AN ANALYSIS OF PERCEPTIONS, KNOWLEDGE, AND MANAGEMENT OF RAINWATER HARVESTING (RWH) TECHNOLOGIES AMONG AGROPASTORALISTS IN ODWAYNE DISTRICT, SOMALILAND †

[ANÁLISIS DE LAS PERCEPCIONES, EL CONOCIMIENTO Y LA GESTIÓN DE LAS TECNOLOGÍAS DE RECOLECCIÓN DE AGUA DE LLUVIA (RWH) ENTRE AGROPASTORALISTAS DEL DISTRITO DE ODWAYNE, SOMALILANDIA]

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SUMMARY

Background. Despite the increased efforts in promoting rainwater harvesting (RWH) technologies, the benefits accrued from the adoption remain low. Understanding the causes of low adoption and the socioeconomic differences between adopters and non-adopters is important to inform interventions aimed at increasing the adoption. **Objective**. This study, therefore, sought to address this by assessing the differences in socio-economic and institutional attributes among adopters and non-adopters of RWH technologies, the knowledge, and perceptions of agropastoral regarding RWH, while also documenting the existing management and organizational structures for different RWH technologies in Odwayne District, Somaliland. Information from this study is essential in providing information about the existing RWH technologies for the effective planning of future interventions. **Methodology.** Participatory rural appraisal techniques were used in collecting qualitative data regarding the attitude and practices of rainwater harvesting techniques in the area. A multistage sampling technique was used to collect primary data from 194 respondents using a semi-structured questionnaire. Descriptive statistics like frequency and percentages were used to resent the data from the study. **Results.** Results showed a significant difference in terms of education and access to training among adopters compared to non-adopters of RWH technologies. The majority of the adopters of RWH technologies (88.8%) belonged to water associations. This shows that social capital among the adopters was very high. Membership to the water association/group is deemed necessary as members benefit from information sharing, access to water resources, and usage through collective action. The study also finds that crop-livestock integration was commonly practiced by more than three-quarters (75.6%) of both adopters and non-adopters in the area, thus multiple water use sources should be considered in future investments. Elders played a critical role in water resource regulation through the resolution of conflicts and disputes that arose from the access and utilization of the resources. **Implications.** The results of this study confirms most of the adopters of the RWH technologies had positive perceptions (ranging from good to excellent) regarding the RWH technologies. This shows that the technologies served their purpose and were effective in ensuring the availability of water for the communities during seasons where water was scarce. The extension also played a critical role in providing information to the communities regarding important aspects such as climate change, water treatment, watercatchment as well as RWH. **Conclusion**. Based on these results, the government should develop permanent water sources that are adequate for multiple use through collaboration with development organizations and NGOs. Technical knowledge among community members can also be improved through training and extension services as noted to be critical source of information among the adopters. Policies and interventions by the government should target the promotion of water harvesting techniques through the provision of capital as well as equipment that can be used to facilitate water harvesting by the communities.

Keywords: Community perceptions; Technology adoption; Rainwater harvest.

RESUMEN

Antecedentes. A pesar de los mayores esfuerzos para promover las tecnologías de recolección de agua de lluvia (RWH), los beneficios acumulados por la adopción siguen siendo bajos. Comprender las causas de la baja adopción y las diferencias socioeconómicas entre adoptantes y no adoptantes es importante para informar las intervenciones destinadas a aumentar la adopción. **Objetivo.** Este estudio, por lo tanto, buscó abordar esto mediante la evaluación

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de las diferencias en los atributos socioeconómicos e institucionales entre los adoptantes y no adoptantes de tecnologías RWH, el conocimiento y las percepciones de los agropastoralistas respecto a RWH, al tiempo que documenta las estructuras organizativas y de gestión existentes para diferentes tecnologías de RWH en el distrito de Odwayne, Somalilandia. La información de este estudio es esencial para proporcionar información sobre las tecnologías RWH existentes para la planificación eficaz de futuras intervenciones. **Metodología.** Se utilizaron técnicas de evaluación rural participativa para recopilar datos cualitativos sobre la actitud y las prácticas de las técnicas de recolección de agua de lluvia en el área. Se utilizó una técnica de muestreo de varias etapas para recopilar datos primarios de 194 encuestados mediante un cuestionario semiestructurado. Se utilizaron estadísticas descriptivas como frecuencia y porcentajes para reenviar los datos del estudio. **Resultados.** Los resultados mostraron una diferencia significativa en términos de educación y acceso a la capacitación entre los adoptantes en comparación con los no adoptantes de tecnologías RWH. La mayoría de los adoptantes de tecnologías RWH (88.8%) pertenecían a asociaciones de agua. Esto muestra que el capital social entre los adoptantes era muy alto. La membresía a la asociación/grupo del agua se considera necesaria ya que los miembros se benefician del intercambio de información, el acceso a los recursos hídricos y el uso a través de la acción colectiva. El estudio también encuentra que la integración de cultivos y ganado fue practicada comúnmente por más de las tres cuartas partes (75.6%) tanto de los adoptantes como de los no adoptantes en el área, por lo que se deben considerar múltiples fuentes de uso de agua en futuras inversiones. Los ancianos desempeñaron un papel fundamental en la regulación de los recursos hídricos a través de la resolución de conflictos y disputas que surgieron por el acceso y la utilización de los recursos. **Implicaciones.** Los resultados de este estudio confirman que la mayoría de los que adoptaron las tecnologías RWH tenían percepciones positivas (de buenas a excelentes) con respecto a las tecnologías RWH. Esto muestra que las tecnologías cumplieron su propósito y fueron efectivas para asegurar la disponibilidad de agua para las comunidades durante las temporadas en las que el agua escaseaba. La extensión también jugó un papel fundamental en el suministro de información a las comunidades sobre aspectos importantes como el cambio climático, el tratamiento del agua, la captación de agua y la RWH. **Conclusión.** Con base en estos resultados, el gobierno debería desarrollar fuentes de agua permanentes que sean adecuadas para usos múltiples mediante la colaboración con organizaciones de desarrollo y ONG. El conocimiento técnico entre los miembros de la comunidad también se puede mejorar a través de la capacitación y los servicios de extensión, como se ha señalado como una fuente fundamental de información entre los adoptantes. Las políticas e intervenciones del gobierno deben apuntar a la promoción de técnicas de recolección de agua a través de la provisión de capital y equipo que pueda ser utilizado para facilitar la recolección de agua por parte de las comunidades.

Keywords: Percepciones de la comunidad; Adaptación de tecnología; Recolección de agua de lluvia.

INTRODUCTION

Despite the crucial role of agriculture as the mainstay of the economy in most African countries, it is mostly rainfed systems. This is further escalated by the scarcity and unreliable rainfall that results in the loss of rainwater through non-productive pathways (Biazin *et al*., 2011). The Somali economy is mainly dependent on the livestock subsector, which mainly relies on the pasture and vegetation within the environment. Livestock production is the leading GDP contributor Somaliland at 60 %, making it the biggest exporter of livestock products, accounting for 91 % of animal products IGAD, (2013). Somaliland is characterized by variability in rainfall patterns, coupled with uncontrolled exploitation of soil and water resources Qadir *et al*. (2013). This has resulted in increased strain on soil functionality. The dependence on rain-fed agriculture has resulted in susceptibility due to climate variability which severely affects food production, therefore, impacting negatively on livelihoods Bunclark, L. (2011).

The efficient use of soil and water resources is important in improving livelihoods, amid the growing population in the drylands Recha *et al*. (2014). Agro-pastoral farmers in Somaliland, face many challenges relating to the enhancement of water productivity resulting from rainfed agriculture. This has resulted in significant efforts aimed at intra-seasonal dry spell through the adoption of new RWH technologies, resulting in an increased clamor for the adoption of soil and water conservation measures such as rainwater RWH technologies. Motsi *et al*. (2004) define rainwater harvesting as methods aimed at inducement, collection, storage, and conservation of surface runoff for agricultural production. Rainwater harvesting is the process of collecting rainwater from rooftop surfaces and other designed catchments, the collection of sheet runoff from the artificial ground or natural catchments for multiple uses Ezenwaji, (2014). According to Zingiro *et al.* (2014), the adoption of RWH technologies is seen as a major strategy for enhancing productivity and raising farm incomes in areas that are prone to drought. For a long time, environmental conservation as well as the sustainable use of land and water resources has been a major policy issue in many developing countries Shiferaw *et al*., (2013). Dean *et al.* (2012) assert that rainwater harvesting practices in various places in the world, and can deliver a convenient, low-cost, and sustainable source of clean water if well used.

In recent years, there have been increased and creditable efforts in supporting community-based rainwater harvesting projects through interventions by government institutions as well as developmental and non-governmental organizations in Somaliland. This has been aimed at increasing resilience to frequent droughts as well as enhancing food security among agro-pastoralist communities. This has led to an increase in the construction of dams, shallow wells, and *Berkads* underground water tanks around Odwayne District,Somaliland. Despite the increased efforts to promote RWH technologies and the benefits accrue from adopting RWH technologies, there has been low adoption. Wildemeersch *et al*. (2013) suggest that it is important to determine the low adoption rates of RWH technologies, in light of issues such as food security and infertile land. Similarly, there is limited empirical information regarding RWH especially in countries like Somaliland. Thus , it is important to assess the socioeconomic differences between adopters and non-adopters to provide an entry point for interventions to increase the adoption of the RWH technologies. This study, therefore, sought to fill this gap by assessing the socio-economic and institutional differences between adopters and non-adopters of RWH technologies, the knowledge and perceptions of agropastoral regarding RWH as well as documenting the existing management and organizational structures for different RWH technologies in Odwayne District, Somaliland.

This study provids information about the existing rainwater harvesting technologies for the effective planning of future interventions. It also provides policymakers with information in incorporating investments in rainwater harvesting technologies into the annual budgetary allocations of capital investments. The information also help policymakers and researchers develop cost-effective and appropriate RWH technologies and interventions for adoption by communities in Somaliland.

MATERIALS AND METHODS

Sampling and Research Design

A multistage sampling technique was then used to select respondents for the study. In stage one, the Odwayne District of Somaliland was purposively selected as the study area as it is one of the regions where there have been increased efforts to promote RWH technologies. The area is also dominated by agropastoral who practice small scale agriculture. In the second stage, villages were selected based on the intensity of adoption of RWH technologies. Villages with high adoption rates as well as those with lower rates of adoption were selected to cater to the differences in adoption. Respondents were divided into two strata: adopters and non-adopters of RWH technologies. A simple random sample was then used to select respondents from the two strata for interviews.

Sample size determination

The study adopted a random sampling procedure in obtaining the respondents for the survey. The sample frame of the study included a representative sample of the individuals living in the community.

The calculated sample was calculated based on the formula of proportional probability to an unknown population by Anderson *et al*. (2011) as stated below:

$$N = Z^2 (1\text{-}P)\, P/e^2 = [0.5(1\text{-}0.5)\, (1.96)\, 2 / (0.0703)2] = 194$$

Where,
N = sample size, Z = degree of confidence 1.96 %, e = error 0.0703, *p-value = 0.05*

Data collection

Participatory appraisal approaches such as Focus Group Discussion (FGD) and Key Informant Interviews (KIIs) and was used to collect qualitative data. The KIIs were conducted to gain an in-depth understanding of rainwater harvesting as well as to account for the difference in perspective from the different stakeholders. The key informants included lead farmers, extension officers, village elders, government institutions, and NGO officials. The FGDs were conducted with selected participants from the agropastoral community, elders, and government and NGO representatives to collect additional qualitative data on attitude and knowledge regarding rainwater harvesting techniques. Existing technologies, their sustainability, management by community and utilization levels, and benefits to the community were also discussed. The information generated from the FGD and key informant interviews were utilized to refine the study questionnaire used during data collection. Data collected from the FGD was analyzed and used to validate the descriptive results obtained in the study.

A semi-structured questionnaire was used for data collection after the pre-test. The primary data was collected through face-to-face interviews. The questionnaire was divided into different thematic areas that included the socioeconomic characteristics of the respondents, farm characteristics, the types of technologies as well as awareness and perceptions regarding the RWH technologies. A 5-level Likert scale was used to elicit responses from the respondents regarding the different levels of perceptions regarding the costs and use of RWH

technologies. The 5 levels include: very poor, poor, good, very good, and excellent.

Data Handling and Statistical Analysis

Quantitative and qualitative approaches were jointly used for data analysis. The Statistical Package for Social Sciences (SPSS) Version 22 software was used to capture the data from the questionnaires. Descriptive statistics like the means, standard deviations, and frequencies were calculated using the STATA 14 software. The results obtained were presented in tabular and graphical formats. Test of significance (*t*-tests) were also performed to establish significant differences between adopters and non-adopters of RWH technologies.

RESULTS AND DISCUSSION

Socioeconomic characteristics of adopters and non-adopters of RWH technologies

The socioeconomic and institutional characteristics of the adopters, as well as non-adopters of RWH technologies, are presented in Table 1. In both categories (adopters and non-adopters), most respondents were male. This is attributed to the the cultural practices in the area where men are primarily responsible for decision-making in the households and community. The men are involved in crop and animal production, whereas, the women play a secondary role in the household chores within the community. This leads to the low likelihood of women being involved in adoption decisions.

In terms of age, more than half of the respondents across both adopters and non-adopters were youthful farmers (below 35 years of age). Roles and duties within households that are labor-intensive such as crop and livestock production are primarily done by the youthful members of the household. The older members are primarily involved in making decisions and conflict resolution. According to Warsame (2018), the dominance of a productive age group is attributed to the fact that they are the ones involved in herd management and thus dominate the herding decision making for households. This justifies the dominance of younger members across adopters and non-adopters.

The level of education is always a crucial aspect that influences adoption decisions. Highly educated individuals have a higher likelihood of adopting newer improved technologies than those with low education levels. As shown in Table 1, there was a significant difference between the adopters and non-adopters ($t = 1.933$). Norris *et al*. (2007) in their study regarding community resilience and disaster readiness in assert that high numbers of uneducated members influence the coping capacity of a household. This in turn affects the decision-making at the household or individual level. The high illiteracy rate could be attributed to the time lost for water harvesting and collecting together with other household chores expenses for education and development (Warsame, 2018). Despite the low access to education across both samples, the education level was higher among adopters compared to non-adopters. Highly educated individuals are informed of RWH technologies and their benefits, hence a higher likelihood of adoption, compared to individuals with low or no education.

The average household size was 10, indicative of larger households. In communities around Somaliland, family structures and cultural practices result in larger families hence the dominance of large families. Arouna and Dabbert, (2010) indicated that the more the household size increases, the more their water need will increase. This results in the need for RWH technologies to increase the availability of water to meet the household demand. Elsewhere, Mugerwa (2007) and Bunclark (2011) report that the number of household members influences labor distribution in terms of the preparation and rehabilitation of RWH techniques.

Compared to other uses like exclusive crop or livestock production or homestead, the land was mostly used for mixed crop and livestock production by the majority of the households. This shows that crop-livestock integration was commonly practiced by more than three-quarters (75.6 %) of both adopters and non-adopters in the area. Awareness of RWH technologies was very high for both adopters and non-adopters. However, there was no statistical difference across the categories ($t = 0.283$). This highlights that most adopters, as well as non-adopters of RWH technologies, had prior knowledge regarding the technologies.

Awareness is generally viewed as a crucial determinant in adoption decisions, where, high awareness increases the probability of adoption. Due to a lack of knowledge in seeking alternatives, awareness creation is essential to agropastorals who derive their water from various sources. Calderone *et al.* (2014) in Sudan note that supporting programs aimed at providing food and revenue to rural settlements helps individuals cope with and mitigate the effects associated with multiple shocks. McGregor (2004) suggested that the creation of awareness helps pastoralists derive water from different sources. Thus, showing the crucial role

Table 1. Socioeconomic characteristics of the respondents.

Variables	Adopters (n= 80)	Non- adopters (n= 100)	Pooled (n= 180)	t-test
Socioeconomic characteristics				
Gender (% male)	78.8	82.0	80.6	0.545
Age (% 35years and below)	58.8	59.0	58.9	0.034
Education level				
No education	77.5	91.0	85.0	1.933*
Primary	21.3	9.0	14.4	
Secondary	-	-	-	
Tertiary/ College	1.25	-	0.6	
Education (% with education)	22.5	9.0	15	2.552***
Average household size	9 (4)	10 (4)	10 (4)	1.108
Main Income source (% farming)	7.5	5.0	6.0	0.693
Farm characteristics				
Average land size (acres)	2.9 (1.1)	3.2 (1.6)	3.1 (1.1)	
Usage of land				
Crop production	-	-	-	0.311
Livestock production	2.5	2.0	2.2	
Crop and livestock combined	75.0	76.0	75.6	
Homestead	-	1.0	0.6	
Other uses	22.5	21.0	21.6	
Awareness of RWH (% yes)	91.4	90.0	90.7	0.283
Institutional characteristics				
Agricultural training access (% yes)	88.8	76.0	81.7	2.214***

Note: ***, **, * are significance levels at 1, 5, and 10 percent respectively.
Source: Survey Data (2019).

of awareness in increasing the availability of water and hence the adoption of RWH technologies.

Access to agricultural training among adopters of RWH technologies was higher, compared to non-adopters, with a significant difference in access. Respondents who had access to training were likely to adopt RWH technologies as it provides them with knowledge information regarding the technologies, their benefits, and how to use them. Recha *et al*. (2014) working in Tharaka District, Kenya found that respondents accrued benefits resulting from access to extension and training, specifically on RWH technologies. The lack of training and awareness on RWH technologies results in lower rates of adoption of the practices.

Sources of water used by adopters and non-adopters of RWH technologies

The adoption of RWH technologies aims at mitigating the effects resulting from climate change. The water stored during floods is used during the dry seasons for irrigation, domestic use, and livestock production. The existence of technologies like *berkads (underground* water reservoirs used in arid areas to collect water during the wet season for use in the dry season) shows the existence of efforts to harness water for use. However, the exclusive use of *berkads* was the most commonly used source of water among adopters of RWH technologies (Table 2).

Shallow wells, boreholes, and springs were rarely used as sources of water by households across both adopters and non-adopters of RWH technologies as exhibited from the study. However, this was contrary to Warsame (2018) who revealed that the wells and boreholes were the most common sources of water for domestic use and livestock production in the Qardho District of Puntland. However, the boreholes and rainwater were the most common water sources for the majority of the households.

Water-related variables among adopters of RWH technologies are shown in Table 3. The access to water sources among adopters of RWH technologies was mainly restricted and controlled by groups or communities. The protection of water sources and regulation of the frequency of use was the best practices used in the management of water resources (Warsame, 2018). Control of the water resources and water use was mainly done by elders within the community. In communities within the areas, cultural practices give elders the authority to control and make decisions regarding important matters. Ahmed (2017) reported that traditional institutions in

Somaliland is the prime force in conflict resolution as well as regulation of access to resources like water, land, and pasture.

Table 2. Sources of waters among adopters and non-adopters of RWH technologies.

Main sources of water	Adopters (n= 80)	Non-adopters (n= 100)	Pooled (n= 180)
Berkad (Underground water tank)	61.3	19.0	37.8
Dams	2.5	-	1.1
Shallow well	1.3	-	0.6
Boreholes	-	-	-
Springs	-	-	-
Berkad and Bac	35.0	81.0	60.6

Source: Survey Data (2019).

Table 3. Access and management of water among adopters of RWH technologies.

Variables	Adopters (n= 80)
Water access related Variables	
Access to water (% restricted access)	6.7
Access to clean water (% yes)	7.5
Experienced water shortage (% yes)	93.7
Access to information on water (% yes)	94.0
Water management variables	
Abide by water use agreement (% yes)	95.9
Control of water use (% elders)	77.5
Experienced water-related conflict (% yes)	2.2
Participation in technology maintenance (% yes)	91.3
Group-related variables	
Membership to water association (% yes)	88.8
Appointment of leaders (% elected)	2.8

Source: Survey Data (2019).

In communities within the areas, cultural practices give elders the authority to control and make decisions regarding important matters. Ahmed (2017) reported that traditional institutions in Somaliland are the prime force in conflict resolution as well as regulation of access to resources like water, land, and pasture.

The elders dictate the frequency and basis of access and assignment of the roles regarding maintenance and management of the water sources. The disputes relating to the use and access of the water resources are therefore reported to the elders or authorities in charge, and disputes are then listened to and resolved. Gundel and Dharbaxo (2006) reported that traditional institutions are instrumental in establishing relatively stable structures relating to governance, jurisprudence, and security in communities in Somaliland. This helps in reducing conflicts related to resource access and use. Ahmed (2017) in his study in Somaliland acknowledges the important role played by traditional institutions like elders in maintaining law and order through customary law and elder-based leadership

The Government of Somalia has been at the forefront in developing a national strategic plan for integrated water resource management (IWRM), (rainwater harvesting (RWH), groundwater (GW), and shallow wells (SHW). According to Oduor and Gadain (2007), the Water Act for Somaliland aimed at recognizing legitimatizing empowering, and endorsing Somaliland's customary laws and as well as traditional institutions in administrative, fiscal, and judicial affairs relating to water use. Join this to the next

Restriction of the water sources was mainly based on membership to the association and seasonality. Association members had privileged access to the water resources controlled by the association while non-members were restricted in terms of access and utilization to the water resources. Seasonality was also a factor that influenced restriction. During the wet season, there were fewer restrictions regarding the water sources as the water was readily available for use. However, scarcity during the dry season resulted in restrictions regarding access and use due to the unavailability of water. The restrictions put in place during the dry season are meant to regulate and control the use of the water to ensure the conservation of the resource because of the scarcity.

The majority of the adopters of RWH technologies (88.8 %) belonged to water associations. This shows that social capital among the adopters was very high. Membership to the water association/group is deemed necessary as members benefit from information sharing, access to water resources, and usage through collective action. Members of water associations are provided with privileges such as access to water sources which was mainly restricted. Studies like Odendo *et al*. (2010) in Western Kenya and Zingiro *et al*. (2014) in Rwanda report that membership in groups' plays a role in influencing adoption through collective action, which influences the adoption of new techniques. The existence of strong water

associations and groups creates an avenue for information sharing and access to group-based training, extension, and water-related benefits.

Most of the leaders in the water association are elected to different positions by the members of the association and community members. Leadership structures are important in groups especially on matters requiring decision making. Leaders in the groups are elected to act as representatives and pursue interests that are beneficial to the other members. De Fraiture (2007) in his study on integrated water and food analysis at the global and basin level in …, suggests that local people's participation in decision making and implementation of suitable strategies and institutions for water resource management is key in establishing resilient strategies. The elected leaders of the respective associations make decisions regarding access and use of the water restrictions as well as in conflict mediation and resolving when disputes regarding the water resources arise.

Very few respondents (2%) experienced water-related conflicts. Water-related conflicts generally involve issues relating to access, frequency of use, and time of access. The low cases of conflicts can be explained by the fact that management of the water resources is mostly determined by the authorities in charge such as elders in the community and authorities. This suggests the existence of clear dispute resolving mechanisms available to prevent conflicts as well as resolve conflicts arising from the access and use of the resources. Studies by Gundel and Dharbaxo (2006) and Ahmed (2017) in the Somaliland region have highlighted that conflict resolutions in communities are mostly carried out by traditional based institutions such as clan and elder-based leadership. The community's role is the management of shared resources such as water and pasture through the resolution of conflicts by traditional institutions within the community. Flouting of the rules governing the access and use of the resources results in members being penalized by having their animals confiscated as a means of compensation.

To regulate and monitor the use and access of the water resources, agreements are put in place to prevent conflicts that may arise as a result of access and utilization of the water resources. As shown in Table 1, the majority of the respondents (95.6 %) abided by the agreements regarding the use of water. The agreements (formal or informal) are deemed as an essential institution in regulating and controlling the access, utilization, and management of the crucial water resources available. Abiding by the water use agreement results in fewer conflicts that may arise. From the survey, it is also evident that access to clean water was a challenge as only 7.5 % of the respondents highlighted that they had access to clean water. In Sub Saharan Africa (SSA), access to clean water has deemed a challenge, as households travel for long distances to access clean water, despite having access to water sources

Perceptions and knowledge regarding RWH technologies

Perceptions were provided for the RWH technologies among the adopters with majority adopting *berkads* as good. Perception regarding shallow wells, boreholes, and springs was highest among the RWH technologies adopted, as they were perceived as excellent.

This shows that in their view, the technologies were efficient in use and provided the best outcomes in terms of water harvesting, resulting in high perception. The use of the dam had relatively low perceptions among the adopters. This may be explained by the high costs required in the construction, water safety/sanitation and maintenance of the technology.

Information access is also critical in aspects regarding the adoption and utilization of the adopted technologies. More than 95 % of the respondents had access to information regarding water (see Figure 1). Such information included aspects such as ownership of water resources, availability of water, water safety and sanitation, and access. The information accessed centered on water treatment, water catchment, climate change, and RWH technologies. Different sources were used to access the information regarding water-specific issues (Figure 1).

Table 3. Perceptions regarding RWH technologies among adopters in Somaliland.

	Perceptions regarding RWH technologies (%)				
	Very Poor	**Poor**	**Good**	**Very Good**	**Excellent**
Berkad	-	8.75	53.7	35.0	2.5
Shallow well	1.27	-	22.7	20.3	55.7
Borehole	1.28	-	10.3	26.9	61.6
Springs	-	-	6.4	16.7	76.9
Dam Water	15	22.5	35.0	27.5	-

Source: Survey Data (2019).

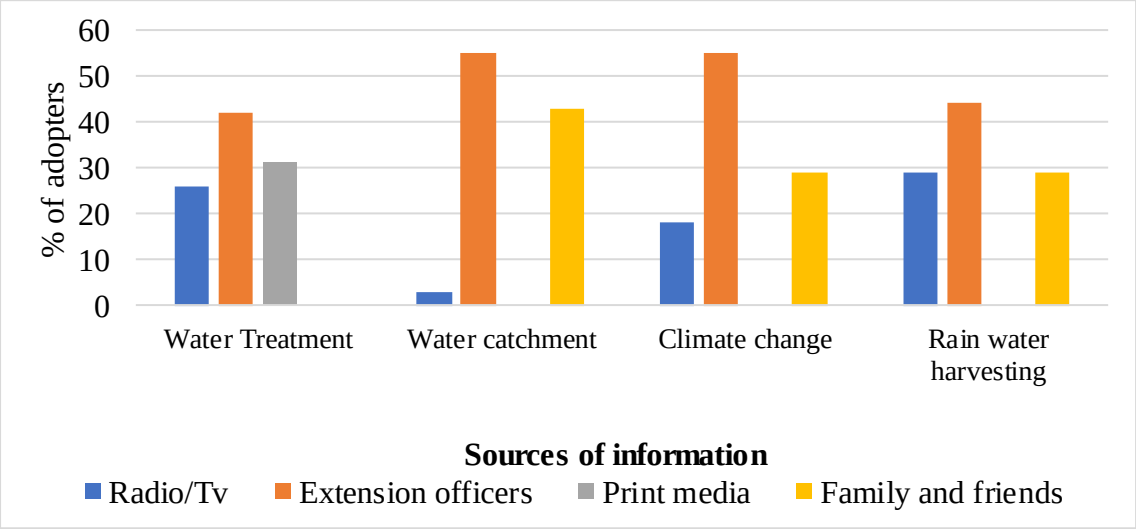

Figure 1. Information types and sources accessed by respondents.
Source: Survey Data (2019).

The extension was the most relied upon source of information regarding water treatment, water catchment, climate change, and RWH. It plays a crucial role in providing relevant information regarding water-related aspects to farmers. Lack of extension limits information flow to farmers, and communities, resulting in low adoption of technologies such as RWH technologies. Recha *et al.* (2017) highlight the crucial role played by extension, especially regarding training on RWH technologies. The respondents relied on visits by government extension officers from NGOs as well as donor organizations for the services.

Recommendations and policy implications

Based on these results, the government should develop permanent water sources that are adequate for use by the communities. This can be done through collaboration with donor organizations and NGOs in the area. Through this, resources can be jointly mobilized and used to target interventions aimed at increasing water access by developing water sources for the communities. New water sources should be provided/developed for the communities to reduce conflicts arising from the shared use and utilization of the available water resources. Technical knowledge among community members can also be improved through training and extension services. Owing to the high social capital and collective action that exists through membership to water associations, group-based training can be prioritized as avenues to increase technical knowledge and boost information flow regarding RWH technologies. Local community participation in the management of the water resources is influenced by traditional and cultural and beliefs. It is therefore important for government authorities and donor organizations to partner with local institutions such as elders to promote the necessary awareness to different clans as well as in developing and management of new water sources. Policies and interventions by the government should target the promotion of water harvesting techniques through the provision of capital as well as equipment that can be used to facilitate water harvesting by the communities. There is also a need for a participatory approach to sensitize on aspects such as climate change, to enhance resilience to water scarcity.

CONCLUSION

Results from the study showed that education level and access to training had a statistical difference among adopters compared to non-adopters of RHW technologies. This shows that education and training influenced the adoption of RWH technologies, where, highly educated farmers and those who had accessed training were likely to adopt RWH technologies. The results also show that *berkad* and *bac (Plastic linings)* were the main sources of water for domestic and livestock use in the area. Water scarcity escalates conflicts among community members on water resources. Regulation of frequency of water usage, therefore, plays a big role in the sustenance of resilience to water scarcity. Social capital and collective action were very high, owing to the large number of respondents who were members of water associations. The associations play a major role in regulating the water resources through restrictions and management of access and use. The elders play a critical role in regulating the water resources through the resolution of conflicts and disputes that arise from the access and utilization of the resources.

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Data availability. Data are available upon request with the corresponding author Mr. Mustafe Jirde (e-mail: Mustafe,jirde@yahoo.com).

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