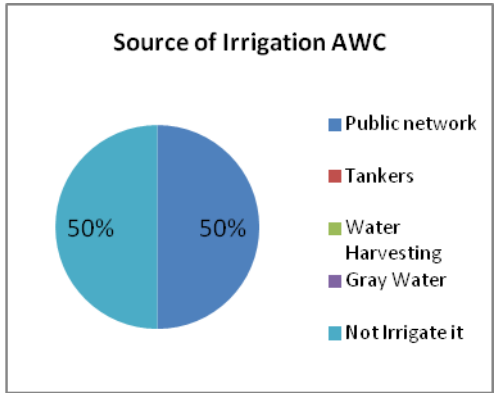
Figure 21 Employment and Expenditures at

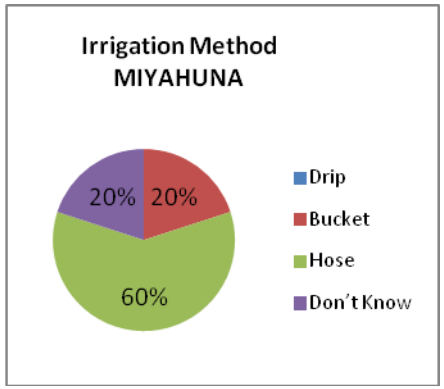
Figure 22 Employment and Expenditures

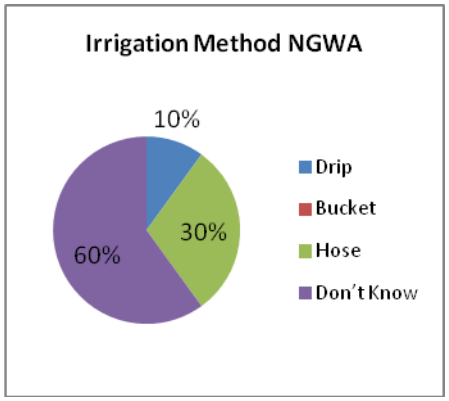
MIYAHUNA	NGWA	at AW











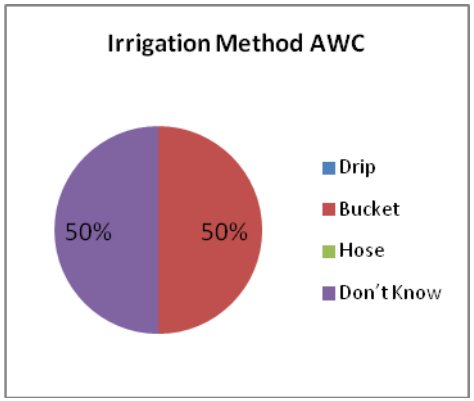


Figure 23 Source and Method of Irrigation for gardens at MIYAHUNA	Figure 24 Source and Method of Irrigation for gardens at NGWA	Figure 25 Source and Method of Irrigation for gardens at AW

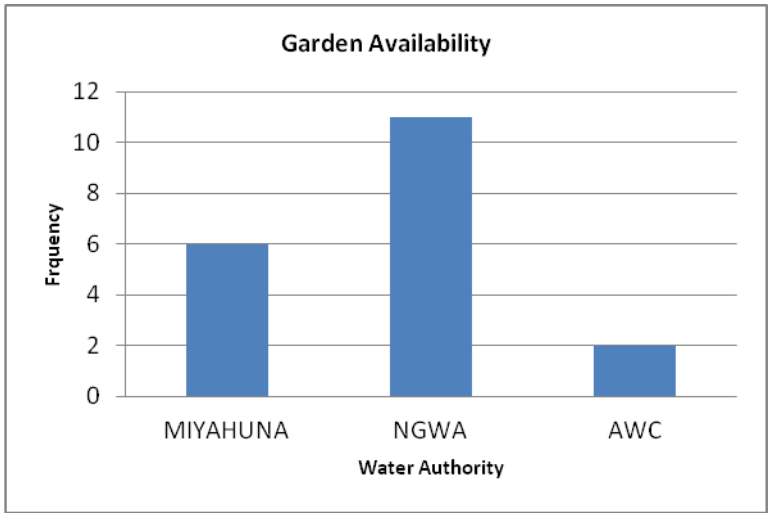


Figure 26., Comparison for the availability of garden

Appendix C: Wealth Index

List of all variables and their frequencies that were included in the calculating the wealth index of the surveyed households at the three service areas; MIYAHUNA, NGWA and AW.

Variable		MIYAHUNA		NGWA		AW	
		No.	%	No.	%	No.	%
1.	(Household Type/Apartment)المسكن شقة	1243	88.3	494	70.0	310	87.8
2.	(Household Type/Villa, Dar))المسكن دار أو فيلا	165	11.7	208	29.5	43	12.2
3.	(Type of Tenure/ Owned by the household or one of its members)المسكن ملك للأسرة أو احد أفرادها	1088	77.3	568	80.5	244	69.1
4.	(Type of Tenure/ Rented)المسكن مستأجر	316	22.4	133	18.8	106	30.0
5.	(Employment Status for the head of family/ Public Sector)رب الأسرة موظف قطاع عام	203	14.4	178	25.2	61	17.3
6.	(Employment Status for the head of family/ Private Sector)رب الأسرة موظف قطاع خاص	575	40.8	227	32.2	127	36.0
7.	(Employment Status for the head of family/ Self Employed Sector)رب الأسرة صاحب عمل	149	10.6	46	6.5	55	15.6
8.	(Employment Status for the head of family/ Don't Know, Other)رب الأسرة أخرى أو لا يعرف	481	34.2	240	34.0	108	30.6
9.	(average monthly household spending/ Less than 250JD)معدل إنفاق الأسرة الشهري أقل من 250 دينار	168	11.9	69	9.8	44	12.5
10.	(average monthly household spending/251-500JD) معدل إنفاق الأسرة الشهري 251- 500 دينار	602	42.8	396	56.1	131	37.1
11.	(average monthly household spending/501-1000JDمعدل إنفاق الأسرة الشهري 501- 1000 دينار	455	32.3	203	28.8	102	28.9
12.	(average monthly household spending/more than 1000)معدل إنفاق الأسرة الشهري أكثر من 1000 دينار	152	10.8	27	3.8	17	4.8
13.	(average monthly household income/ Less than 250JDمعدل دخل الأسرة الشهري أقل من 250 دينار	162	11.5	70	9.9	44	12.5
14.	251-500 (average monthly household income/ معدل دخل الأسرة الشهري من 251-500 دينار	582	41.3	373	52.8	132	37.4
15.	(average monthly household income/501-1000 معدل دخل الأسرة الشهري من 501-1000 دينار	438	31.1	213	30.2	101	28.6
16.	More than 1000 (average monthly household income/معدل دخل الأسرة الشهري أكثر من 1000 دينار	178	12.6	36	5.1	17	4.8
17.	Public water) (water sources in the house/ شبكة المياه العامة	1403	99.6	699	99.0	353†	100
18.	(water sources in the house/ Rain water harvesting well or Tankers بئر تجميع مياه أمطار أو	96	6.8	208	29.5	0†	0

19.	(source of drinking water at home/ Public water)مصدر مياه الشرب في المسكن من الخزان	296	21.0	227	32.2	318	90.1
20.	(source of drinking water at home/ RO) مصدر مياه الشرب في المسكن من جهاز فلتره	542	38.5	173	24.5	20	5.7
21.	(source of drinking water at home/ Bottled waterمصدر مياه الشرب في المسكن مياه معبأة	566	40.2	280	39.7	15	4.2
22.	(there is a garden at homeيوجد حديقة في المنزل	385	27.3	230	32.6	80	22.7
23.	(garden planted with grass)الحديقة مزروعة بالنجيل	23	1.6	4	0.6	2	.6
24.	(Irrigation Type/ Drip irrigation or Sprinkler) رشاشات المياه)أسلوب الري بنظام التنقيط أو أسلوب ري بنظام	32	2.3	4	0.6	4	1.1
25.	(Irrigation Type/ Using Bucket or hose أسلوب الري بدلو السقاية أو أسلوب الري بخرطوم المياه	304	21.6	174	24.6	73	20.7
26.	(How many cars do you have/ Zero) لا يوجد سيارة في المسكن	386	27.4	255	36.1	98	27.8
27.	(How many cars do you have/ One) يوجد سيارة واحدة في المسكن	676	48.0	382	54.1	217	61.5
28.	(How many cars do you have/>=2 لدى الأسرة سيارتين فأكثر	317	22.5	66	9.3	38	10.8
29.	(Do you have a swimming pool/Yes) يوجد بركة سباحة في المسكن	17	1.2	0†	0	1	.3
30.	(Do you have a dishwasher/Yes) لدى الأسرة جلاية صحون	64	4.5	8	1.1	1	.3
31.	(Do you have a washing machine/No) لا يوجد غسالة لدى الأسرة	10	.7	2	0.3	3	.8
32	(Do you have automatic washing machine) لدى الأسرة غسالة اتوماتيك	748	53.1	286†	40.5	201	56.9
33.	(Do you have a washing machine/ basin washing machine)لدى الأسرة غسالة عادية	649	46.1	414	58.6	148	41.9
34.	(source of the hot water in the house/ Heating boilerمصدر المياه الساخنة بويلر تدفئة	313	22.2	61	8.6	2	.6
35.	(source of the hot water in the house/ Electrical or gas heaterمصدر المياه الساخنة غيزر كهرباء أو غاز	922	65.5	535	75.8	333	94.3
36.	(source of the hot water in the house/ Solar heaterمصدر المياه الساخنة سخان شمسي	350	24.9	131	18.6	14	4.0
37.	((Do you have an AC/Yes) يوجد لدى الأسرة نظام تكييف	342	24.3	106	15.0	345	97.7
38.	(Building age/5Years)عمر المسكن أقل من 5 سنوات	90	6.4	45	6.4	28	7.9
39.	(Building age/5 to 20Years)20 -5 عمر المسكن	535	38.0	284	40.2	186	52.7
40.	(Building age/more than 21Years) 21 عمر المسكن سنة فأكثر	778	55.3	377	53.4	125	35.4

41.	(Do you have a Jacuzzi/Yes)يوجد لدى الأسرة جاكوزي	24	1.7	2	0.3	5	1.4
42.	(Housing unit area (in m²)/Less than 100) مساحة المسكن أقل من 100متر مربع	116	8.2	32	4.5	56	15.9
43.	(Housing unit area (in m²)/ 100 to 150) مساحة المسكن 100-150 متر مربع	592	42.0	335	47.5	196	55.5
44.	(Housing unit area (in m²)/ 151 to 200) مساحة المسكن 151-200 متر مربع	366	26.0	220	31.2	66	18.7
45.	(Housing unit area (in m²)/ more than 200) مساحة المسكن أكثر من 200 متر مربع	287	20.4	108	15.3	27	7.6
46.	(number of family members who are currently working/ Zero)لا يوجد أفراد عاملين في الأسرة	175	12.4	81	11.5	32	9.1
47.	(number of family members who are currently working/ One)فرد عامل واحد في الأسرة	784	55.7	432	61.2	215	60.9
48.	(number of family members who are currently working/ Two)فردان عاملان في الأسرة	238	16.9	115	16.3	53	15.0
49.	(number of family members who are currently working/ >=3)ثلاثة أفراد عاملين فأكثر في الأسرة	129	9.2	45	6.4	28	7.9
	Total	**1408**		**706**		**353**	

† Variables that have 0 variance and were not included in the calculation of households wealth index.

Appendix D: MIYAHUNA Raw Data

Data of the 1408 filled questionnaires collected at the MIYAHUNA service area extracted from the Database and analyzed using the SPSS software.

Table 1. Percent Distribution of the Subscribers by Wealth Class and Area

Area	Wealth Class			Total	No. of Households
	Poor	Middle	Rich		
Abdoon	8.1	19.9	72.1	100.0	136
Khalda	15.9	25.0	59.1	100.0	232
Shafa-Badran	9.1	34.7	56.3	100.0	176
Sweleh-East	44.6	33.7	21.8	100.0	101
Weibdeh	37.5	39.3	23.2	100.0	56
North-Hashmi	41.3	38.4	20.2	100.0	242
North-Marka	58.3	33.6	8.1	100.0	271
Ras-El-Ein	75.0	25.0	0.0	100.0	8
Qwesmeh	39.8	44.6	15.7	100.0	83
Lubban	40.8	43.7	15.5	100.0	103
Total	**33.3**	**33.4**	**33.3**	**100.0**	**1408**

Table 2. Percent distribution of Subscribers by Billed Water Consumption Quintiles

Area	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Abdoon	36	26.5	22	16.2	10	7.4	39	28.7	29	21.3	136	100.0
Khalda	88	37.9	59	25.4	34	14.7	36	15.5	15	6.5	232	100.0
Shafa-Badran	55	31.3	29	16.5	58	33.0	17	9.7	17	9.7	176	100.0
Sweleh-East	42	41.6	26	25.7	13	12.9	13	12.9	7	6.9	101	100.0
Weibdeh	25	44.6	15	26.8	8	14.3	6	10.7	2	3.6	56	100.0
North-Hashmi	116	47.9	57	23.6	26	10.7	30	12.4	13	5.4	242	100.0
North-Marka	131	48.3	75	27.7	37	13.7	17	6.3	11	4.1	271	100.0
Ras-El-Ein	5	62.5	3	37.5	0	0.0	0	0.0	0	0.0	8	100.0
qwesmeh	17	20.5	16	19.3	26	31.3	14	16.9	10	12.0	83	100.0

Lubban	26	25.2	10	9.7	37	35.9	16	15.5	14	13.6	103	100.0
Total	**541**	**38.4**	**312**	**22.2**	**249**	**17.7**	**188**	**13.4**	**118**	**8.4**	**1408**	**100.0**

Table 3. Percent distribution of subscribers by water consumption group and wealth index class

Wealth class	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Poor	236	50.3	93	19.8	68	14.5	43	9.2	29	6.2	469	100.0
Middle	173	36.8	127	27.0	87	18.5	56	11.9	27	5.7	470	100.0
Rich	132	28.1	92	19.6	94	20.0	89	19.0	62	13.2	469	100.0
Total	541	38.4	312	22.2	249	17.7	188	13.4	118	8.4	1408	100.0

Table 4. Percent distribution of subscribers by water consumption group and Income group

Income groups	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less than 1001	479	40.5	263	22.3	216	18.3	146	12.4	78	6.6	1182	100.0
1001 – 2000	36	28.3	30	23.6	15	11.8	23	18.1	23	18.1	127	100.0
2001+	10	19.6	6	11.8	14	27.5	8	15.7	13	25.5	51	100.0
Unknown	16	33.3	13	27.1	4	8.3	11	22.9	4	8.3	48	100.0
Total	**541**	**38.4**	**312**	**22.2**	**249**	**17.7**	**188**	**13.4**	**118**	**8.4**	**1408**	**100.0**

Table 5. Percent distribution of subscribers by water consumption group and housing unit type

Housing Unit Type	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Apartment	494	39.7	288	23.2	217	17.5	158	12.7	86	6.9	1243	100.0
Villa/Dar	47	28.5	24	14.5	32	19.4	30	18.2	32	19.4	165	100.0
Total	**541**	**38.4**	**312**	**22.2**	**249**	**17.7**	**188**	**13.4**	**118**	**8.4**	**1408**	**100.0**

Table 6. Percent distribution of subscribers by water consumption group and Gender of Respondent

Gender of respondent	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	255	38.8	134	20.4	123	18.7	86	13.1	59	9.0	657	100.0
Female	286	38.1	178	23.7	126	16.8	102	13.6	59	7.9	751	100.0
Total	**541**	**38.4**	**312**	**22.2**	**249**	**17.7**	**188**	**13.4**	**118**	**8.4**	**1408**	**100.0**

Table 7. Percent distribution of subscribers by water consumption group and age groups of members

Age groups of members	Billed Water Consumption Group (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-14	694	36.7	434	23.0	341	18.0	262	13.9	160	8.5	1891	100.0
15 - 24	491	30.3	386	23.8	324	20.0	229	14.1	189	11.7	1619	100.0
25 - 34	393	35.1	242	21.6	204	18.2	160	14.3	121	10.8	1120	100.0
35 - 44	291	37.7	175	22.7	122	15.8	108	14.0	75	9.7	771	100.0
45 - 54	213	30.4	178	25.4	142	20.3	99	14.1	68	9.7	700	100.0
55 - 64	200	37.0	117	21.6	91	16.8	74	13.7	59	10.9	541	100.0
65 +	171	37.1	88	19.1	94	20.4	66	14.3	42	9.1	461	100.0
Total	2453	34.5	1620	22.8	1318	18.6	998	14.1	714	10.1	7103	100.0

Table 8. Percent distribution of subscribers by water consumption group and Education level of members

Education level of members	Billed Water Consumption Group (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Illiterate	66	28.6	48	20.8	40	17.3	40	17.3	37	16.0	231	100.0
Read & write	50	33.3	27	18.0	22	14.7	26	17.3	25	16.7	150	100.0
Elementary	275	35.7	147	19.1	158	20.5	114	14.8	77	10.0	771	100.0
Secondary	515	37.5	337	24.5	226	16.4	174	12.7	123	8.9	1375	100.0
Inter diploma	167	34.9	123	25.7	90	18.8	61	12.8	37	7.7	478	100.0
Bachelor	507	32.6	332	21.4	316	20.3	234	15.1	165	10.6	1554	100.0

High diploma	12	37.5	13	40.6	4	12.5	2	6.3	1	3.1	32	100.0
Master degree	23	20.9	27	24.5	20	18.2	18	16.4	22	20.0	110	100.0
Ph.D	22	23.9	15	16.3	24	26.1	16	17.4	15	16.3	92	100.0
Total	**1637**	**34.2**	**1069**	**22.3**	**900**	**18.8**	**685**	**14.3**	**502**	**10.5**	**4793**	**100.0**

Table 9. Volume of cubic meters storage per household.

Areas	No. of Households	Volume (m 3)	Mean of Volume
Abdoon	134	2023	15.10
Khalda	229	2607	11.38
Shafa-Badran	175	1663	9.50
Sweleh-East	99	744	7.52
Weibdeh	56	278	4.96
North-Hashmi	242	1427	5.90
North-Marka	270	1184	4.39
Ras-El-Ein	8	19	2.38
Qwesmeh	83	458	5.52
Lubban	103	695	6.75
Total	**1399**	**11098**	**7.93**

Table 10. Ratio of grass area to the total planted area

Areas	Garden Area m2	Planted Area m2	Grass Area m2	% Grass Area to Garden Area	% Grass Area to Planted Area	% Planted Area to Garden Area
Abdoon	9,063	5,109	519	5.7	10.2	56.4
Khalda	16,000	9,380	335	2.1	3.6	58.6
Shafa-Badran	14,184	8,450	0	0.0	0.0	59.6
Sweleh-East	4,742	3,577	25	0.5	0.7	75.4
Weibdeh	2,314	1,400	0	0.0	0.0	60.5
North-Hashmi	4,136	1,634	0	0.0	0.0	39.5
North-Marka	2,521	1,249	0	0.0	0.0	49.5
qwesmeh	701	241	0	0.0	0.0	34.4

Lubban	6,515	3,317	0	0.0	0.0	50.9
Total	**60,176**	**34,356**	**879**	**1.5**	**2.6**	**57.1**

Table 11. Toilets Statistics

Toilets				
Area	**Volume of Toilet Tank**	**Avg. Frequancy use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Abdoon	9.112	4.42	N/A	2.4
Khalda	8.1254	4.36	N/A	2.4
Shafa-Badran	8.7595	4.37	N/A	2.3
Sweleh-East	8.4329	4.48	N/A	1.8
Weibdeh	8.8519	5.35	N/A	1.6
North-Hashmi	8.446	4.69	N/A	1.8
North-Marka	8.4961	4.44	N/A	1.4
Ras-El-Ein	9	4.38	N/A	1.5
qwesmeh	8.3585	4.43	N/A	1.6
Lubban	8.7436	4.31	N/A	1.7
Total	**8.5469**	**4.49**	**N/A**	**1.9**

Table 12. Kitchens Statistics

Kitchen Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequancy use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Abdoon	10.5	5.41	12.72	1.1
Khalda	9.6	5.55	12.4	1.1
Shafa-Badran	9.1	4.94	12.56	1
Sweleh-East	9.2	4.79	12.3	1
Weibdeh	9.8	6.67	9.42	1.1
North-Hashmi	10.5	6.16	10.46	1
North-Marka	9.6	4.81	13.86	1
Ras-El-Ein	11.2	3.25	18.13	1
qwesmeh	10.6	4.71	10.59	1.1
Lubban	10.2	4.6	12.98	1
Total	**9.9**	5.28	12.25	**1**

Table 13. Bathrooms Faucets Statistics

Bathroom Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequancy use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Abdoon	22.9	N/A		2.6

Khalda	18.9	N/A		2.4
Shafa-Badran	19.9	N/A		2.3
Sweleh-East	15.1	N/A		1.8
Weibdeh	14.3	N/A		1.5
North-Hashmi	17.7	N/A		1.8
North-Marka	14.9	N/A		1.5
Ras-El-Ein	18.4	N/A		1.5
qwesmeh	14.8	N/A		1.6
Lubban	16.9	N/A		1.8
Total	**17.6**	N/A		**1.9**

Table 14. Showers Statistics

Shower Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequancy use/week**	**Avg. Duration**	**Avg. Number of Fixture**
Abdoon	13.3	5.48	14.31	1.8
Khalda	11.8	4.81	13.58	1.7
Shafa-Badran	10.8	5.12	13.85	1.7
Sweleh-East	9.8	4.18	12.46	1.3
Weibdeh	9.5	4.98	13.86	1.2
North-Hashmi	8.9	4.53	13.42	1.3
North-Marka	7.9	3.8	14.79	1.1
Ras-El-Ein	8.6	4.25	19.38	0.9
qwesmeh	8.8	3.96	11.09	1.2
Lubban	9.2	3.91	13.35	1.2
Total	**10**	**4.51**	**13.69**	**1.4**

Table 15. Some Useful Percentages

Appliances		**Utility**		
		MIYAHUNA	**AWC**	**AW**
Dish Washer		4.5	1.1	0.3
Washing Machine	**Automatic**	42	42	41
	Two Compartments	57	57	59
Cooling Types	**Air Conditioner**	14.3	14.3	60.6
	Desert Air Conditioner	0.7	0.7	37.1
	Central Air Conditioner	0	0	0
Jacuzzi		1.7	0.3	1.4

Having Garden	27.3	32.6	23
Turkish Toilets	26.9	48.7	38.3
Tank Toilets	65.3	40.3	53.3
Both (Turkish and Tank) Toilets	7.7	11.1	8.3
Ratio of bidet to hoses	1.3	94	93.8
dual flash toilets	6.8	2.8	3.7
Average Volume of Swimming Pool (m3)	63.94	0	0
Percentage of subscribers who are aware of WSD's	46.9	49.7	46.2
Percentage of subscribers already installed WSD's	5.5	4.8	3.7
Percentage of subscribers who re-use water for irrigation	21.9	29.3	33.1
Percentage of subscribers have water harvesting well	3	6.7	0
Percentage of subscribers who use tanker water	5	23.5	0
Percentage of subscribers fills the bathtub	1.6	1.4	0.3

Appendix E: AWC Raw Data

Data of the 706 filled questionnaires collected at the NGWA service area extracted from the Database and analyzed using the SPSS software.

Table 1. Percent Distribution of the Subscribers by Wealth Class and Area

Area	Wealth Class			Total	No. of Households
	Poor	Middle	Rich		
Ajloun-city	21.4	17.9	60.7	100.0	28
Ajloun-Kofranja	35.6	37.8	26.7	100.0	45
Irbid-Janobi	13.3	37.8	48.9	100.0	45
Irbid-Sharki	26.2	35.7	38.1	100.0	168
Irbid-Turkman	50.0	33.9	16.1	100.0	56
Jerash-Balilah	18.2	54.5	27.3	100.0	11
Jerash-city	37.5	30.4	32.1	100.0	112
Mafraq-Baej	54.5	27.3	18.2	100.0	11
Mafraq-city	41.9	31.8	26.4	100.0	148
Ramtha	28.0	34.1	37.8	100.0	82
Total	**33.3**	**33.4**	**33.3**	**100.0**	**706**

Table 2. Percent distribution of Subscribers by Billed Water Consumption Quintiles

Area	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ajloun-city	15	53.6	3	10.7	2	7.1	6	21.4	2	7.1	28	100.0
Ajloun-Kofranja	29	64.4	4	8.9	6	13.3	6	13.3	0	0.0	45	100.0
Irbid-Janobi	32	71.1	3	6.7	6	13.3	4	8.9	0	0.0	45	100.0
Irbid-Sharki	73	43.5	54	32.1	25	14.9	13	7.7	3	1.8	168	100.0
Irbid-Turkman	23	41.1	21	37.5	5	8.9	7	12.5	0	0.0	56	100.0
Jerash-Balilah	0	0.0	0	0.0	2	18.2	1	9.1	8	72.7	11	100.0
Jerash-city	18	16.1	11	9.8	14	12.5	38	33.9	31	27.7	112	100.0

Mafraq-Baej	4	36.4	0	0.0	5	45.5	1	9.1	1	9.1	11	100.0
Mafraq-city	51	34.5	59	39.9	19	12.8	12	8.1	7	4.7	148	100.0
Ramtha	15	18.3	7	8.5	48	58.5	8	9.8	4	4.9	82	100.0
Total	**260**	**36.8**	**162**	**22.9**	**132**	**18.7**	**96**	**13.6**	**56**	**7.9**	**706**	**100.0**

Table 3. Percent distribution of subscribers by water consumption group and wealth index class

Wealth class	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Poor	79	33.6	55	23.4	39	16.6	41	17.4	21	8.9	235	100.0
Middle	98	41.5	56	23.7	47	19.9	19	8.1	16	6.8	236	100.0
Rich	83	35.3	51	21.7	46	19.6	36	15.3	19	8.1	235	100.0
Total	**260**	**36.8**	**162**	**22.9**	**132**	**18.7**	**96**	**13.6**	**56**	**7.9**	**706**	**100.0**

Table 4. Percent distribution of subscribers by water consumption group and Income group

Income groups	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Less than 1001	243	37.0	153	23.3	121	18.4	86	13.1	53	8.1	656	100.0
1001 – 2000	13	43.3	3	10.0	6	20.0	8	26.7	0	0.0	30	100.0
2001+	1	16.7	2	33.3	1	16.7	1	16.7	1	16.7	6	100.0
Unknown	3	21.4	4	28.6	4	28.6	1	7.1	2	14.3	14	100.0
Total	**260**	**36.8**	**162**	**22.9**	**132**	**18.7**	**96**	**13.6**	**56**	**7.9**	**706**	**100.0**

Table 5. Percent distribution of subscribers by water consumption group and housing unit type

Housing unit type	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Apartment	180	36.4	114	23.1	92	18.6	72	14.6	36	7.3	494	100.0
Villa/Dar	80	38.5	48	23.1	38	18.3	24	11.5	18	8.7	208	100.0
Total	**260**	**37.0**	**162**	**23.1**	**130**	**18.5**	**96**	**13.7**	**54**	**7.7**	**702**	**100.0**

Table 6. Percent distribution of subscribers by water consumption group and Gender of Respondent

Gender of respondent	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Male	147	38.5	88	23.0	70	18.3	48	12.6	29	7.6	382	100.0
Female	112	34.9	73	22.7	62	19.3	47	14.6	27	8.4	321	100.0
Total	**259**	**36.8**	**161**	**22.9**	**132**	**18.8**	**95**	**13.5**	**56**	**8.0**	**703**	**100.0**

Table 7. Percent distribution of subscribers by water consumption group and age groups of members

Age groups of members	Billed Water Consumption Group (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-14	383	31.8	285	23.7	264	21.9	174	14.5	97	8.1	1203	100.0
15 - 24	259	26.8	257	26.6	180	18.7	152	15.8	117	12.1	965	100.0
25 - 34	216	37.1	114	19.6	97	16.7	97	16.7	58	10.0	582	100.0
35 - 44	149	36.6	100	24.6	79	19.4	58	14.3	21	5.2	407	100.0
45 - 54	103	27.2	107	28.2	75	19.8	52	13.7	42	11.1	379	100.0
55 - 64	96	37.8	51	20.1	53	20.9	32	12.6	22	8.7	254	100.0
65 +	82	39.6	46	22.2	37	17.9	24	11.6	18	8.7	207	100.0
Total	**1288**	**32.2**	**960**	**24.0**	**785**	**19.6**	**589**	**14.7**	**375**	**9.4**	**3997**	**100.0**

Table 8. Percent distribution of subscribers by water consumption group and Education level of members

Education level of members	Billed Water Consumption Group (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Illiterate	49	38.0	25	19.4	24	18.6	12	9.3	19	14.7	129	100.0
Read & write	29	37.7	14	18.2	18	23.4	11	14.3	5	6.5	77	100.0
Elementary	117	30.9	71	18.7	91	24.0	53	14.0	47	12.4	379	100.0
Secondary	253	30.7	205	24.9	141	17.1	144	17.5	80	9.7	823	100.0
Inter diploma	66	29.5	66	29.5	45	20.1	27	12.1	20	8.9	224	100.0

Bachelor	286	35.9	198	24.9	126	15.8	114	14.3	72	9.0	796	100.0
High diploma	9	40.9	6	27.3	5	22.7	1	4.5	1	4.5	22	100.0
Master degree	12	26.7	12	26.7	11	24.4	7	15.6	3	6.7	45	100.0
Ph.D	12	33.3	12	33.3	7	19.4	5	13.9	0	0.0	36	100.0
Total	**833**	**32.9**	**609**	**24.1**	**468**	**18.5**	**374**	**14.8**	**247**	**9.8**	**2531**	**100.0**

Table 9. Volume of cubic meters storage per household

Areas	No. of Households	Volume (m 3)	Mean of Volume
Ajloun-city	28	195	6.96
Ajloun-Kofranja	45	348	7.73
Irbid-Janobi	45	420	9.33
Irbid-Sharki	168	1520	9.05
Irbid-Turkman	56	654	11.68
Jerash-Balilah	11	47	4.27
Jerash-city	111	921	8.30
Mafraq-Baej	11	47	4.27
Mafraq-city	148	898	6.07
Ramtha	82	684	8.34
Total	**705**	**5734**	**8.13**

Table 10. Ratio of grass area to total planted area

Areas	Garden Area m2	Planted Area m2	Grass Area m2	% Grass Area to Garden Area	% Grass Area to Planted Area	% Planted Area to Garden
Ajloun-city	5,723	3,830	0	0.0	0.0	66.9
Ajloun-Kofranja	6,168	3,456	0	0.0	0.0	56.0
Irbid-Janobi	3,835	2,111	0	0.0	0.0	55.1
Irbid-Sharki	23,344	13,267	0	0.0	0.0	56.8
Irbid-Turkman	2,650	1,303	0	0.0	0.0	49.2
Jerash-Balilah	2,700	1,825	0	0.0	0.0	67.6
Jerash-city	12,016	9,201	0	0.0	0.0	76.6

Mafraq-Baej	250	100	0	0.0	0.0	40.0
Mafraq-city	16,974	10,752	0	0.0	0.0	63.3
Ramtha	5,114	2,683	0	0.0	0.0	52.5
Total	**78,774**	**48,527**	**0**	**0.0**	**0.0**	**61.6**

Table 11. Toilets Statistics

Toilets				
Area	**Volume of Toilet Tank**	**Avg. Frequency use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Ajloun-city	8.39	5.1	N/A	1.9
Ajloun-Kofranja	8.1	4.8	N/A	1.7
Irbid-Janobi	8.42	4.7	N/A	1.7
Irbid-Sharki	8.52	4.9	N/A	2.2
Irbid-Turkman	9.26	4.2	N/A	1.7
Jerash-Balilah	9	4.5	N/A	1.4
Jerash-city	8.7	4.6	N/A	1.8
Mafraq-Baej	9	4.5	N/A	1
Mafraq-city	9.32	4.4	N/A	1.8
Ramtha	8.9	4.2	N/A	1.6
Total	8.77	4.6	N/A	**1.8**

Table 12. Kitchens Statistics

Kitchen Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequency use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Ajloun-city	11.6	4.04	11.5	1.1
Ajloun-Kofranja	9.8	5.17	9.78	1
Irbid-Janobi	8.4	5.27	11.23	1
Irbid-Sharki	9.6	5.86	11.22	1.1
Irbid-Turkman	8.8	6.09	9.76	1
Jerash-Balilah	9.2	4.44	9.22	1
Jerash-city	9.2	5.19	10.93	1
Mafraq-Baej	10.9	5.78	8.67	0.8
Mafraq-city	8.9	11.66	10.27	1
Ramtha	8.5	5.34	12.82	1
Total	9.2	**6.69**	**10.92**	**1**

Table 13. Bathrooms Faucets Statistics

Bathroom Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequancy use/day**	**Avg.**	**Avg. Number of**

			Duration	Fixture
Ajloun-city	15.2	N/A	N/A	1.7
Ajloun-Kofranja	15.5	N/A	N/A	1.7
Irbid-Janobi	14.7	N/A	N/A	1.8
Irbid-Sharki	19	N/A	N/A	2.2
Irbid-Turkman	14.4	N/A	N/A	1.7
Jerash-Balilah	13.5	N/A	N/A	1.4
Jerash-city	14.6	N/A	N/A	1.7
Mafraq-Baej	11.3	N/A	N/A	1
Mafraq-city	16.5	N/A	N/A	1.8
Ramtha	12.4	N/A	N/A	1.6
Total	15.8	N/A	N/A	1.8

Table 14. Showers Statistics

Shower Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequancy use/week**	**Avg. Duration**	**Avg. Number of Fixture**
Ajloun-city	8.5	3.6	14.3	1.1
Ajloun-Kofranja	7.2	3.8	14.3	1.2
Irbid-Janobi	7	5.3	15.9	1.3
Irbid-Sharki	9.5	5.1	13.8	1.5
Irbid-Turkman	8.1	3.9	12.4	1.1
Jerash-Balilah	5.8	3	14.1	0.9
Jerash-city	7.8	4.1	13.8	1.1
Mafraq-Baej	7.6	2.3	11.8	0.8
Mafraq-city	8.9	3.7	15	1.3
Ramtha	7.2	3.6	14.2	1.3
Total	8.3	**4.20**	**14.10**	**1.3**

Table 15. Some Useful Percentages

Appliances		**Utility**		
		MIYAHUNA	**NGWA**	**AW**
Dish Washer		4.5	1.1	0.3
Washing Machine	**Automatic**	42	42	41
	Two Compartments	57	57	59
Cooling Types	**Air Conditioner**	14.3	14.3	60.6
	Desert Air Conditioner	0.7	0.7	37.1

Central Air Conditioner	0	0	0
Jacuzzi	1.7	0.3	1.4
Having Garden	27.3	32.6	23
Turkish Toilets	26.9	48.7	38.3
Tank Toilets	65.3	40.3	53.3
Both (Turkish and Tank) Toilets	7.7	11.1	8.3
Ratio of bidet to hoses	1.3	94	93.8
dual flash toilets	6.8	2.8	3.7
Average Volume of Swimming Pool (m3)	63.94	0	0
Percentage of subscribers who are aware of WSD's	46.9	49.7	46.2
Percentage of subscribers already installed WSD's	5.5	4.8	3.7
Percentage of subscribers who re-use water for irrigation	21.9	29.3	33.1
Percentage of subscribers have water harvesting well	3	6.7	0
Percentage of subscribers who use tanker water	5	23.5	0
Percentage of subscribers fills the bathtub	1.6	1.4	0.3

Appendix F: AW Raw Data

Data of the 353 filled questionnaires collected at the AW service area was extracted from the Database and analyzed using the SPSS software.

Table 1. Percent Distribution of the Subscribers by Wealth Class and Area

Area	Wealth Class			Total	No. of Households
	Poor	Middle	Rich		
Almahdoud Area	50.6	37.2	12.2	100.0	180
Third Area	24.7	25.9	49.4	100.0	81
Fifth Area	6.3	29.2	64.6	100.0	48
Eight Area	9.1	36.4	54.5	100.0	44
Total	**33.4**	**33.4**	**33.1**	**100.0**	**353**

Table 2. Percent distribution of Subscribers by Billed Water Consumption Quintiles

Area	Billed Water Consumption Quintiles (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Almahdoud Area	54	30.0	47	26.1	33	18.3	32	17.8	14	7.8	180	100.0
Third Area	25	30.9	16	19.8	9	11.1	15	18.5	16	19.8	81	100.0
Fifth Area	12	25.0	8	16.7	18	37.5	5	10.4	5	10.4	48	100.0
Eight Area	12	27.3	12	27.3	10	22.7	5	11.4	5	11.4	44	100.0

Table 3. Percent distribution of subscribers by water consumption group and wealth index class

Wealth class	Billed Water Consumption Group (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Poor	44	37.3	30	25.4	17	14.4	20	16.9	7	5.9	118	100.0
Middle	36	30.5	27	22.9	29	24.6	13	11.0	13	11.0	118	100.0
Rich	23	19.7	26	22.2	24	20.5	24	20.5	20	17.1	117	100.0
Total	**103**	**29.2**	**83**	**23.5**	**70**	**19.8**	**57**	**16.1**	**40**	**11.3**	**353**	**100.0**

Table 4. Percent distribution of subscribers by water consumption group and Income group

Income groups	Billed Water Consumption Group (m3/hh/day)	Total

	lowest		Second		Middle		Fourth		Highest			
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Less than 1001	87	31.4	66	23.8	50	18.1	44	15.9	30	10.8	277	100.0
1001 – 2000	1	7.1	1	7.1	7	50.0	2	14.3	3	21.4	14	100.0
2001+	0	0.0	1	33.3	0	0.0	1	33.3	1	33.3	3	100.0
Unknown	15	25.4	15	25.4	13	22.0	10	16.9	6	10.2	59	100.0
Total	**103**	**29.2**	**83**	**23.5**	**70**	**19.8**	**57**	**16.1**	**40**	**11.3**	**353**	**100.0**

Table 5. Percent distribution of subscribers by water consumption group and housing unit type

Housing unit type	**Billed Water Consumption Group (m3/hh/day)**										**Total**	
	lowest		**Second**		**Middle**		**Fourth**		**Highest**			
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Apartment	92	29.7	79	25.5	59	19.0	48	15.5	32	10.3	310	100.0
Villa/Dar	11	25.6	4	9.3	11	25.6	9	20.9	8	18.6	43	100.0
Total	**103**	**29.2**	**83**	**23.5**	**70**	**19.8**	**57**	**16.1**	**40**	**11.3**	**353**	**100.0**

Table 6. Percent distribution of subscribers by water consumption group and Gender of Respondent

Gender of respondent	**Billed Water Consumption Group (m3/hh/day)**										**Total**	
	lowest		**Second**		**Middle**		**Fourth**		**Highest**			
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Male	58	29.3	44	22.2	38	19.2	35	17.7	23	11.6	198	100.0
Female	45	29.0	39	25.2	32	20.6	22	14.2	17	11.0	155	100.0
Total	103	29.2	83	23.5	70	19.8	57	16.1	40	11.3	353	100.0

Table 7. Percent distribution of subscribers by water consumption group and age groups of members

Age groups of members	Billed Water Consumption Group (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0-14	198	31.7	152	24.4	122	19.6	85	13.6	67	10.7	624	100.0
15 - 24	147	28.7	101	19.7	98	19.1	102	19.9	64	12.5	512	100.0
25 - 34	81	28.9	57	20.4	50	17.9	59	21.1	33	11.8	280	100.0
35 - 44	58	27.4	54	25.5	50	23.6	29	13.7	21	9.9	212	100.0
45 - 54	57	27.9	41	20.1	42	20.6	36	17.6	28	13.7	204	100.0
55 - 64	39	33.9	26	22.6	15	13.0	20	17.4	15	13.0	115	100.0
65 +	22	25.6	26	30.2	16	18.6	14	16.3	8	9.3	86	100.0
Total	**602**	**29.6**	**457**	**22.5**	**393**	**19.3**	**345**	**17.0**	**236**	**11.6**	**2033**	**100.0**

Table 8: Percent distribution of subscribers by water consumption group and Education level of members

Education level of members	Billed Water Consumption Group (m3/hh/day)										Total	
	lowest		Second		Middle		Fourth		Highest			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Illiterate	22	41.5	10	18.9	6	11.3	8	15.1	7	13.2	53	100.0
Read & write	4	8.9	18	40.0	6	13.3	9	20.0	8	17.8	45	100.0
Elementary	80	36.7	43	19.7	26	11.9	44	20.2	25	11.5	218	100.0
Secondary	129	27.4	104	22.1	88	18.7	97	20.6	53	11.3	471	100.0
Inter diploma	45	30.0	30	20.0	35	23.3	28	18.7	12	8.0	150	100.0
Bachelor	64	23.5	67	24.6	66	24.3	37	13.6	38	14.0	272	100.0
High diploma	0	0.0	0	0.0	1	100.0	0	0.0	0	0.0	1	100.0
Master degree	3	30.0	1	10.0	3	30.0	2	20.0	1	10.0	10	100.0
Ph.D	1	25.0	1	25.0	1	25.0	1	25.0	0	0.0	4	100.0
Total	**348**	**28.4**	**274**	**22.4**	**232**	**19.0**	**226**	**18.5**	**144**	**11.8**	**1224**	**100.0**

Table 9. Volume of cubic meters storage per household

Areas	No. of Households	Volume (m 3)	Mean of Volume
Almahdoud Area	180	395	2.19
Third Area	81	183	2.26
Fifth Area	48	126	2.63
Eight Area	44	113	2.57
Total	353	817	2.31

Table 10: Ratio of grass area to the total planted area

Areas	Garden Area m2	Planted Area m2	Grass Area m2	% Grass Area to Garden Area	% Grass Area to Planted Area	% Planted Area to Garden
Almahdoud Area	3,158	1,637	15	0.47	0.92	51.82
Third Area	1,486	812		-	-	54.61
Fifth Area	2,873	1,434	10	0.35	0.70	49.90
Eight Area	416	213		-	-	51.08
Total	7,933	4,094	25	0.32	0.61	51.61

Table 11: Toilets Statistics

Toilets				
Area	**Volume of Toilet Tank**	**Avg. Frequency use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Almahdoud Area	**8.34**	**5.2**		**1.8**
Third Area	**8.52**	**5.2**		**1.6**
Fifth Area	**7.92**	**4.8**		**2.3**
Eight Area	**7.92**	**4.8**		**2.5**
Total	**8.25**	**5.1**		**1.9**

Table 12: Kitchens Statistics

Kitchen Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequency use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Almahdoud Area	12.7	5.12	11	1
Third Area	12.0	5	10	1
Fifth Area	12.0	4.73	11	1.1

Eight Area	11.2	5.09	12	1
Total	**12.3**	**5.04**	**11**	**1.1**

Table 13: Bathrooms Faucets Statistics

Bathroom Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequency use/day**	**Avg. Duration**	**Avg. Number of Fixture**
Almahdoud Area	19	N/A	N/A	1.8
Third Area	18.5	N/A	N/A	1.6
Fifth Area	24.2	N/A	N/A	2.4
Eight Area	25.3	N/A	N/A	2.4
Total	**20.3**	N/A	N/A	**1.9**

Table 14: Showers Statistics

Shower Faucets				
Area	**Avg. Flow Rate**	**Avg. Frequency use/week**	**Avg. Duration**	**Avg. Number of Fixture**
Almahdoud Area	7.5	8	13.5	1.2
Third Area	8	6.9	14.1	1.2
Fifth Area	10.8	7.6	13.8	1.6
Eight Area	11.5	6.8	12	1.6
Total	**8.5**	**7.5**	**13.5**	**1.3**

Table 15: Some Useful Percentages

Appliances		**Utility**
		AW
Dish Washer		**0.3**
Washing Machine	**Automatic**	**41**
	Two Compartment	**59**
Cooling Types	**Air Conditioner**	**60.6**
	Desert Air Conditioner	**37.1**
	Central Air Conditioner	**0**
Jacuzzi		**1.4**
Having Garden		**23**
Turkish Toilets		**38.3**
Tank Toilets		**53.3**
Both (Turkish and Tank) Toilets		**8.3**
Ratio of bidet to hoses		**93.8**
dual flash toilets		**3.7**
Average Volume of Swimming Pool		**Zero**

Percentage of subscribers who are aware of WSD's	**46.2**
Percentage of subscribers already installed WSD's	**3.7**
Percentage of subscribers who re-use water for irrigation =33.1	**33.1**
Percentage of subscribers have water harvesting well	**0.0**
Percentage of subscribers who use tanker water	**0.0**
Percentage of subscribers fills the bathtub	**0.3**