

**Full Length Research Paper**

# Social Perception towards Rooftop Rainwater Harvesting–A Case Study of Addis Ababa, Ethiopia.

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**Abstract**

The Rooftop Rainwater Harvesting systems have turned to be dependable and sustainable approaches towards meeting the water crisis; and several research works are being carried out to investigate their feasibility. The success of any sustainable measures depends on the appreciable approaches from the people. A research work was conducted by the authors to assess the Rooftop Rainwater Harvesting potential of Addis Ababa, and this paper addresses the key findings pertaining to the social perceptions towards adopting RRWH systems to sustainable usage of water supply. Descriptive research method was adopted for the study, the primary and secondary data sources included; information obtained from questionnaires/interviews (400Nos-Households, 12Nos -Institutions and 3Nos - Key informants) and data collected from published and unpublished documents relevant to the topic respectively. The collected data were analyzed through SPSS quantitatively and by applying narration qualitatively. The study revealed that, 65% of the respondents were not satisfied with the current city water supply putting the problems of interruption at frontline. It was found that a significant number of respondents had an experience of rooftop rainwater harvesting, 80% of the respondents believed that the system could become an alternative sustainable source of urban water supply and were willing to participate in any way possible. Finally the study concluded that, RRWH systems would turn to be a socially acceptable alternate water source, there is need for strengthening policies and promoting awareness levels many cities of Ethiopia, Addis Ababa in particular.

**Key Words;** Sustainable water measures, Rooftop Rainwater Harvesting Systems (RRWH)

**Introduction**

All over the world, urban water supply and consumption systems are facing many challenges to meet the water demands due to rapid urbanization. Due to the constraints in terms of limited sources, financial and technological capabilities, the conditions are more severe in the developing nations. Ethiopia is the most rapidly urbanizing country among the sub-Saharan Africa, and Addis Ababa being the capital city is experiencing huge pressures due to the developmental crisis. Until recently Addis Ababa doesn't have proper urban planning; the city simply grew in a natural organic way, unforced and unstructured. This unmanaged expansion of Addis Ababa has put pressure on different services and infrastructures, one of which is municipal water supply. Better living hopes attract more and more people to migrate, but the capacity to accommodate is limited (Kidist & Mahesh).

Rain water harvesting is getting increased consideration worldwide as a sustainable approach to augment water sources and to address the increasing water demands. The Rooftop RWH is one of the simplest ways of providing drinking water at household level. Most of the researches that were conducted in Ethiopia were conducted giving attention only to the rural areas in the aspects of the RWH towards agricultural value and similar studies about the potential usage of RWH in the urban set up were very rare. It was identified from various research studies in this field for assessing the potential of RRWH that, most of them could not effectively address the social, economic, political and local preference aspects of the system. They have merely focused on the amount of the water that could be collected from the specific study area. Assessing the potential of the system is helpful for advocating rainwater harvesting as an important contribution towards meeting the MDGs target on water and the African Water Vision.(RELMA UNEP, 2005).

The Addis Ababa urban water supply system is characterized by a low output capacity, inadequate networks and huge transmission losses. Water supply for both household and industry consumption is provided by Addis Ababa water and Sewerage Authority

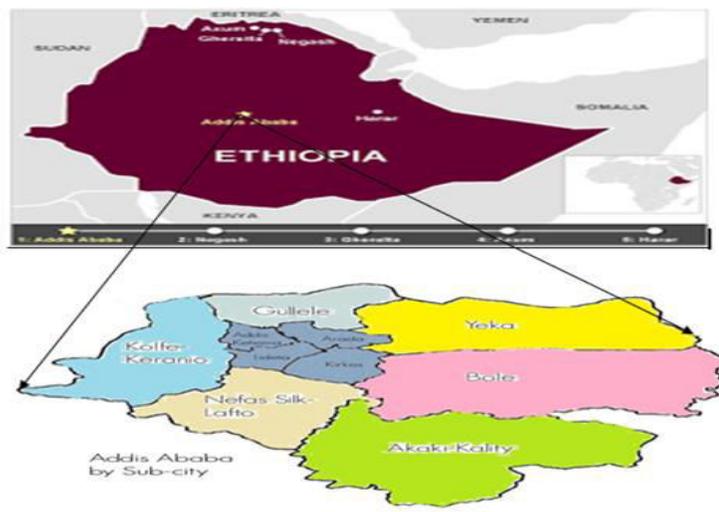
(AAWSA) by extracting the surface and subsurface water sources. The city water demand is not met by more than 60% (AAWSA, 2017) and it is expected to address the estimated 36.5 % leakage of water supply in the system as a way of ensuring that more potable water is made obtainable for the population (World Bank, 2015). Due to high cost and limitations on the availability of land, most of the surface water reservoirs and dams are built outside of the city jurisdiction, and within the city limits the groundwater is being exploited without any restrictions or controls. These activities are contributing mostly towards the decline of ground water table, huge cost involvement in the establishment and conveyance of water are pressing the existence of water crisis. Hence there is a need to search for an alternative water supply within the boundaries of the city which is less in economy, environmentally bearable and socially acceptable, like rainwater harvesting.

The present study was undertaken to assess the RRWH potential of Addis Ababa city, and also to evaluate the public perception toward the adaptation of RRWH systems. Both quantitative and qualitative studies were carried out during the study period (2017), to address the objectives of the study. The focus of this study is to investigate and introduce ways for implementing rooftop rainwater harvesting as an alternative resource for urban water supply in the case of Addis Ababa. Because of the limited capacity of the city administration, rainwater harvesting could become other option in helping the provision of the service as additional and important way in solving the problem. By applying rainwater harvesting in many institutions, manufactures, individual houses; the workload, water pressure and work burden on part of AWASA will be greatly reduced. For this, bringing awareness among the people and organizations will ensure effective and efficient rainwater harvesting systems. However, this paper presents the observations pertaining to the social attitudes of the respondents and the measures needed for encouraging the community involvement in various sustainable measures adopted.

## Materials and methods

### Study area

Addis Ababa is the capital city of Ethiopia, situated at an elevation of 2355m above mean sea level and an average rainfall is about 1165mm (NMA, 2017). For administrative convenience, the city is divided in to 10Nos of Sub Cities and 116Nos of Woredas. The study was conducted in 2017 to assess the potential of rainwater harvesting and the to ascertain the public awareness. The amount of RRWH that could be harvested was also calculated for the dormitory building of Ethiopian Civil Service University. . For assessing the social perception four subcities, viz., Bole, Gulele, Yeka and Kolfe Keraniyo were used as study areas.



**Fig.1** Map of Addis Ababa City (Source; Addis Ababa City Administration, 2015)

### Data Sources

The Population of the study from which the sample is to be drawn comprises from the city of Addis Ababa. The justification for choosing this particular city was due to the fact that, there are serious shortcomings in the provision of water supply to the city. The sampling frames in this study includes Households, Manufactures/Industries, Service provider institutions (Hospitals, Schools, Universities etc.), Business areas/centers within the city of Addis Ababa.

The study incorporated the extensive usage of both primary and secondary data. The primary data included the information gathered from the sampled respondents and Key Informants through Questionnaires and Interviews. In this particular study, the sources for these data were Institutions, Households, People and different responsible connected with the Government and Non-Government organizations; such as AAWSA (Addis Ababa Water and Sewerage Authority) and ERHA (Ethiopian Rainwater Harvesting Association). The secondary data in this study included rainfall data, roof area of the buildings, water supply and consumption details obtained from Addis Ababa Water and Sewerage Authority –AAWSA, Ethiopian Rainwater Harvesting Association – ERHA, Federal Democratic Republic of Ethiopia Policy documents, World bank and UNEP reports.

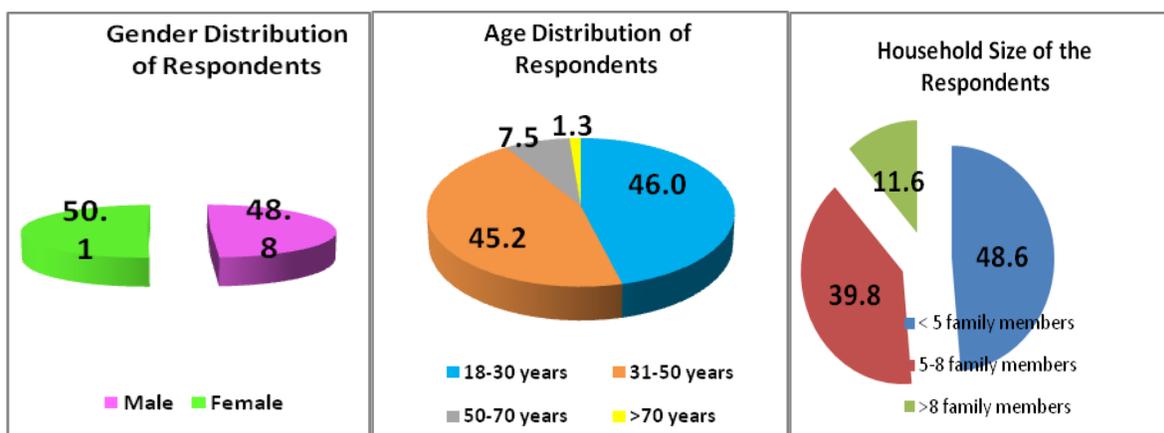
*Data Collection and analysis*

In the study both random sampling was adopted for household respondents and purposive sampling for interview purpose to identify the respondents. The sample size for the households was drawn from the total number of households found in Addis Ababa. Using Yamane (1967) formula, the sample size was determined to be 400Nos Households. These were approximately 400 households for the four randomly selected sub cities. Since every sub city has different population size the sample size for each sub city among the selected four sub cities was determined by taking the proportion technique. And the sample respondents drawn from the four sub cities, viz Kolfe Keraniyo, Yeka, Bole and Gulele are 117 Nos, 109Nos, 95Nos and 75Nos respectively. The sample size for the industries, Educational Institutions, Hospitals, Hotels and different service provider big institutions was determined using purposive sampling method. Therefore, for each sub city 3Nos institutions (industry, service provider and business center) were selected purposively and the total number of the sample size would became  $3 \times 4 = 12$ Nos institutions. The number of the respondents for the interview of officials was limited to maximum size of 5Nos respondents.

A pilot study was conducted before commencing of actual research experiment to examine the reliability of the open ended and semi structured questionnaires, and the comments made were incorporated. A total of 400Nos questionnaires were distributed randomly to households in the sampling frame, and out of them 389Nos questionnaires were returned back, which indicated the response rate was 97.2% of the total sample size. Regarding discussions with the Key Informants, proper orientation was given beforehand and consent was gained for entertaining the interview. For getting the right information regarding water supply system in the city of Addis Ababa and the RRWH system practices the key informants were selected for interview by using purposive sampling. Questionnaires were prepared for the households and institutions which were containing three sections namely demographic data, Water consumption and Water Conservation. After collecting the data descriptive analysis was conducted by using SPSS version 21. Data analysis was done by both Qualitative and Quantitative analysis methods using SPSS and Microsoft Excel Program. The analyzed data was interpreted in the context of the objective and specific research questions.

**Results***Demographic details*

The general demographic information gathered from the research indicated that gender distribution was almost equal but the distribution among the household size was varying. The family size with less than 5Nos family members had scored almost half of the total respondents. However the family size greater than 8Nos have scored the least in frequency. The family size analysis indicate more water requirements for their domestic needs, and the methods adopted by them for alternative sources will provide a good information for the study. The age distribution among respondents found to have equal distribution between 18-30 and 30-50 years of age, which comprised mostly educated and working sectors, and their responses had enriched the quality of the present study.



**Fig 2:** Demographic details of the respondents

*Sources of water supply*

It was aimed at extracting information from the people about their ideas about the water supply service, problems and suggested improving mechanisms regarding the use of rainwater harvesting. Hence, questions were posed relating to existing conditions of the available sources, expenditure towards water consumption, etc.

It might be inferred from the fig above, that about 80.6% were having individual tap connections through which the water is supplied by AAWSA, while the rest of the households were getting water from Wells and by Purchasing from private sources. In case of non-availability of water, the respondents stated that, about 66.1% purchase from private taps of another owners and 18.7% of them used tap water from a shared pipeline (Bono). It is to be noted that about 6.7% have opted rainwater collection as an alternative sources of water, and it is a good sign that few respondents had experiences of collecting and using rainwater.

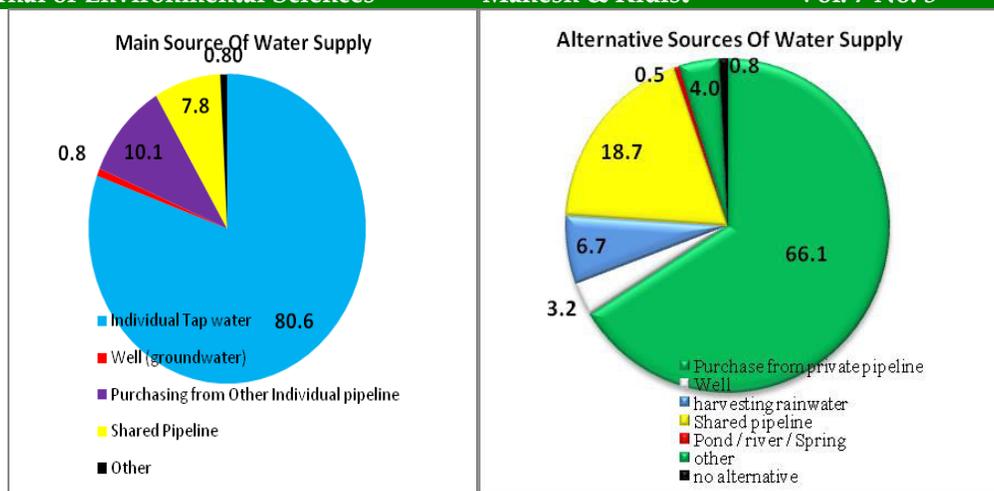


Fig. 3 Source of water supply (Source; Field survey 2017)

Reasons for Dissatisfaction

It was observed that almost 65% of the users are not satisfied with the existing water supply conditions of the city. They have different issues concerning their dissatisfactions which included interruption, availability, cost and cleanliness. During the analysis it was examined that the dissatisfaction was initiated mostly due to availability, interruption and cleanliness. The respondents exhibited intermediate levels of dissatisfaction due to the cost of water from the government tap water. When asked about the frequency of interruptions, about 34.8% of them stated that they were not worried about interruptions, whereas most of them, about 28%, 13.8%, 7.4% and 15.6% have expressed deep pain that they get water once in 2-3days, once 4-5days, once in 6-7days and once in over a weekdays, respectively.

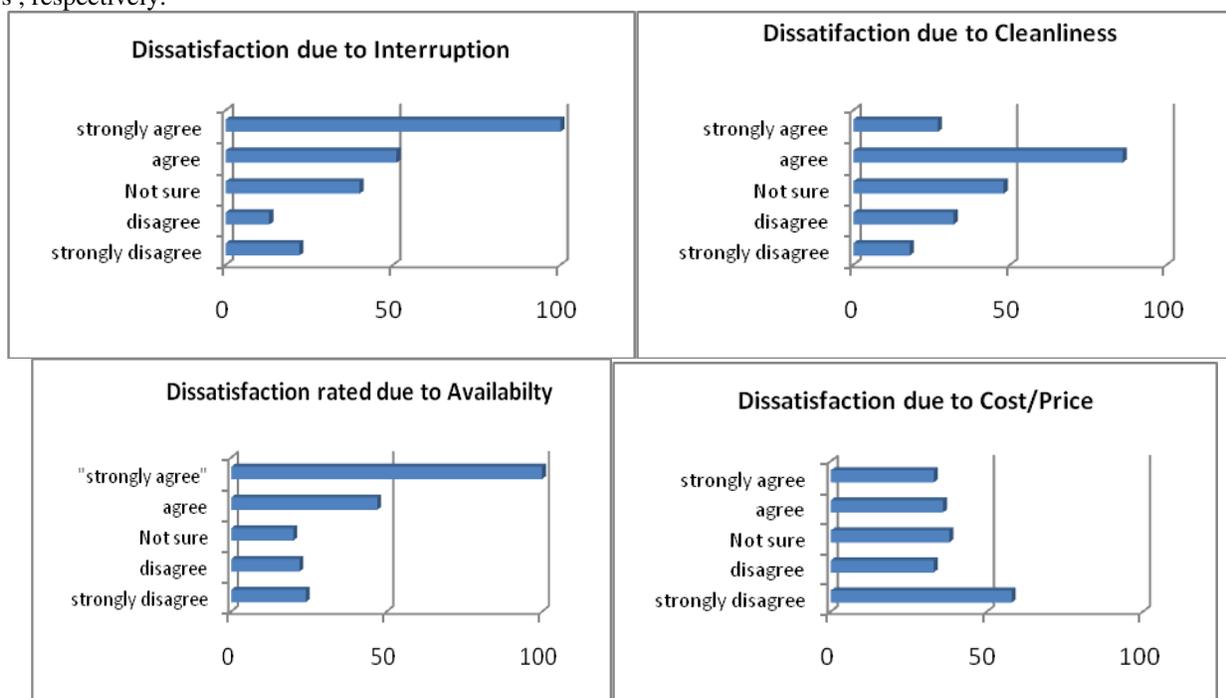


Fig 4 Reasons for Dissatisfaction in Current Water Supply (Source; Field Survey 2017)

Awareness Regarding RRWH Systems

When asked about the experience of practicing RRWH, It was observed that out of 387Nos respondents, about 64% had prior experience whereas 36% do not have any. There were also a significant number of people who do believe in collecting rainwater as an other source of water but on practical they are not doing it due to many rationale. Out of 305 Nos respondents who stated that they support RWH systems, 146Nos of them do not want to practice it. The reasons stated by them for not practicing are huge cost involved in construction, lack of knowledge, lack of reliability on the quality of rainwater, limited space availability etc. Among the justifications given for not collecting rainwater, having no belief in the system is the main reason next to lack of own houses. The people residing in rented houses are not in favour of attempting to constructing RRWH systems. Regarding the methods of collecting rainwater, There was a wide experience of traditional methods of water harvesting in the society. Constructing modern harvesting

systems is almost null due to many reasons. The end use of the harvested rainwater was also studied, and it was noticed that most of it was used to meet the requirements of cleaning utensils and washing clothes.

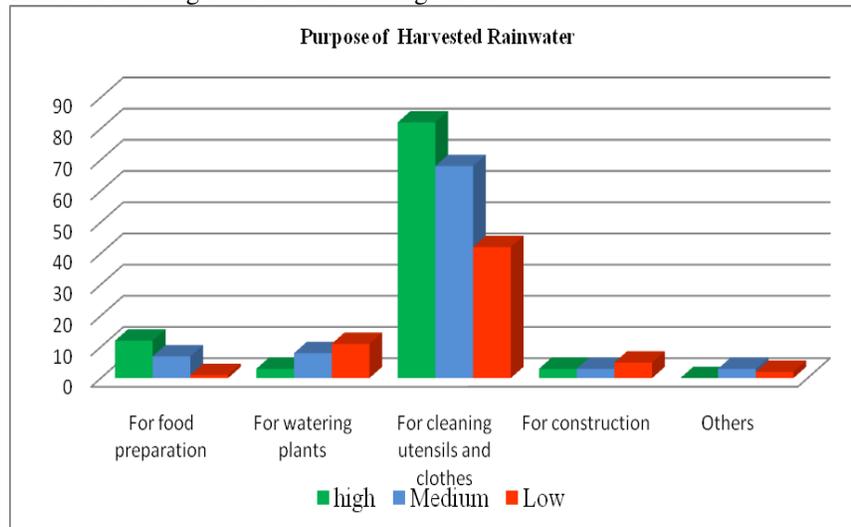


Fig 5 Usage of Harvested Rainwater for Various Purposes (Source; Field Survey 2017)

In the study, it was noticed that the education level of the respondent highly affected the level of participation towards these measures. The respondents were willing to offer their services in terms of finance, labor and skill. The breakup of the responses is shown below.

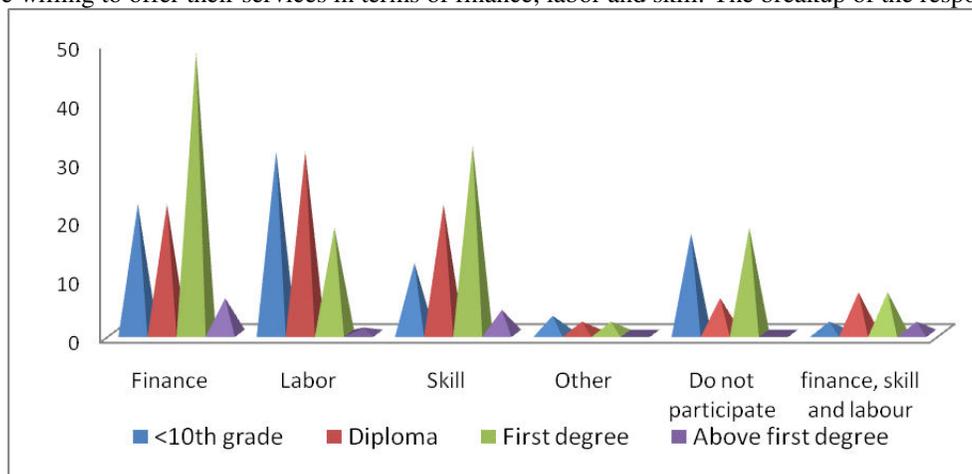


Fig.6 Interest areas to participate in RRWH systems (Source; Field Survey 2017)

*Awareness among Institutions and Public Buildings*

During the survey, questionnaire were distributed among a total of 12 institutions which included Hospitals, Schools, Business buildings and Manufacturing industries. Almost all of these institutions obtained water from the Municipal water line from AAWSA and 16.7 % of them have used private dug wells additionally. When they were asked about the satisfaction rate on water supply, about 58.3% of them were satisfied, which included hospitals and schools. About their experiences of RRWH, none of them have experience in harvesting rainwater for domestic or other purposes. During the observation, it was assessed that due to the vast roof areas of the institutions, they have a potential of RRWH. Because they have high water consumption rate, if they apply RRWH it will have a great impact in reducing water supply pressure to the city.

*Remarks of Key Informants*

Apart from the general information provided, the noteworthy remarks stated by the key informants are;

- Addis Ababa has a great potential of Rain Water Harvesting with its average annual rainfall and the vast area of the catchment surface.
- The water quality of Rainwater by nature is good as it is categorized as soft water, but the actual quality depends on the catchment area and type of roofing.
- Due consideration must be given in the Urban Developmental Plans to promote and encourage the construction of RRWH systems for high building setups.

### Discussion

KwadwoOwusuet al; (2014) evaluated the possibilities of supplementation of urban water supply with rainwater harvesting in Accra, Ghana, and the study examined the challenges associated with rainwater harvesting and usages in Peri-Urban Accra. Various issues such as perceptions on rainwater usage, cost of RWH systems, quality of rainwater, and challenges associated with the use of rainwater were extensively interviewed. It was identified that, though there was ample potential for meeting the water demands by utilizing rainwater, the cost involvement and perception towards the utility were the major constraints. Finally, it was highly recommended that creating awareness and educating the respondents, rendering governmental support to invest in RWH systems would contribute to the success. In this particular study, it was found that about 65% of the users were not satisfied with the existing water supply conditions of the city. The reasons such as frequent interruptions, non-availability, costs involved and cleanliness were the major contributing factors towards dissatisfaction. During the field observation, it was noted that the water losses due to leaks are common, and the AAWSA is taking up measures to prevent them. With regards to the practicing of RRWH, about 64% of the respondents have prior experience in these activities. But the water harvested was mostly utilized towards washing and cleaning purposes only. The reasons behind was the perception of rainwater being inferior quality. Though the responses towards utilizing RRWH options as a sustainable measures was appreciable, the hindering factors were high construction costs, residing in rented houses, lack of knowledge, perception that rainwater is of inferior quality, etc.

Finally it may be concluded that, the reasons stated by respondents for not practicing RRWH in this particular study area were more or less similar to the views obtained from earlier research studies. Suitable measures must be ensured on part of the city administration for improving the awareness levels and adopting the RRWH systems. It is noted that, without the participation and acceptance of the people nothing will go beyond theory.

### Conclusion

From the study, it may be concluded that Addis Ababa is facing water scarcity and the main reason for dissatisfaction among the consumers is the frequent interruptions in supplying water for meeting the basic needs. The concerns on the part of AAWASA are limited resources availability, rapid increase in the urban population and other economical related issues. The availability of wide roofing area and high rainfall amounts, harvesting rainwater would be a sustainable approach for augmenting the water demands of Addis Ababa. To apply proper RRWH technology whether simple or complex, it is mandatory to have the support of the people in the specific area. In encouraging the systems, it is important that people are aware of it in the first instance. During the Social Survey 80% of the respondents believed that it could be an alternative approach in meeting the water demand of the city dwellers. They also are willing to participate by any means possible. Hence, the rooftop rainwater harvesting in Addis Ababa would be successful, if the government promotes and encourages these activities.

### Recommendations

- Water Demand Analysis of urban water supply systems must be ensured by AAWSA to implement the proper mechanism of rendering the city with water supply. Necessary measures must be ensured to reduce the water losses and alternative sustainable approaches like Rainwater Harvesting Systems, Groundwater recharge, etc should be promoted.
- Rainwater Harvesting (Rooftop) systems should be encouraged at the city level by the Government. Creating awareness and training program ensures a successful achievement. Establishing RRWH systems in big buildings and institutions must be made mandatory, to motivate the residents towards these measures.
- Water policies and regulations towards water conservation and sustainable strategies of Water Usage and Land Management must be legalized by government and stringent actions must be taken towards the defaulters.
- Provisions for inhibiting the percolation of rainwater into the ground reservoir aquifers must be ensured by reducing the extent of concrete cover on earth surfaces and allocating a certain percentage of the plot area towards. This will involve a dual coordination of sustainable Land and Water Management Practices.
- Government should be the front leader in taking the responsibility of promoting green development in the city which includes developing green areas, recharging ground water to prevent groundwater depletion, etc.

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