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Determinants of Adoption of Rainwater Harvesting Technology: The Case of Gursum District, East Hararghe Zone, Ethiopia

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Abstract: This study aimed at identifying the determinants of Rainwater Harvesting (RWH) technology adoption for irrigation and farmers practice in water harvesting against drought in Gursum district, Eastern Hararghe zone. The specific objectives were assessing farmer's perception towards the RWH technology and determining the major factors affecting adoption of RWH technology by smallholder farmers in the study area. The data was collected from both primary and secondary sources. The primary data for this study was collected from 150 farmers through application of appropriate statistical procedures while secondary data was gathered from various sources like zonal and district Bureau of Agriculture and Rural Development and district of water bureau. This study has used multi-stage sampling technique in which both purposive and random sampling techniques were applied to select the required sampling units from the total population under study. Likert Scale was employed to measure the perception of respondents towards RWH technology, and binary logit model was used to analyse the factors that affect RWH technology. Both descriptive and econometric data analysis techniques were applied. Logistic regression estimation revealed that farm experience of household head, education level, family size, labor availability, distance to market, Total Tropical Livestock Unit (TTLU) perception and external support have significantly affected the RWH technology adoption decision of households in study area. The finding of this study indicated that any effort in promoting and adopting of RWH practice should recognize the socio-economic, technique, institutional, physical and psychological characteristics for better adoption of RWH technology. Taking the specific characteristics of farmers into account in introducing and promoting RWH may help policymakers to come up with projects that can easily accepted by farmers.

Keywords: Rainwater Harvesting, Binary Logit Model, Likert Scale, Adoption Determinants, Gursum

1. Introduction

In Sub-Saharan Africa (SSA), agriculture accounts for approximately 70% of the economically active population and it remains a very important social and economic sector. In this part of the world, rain-fed agriculture is largely dominant: food security and income of rural populations are vulnerable to rainfall variability and food production is often less than the requirements of growing population. The volatile rains and soil degradation partly explain the stagnation of agricultural yields, one cause of the chronic food deficit (FAO, 2006). And also in other study, in SSA including Ethiopia more than 95% of the farmland is rain-fed, while almost 90% in Latin America, 60% in South Asia, 65% in East Asia and 75% in the near East and North Africa are rain-fed. In India, 60% of water use in agriculture originates from directly infiltrated rainfall. Low and variable productivity is the major cause of poverty for 70% of the world's poor inhabiting these lands (UNEP, 2009). Therefore, rainfall is the major source of agricultural water supply for most of the subsistence farming system in SSA. However, its distribution is also unreliable particularly in the semi-arid and dry sub-humid areas in which crop production as well as animal rearing has become risky enterprise and the lives of the people is extremely precarious. National governments and international organizations have been picking up one and throwing another approach to ensure the reliability of the availability of water for agriculture (Awlachew *et al.,* 2005). As many empirical find out that Ethiopia has a vast water resource potential yet only one percent of the estimated annual surface water of the 110 billion cubic meters is used for irrigation and hydropower (Alamneh, 2003). The agricultural growth rate of the country is low as compared to the rate of the population growth of three percent. Consequently, the country's agriculture becomes highly dependent on rain-fed agriculture. As land pressure rises, more and more marginal areas in the world are being used for agriculture. Much of this land is located in the arid or semi-arid belts where rainfall is irregular and much of the precious water is soon lost as surface runoff. Recently, droughts have highlighted the risks to human beings and livestock, which occur when rains failed. While irrigation may be the most obvious response to drought, it has proved costly and can only benefit a fortunate few. Nowadays, there is increasing interest in the country in the low cost alternative generally referred to as 'water harvesting'. The latter refers to a practice of inducing, collecting, storing and conserving local surface runoff for agricultural production (Nigigi, 2003). However, traditional ponds (birka) and sand-water are often used for livestock in dry land areas such as Somali and in the agro-pastoral communities of southern Tigray, Afar and Borena. Since 2002, RWH has been implemented by the government, particularly in drought-prone areas. Adoption of pond technology for small-scale irrigation is, however, not uniform across the country. In a few areas such as in Tigray, Southern Nation and Nationality of Peoples Representatives (SNNPR) (Alaba Special Woreda), East and West Hararghe zones of Oromia (especially Gursum District) and the neighboring Somali, farmers have widely adopted the technology (MoWR, 2010). So that from the above evidence it can be judged that RWH is still marginal and often goes unacknowledged as a means to improve the economic, social and environmental livelihoods of local rural communities. However, the untapped resource of rainwater is a valuable component of integrated water resources management that contributes to the country efforts towards achieving the Millennium Development Goals and sustainable development. The study area under consideration, Gursum district, was characterized by continuous natural resource degradation. The rainfall is generally low and erratic. It was exposed to low production due to moisture stress. Therefore this study was initiated to identify factors affecting adoption of modern RWH technology currently introduced in Gursum district and farmers' perception towards the technology being promoted in the study areas.

2. Materials and Method

The study was carried out in the rural areas of Gursum district, Eastern Ethiopia situated in the northeastern part of the East Hararghe zone of Oromia regional state. The district was selected purposively based on the potential utilization of RWH technology and also out of the listed 39 kebeles Awdel, Ibsa and Muyadin were selected purposively using purposeful sampling technique. From the total of adopter and non-adopter households of selected PAs, 45 adopters and 105 non-adopters were selected based on proportion to the number of users and non–users of the technology. Moreover, for Focus Group Discussion (FGD) purposive sampling was used and key informant interview was applied in the same manner. In the study area both primary and secondary data were utilized. For this study, binary logit model was used to analyze factors which affect farmers' decision to adopt RWH technology while to measure farmers' perception towards RWH practice likert scale was employed. Farmers perceptions were put as in the form of a statement which it response easily i.e., respondents' perception to each statement was recorded as they "Disagree", "Not decide" or "Agree". These responses were converted to an index by assigning numerical value of 1, 2 and 3 for "Disagree", "Not decide" and "Agree" responses respectively, for positive statements. For negative statements also, the numerical value of 3, 2 and 1 were assigned for "Disagree", "Not decide" and "Agree" responses, respectively. For both categories, i.e., adopters and non-adopters of RWH technology, a set of perception statement were developed on the basis of perceived advantage or benefit, socio-economic impact and technical complexity or difficulty of RWH technology. Totally, 12 perception statements were developed according to proposal designed. From the total of 12 statements, five (5) are positive and seven (7) are negative. For the category of non-adopters of RWH technology were provided with only 5 statements, while all statements were provided for adopters as they have close experience with the technology and can have a say to different attributes of the RWH. The inadequacy of the linear probability model suggests that a non-linear specification is more appropriate and the candidate for this will be an S-shaped curve bounded in the interval of 0 and 1 (Amemiya, 1981; Maddala, 1983). These authors suggested the S-shaped curves satisfying the probability model as those represented by the cumulative logistic function (logit) and cumulative normal distribution function (probit). Hosmer and Lemshew (1989) pointed out that a logistic regression has got advantage over others in the analysis of dichotomous outcome variables. There are two primary reasons for choosing the logistic distribution. These are 1) from a mechanical point of view, it is an extremely flexible and easily used function, and 2) it lends itself to a meaningful interpretation. The logit model is simpler in estimation than the probit model (Pindyck and Rubinfeld, 1981). Therefore, in this study a binary logistic regression model is used to analyzing the factors influencing adoption of RWH technology in Gursum district. Following Hosmer and Lemshew (1989), the logistic distribution function for analysing adoption of RWH technology can be defined as:

$$P_i = \frac{1}{1+e^{-zi}} \quad (1)$$

Where Pi is the probability of being willing to participate for the i^{th} farmer and Z_i is a function of m explanatory variables (X_i), and expressed as:

$$Z_i=\beta_o+\beta_1X_1+\beta_2X_2+..........+ \beta_mX_m \quad (2)$$

Where β_o is the intercept and βi are the slope parameters in the model. The slope tells how the log-odds in favor of being willing to participate in water harvesting practices change as independent variables change. Since the conditional distribution of the outcome variable follows a binomial distribution with a probability given by the conditional mean P_i, interpretation of the coefficient will be understandable if the logistic model can be rewritten in terms of the odds and log of the odds, (Gujarati, 1995). The odds to be used can be defined as the ratio of the probability that a farmer will practice (P_i) to the probability that he/she will not ($1-P_i$). But,

$$1 - P_i = \frac{1}{1+e^{z(i)}} \quad (3)$$

Therefore, $\frac{Pi}{1-Pi} = \frac{1+e^{zi}}{1+e^{-zi}} = e^{z(i)}$ (4)

And

$$\frac{Pi}{1-Pi} = \frac{1+e^{zi}}{1+e^{-zi}} = e^{\beta o} \sum_{i-1}^{m} \beta 1 \gamma 1 \quad (5)$$

Taking the natural logarithms of the odds ratio of equation (5) will result in what is known as the logit model as indicated below.

$$\ln(\frac{Pi}{1-Pi}) = \ln[e^{\beta o} \sum_{i=1}^{m} \beta 1 \gamma 1] = Z_i \quad (6)$$

If the disturbance term Ui is taken in to account the logit model becomes:

$$Z_i = \beta_o + \sum \beta_I X_I + U_i \quad (7)$$

Hence, the above econometric model was used in this part of the study to identify determinant variables that influence adoption practices of RWH technology.

3. Results and Discussion

3.1. Farmers' Perception Towards Rainwater Harvesting Technology

A total of 12 perception statements (5 positive and 7 negative statements) were developed. Non adopters of RWH technology were provided with only 5 statements, while all statements were presented for adopters as they have close experience with the technology and can have a say to different attributes of the same. The response for each question was coded with numbers i.e., (1=Disagree, 2=Not decide, 3=Agree for positive statements and 3=Disagree, 2=Not decide, 1=Agree, for negative statements). Finally, by summing up the mean value of each statement, the perception was coded with positive and negative values towards the perception object, i.e., RWH technology. Percentage, mean and standard deviation were also used to explain the perception of respondents towards each perception objects. To see the degree of association between each statement, correlation matrix was used.

Reliability analysis was undertaken for all statements to observe the degree of scale reliability of each perception statements and to analyze a potential item which influences respondents' perception towards RWH technology. Then it found that the alpha level of all statement is 0.220. The alpha level of all statement was an average of them. Therefore, all items with the value greater than 0.220 were omitted as they are not reliable to estimate the target's perception.

Table 1. *Reliability Analysis for Perception Statements towards RWH technology (N=150).*

Abbreviation of Statements	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Alpha if Item Deleted
DRT	24.70	6.784	0.181
NRE	24.63	6.557	0.132
CRP	24.65	6.391	0.115
FOS	24.75	6.634	0.172
APT	24.81	7.706	0.316*
MAI	26.12	7.138	0.281*
LAB	26.08	6.413	0.196
TRA	26.11	7.024	0.263*
ARE	24.98	6.339	0.182
MAL	25.12	5.717	0.105
POS	24.99	6.812	0.249*
COS	25.90	6.517	0.232*

Note: N= Total number of sampled population

There were a total of twelve (12) perception statements related to RWH technology, among them five statements (APT, MAI, TRA, POS and COS) were found with the alpha (α) value of greater than 0.220. Therefore, these five statements were omitted or dropped and the remained seven reliable statements were used to determine the respondents' perception towards RWH technology.

3.2. Interpretation of Empirical Results

As indicated earlier, adopters RWH technology were provided with all perception statements whereas only five statements were proposed for non-adopters. Out of all statement provided for adopters seven statements were found to be reliable to analyze their perception towards RWH technology. In similar way, out of five statements provided for non-adopters, all of five statements were found to be reliable to analyze their perception towards RWH technology.

Table 2. *Adopters Farmers' Responses to Perception Statements of RWH Technology (N=150).*

No.	Farmers' perception Statements	Sign of Statements	Adopters (%)			
			Agree	Not decide	Disagree	Total
Q1.	RWHT decrease the effect of drought	+	91.1	4.4	4.4	100
Q2.	RWHT conserve natural resource	+	97.8	0.0	2.2	100
Q3.	RWHT increase crop yield	+	88.9	4.4	6.7	100
Q4.	RWHT is improved food security	+	75.6	6.7	17.8	100
Q5.	RWHT is more labor demand	-	22.2	13.3	64.4	100
Q6.	RWHT structure need large area	-	17.8	8.9	73.3	100
Q7.	RWHT can cause malaria disease	-	95.6	0.0	4.4	100

Source: own survey 2014

Table 3. *Non-adopters Farmers' Responses to Perception Statements of RWH Technology (N=150).*

No.	Farmers' perception Statement	Sign of Statement	Non-adopters (%)			
			Agree	Not decide	Disagree	Total
Q1.	RWHT decrease the effect of drought	+	76.2	8.6	15.2	100
Q2.	RWHT conserve natural resource	+	83.8	10.5	5.7	100
Q3.	RWHT is more labor demand	-	70.5	6.7	22.9	100
Q4.	RWHT structure need large area	-	35.2	5.7	59.0	100
Q5.	RWHT can cause malaria disease	-	91.2	4.4	4.4	100

Source: own survey 2014

Table 4. *Mean of Adopters and Non-Adopters Farmers' Responses to Perception Statements of RWH Technology (N=150).*

No.	Farmers' perception Statements	Sign of Statements	Mean ±S.D.		t-value
			Adopters	Non-adopters	
Q1.	RWHT decrease the effect of drought	+	2.87(0.46)	2.61(0.74)	2.16**
Q2.	RWHT conserve natural resource	+	2.96(0.30)	2.78(0.54)	2.05**
Q3.	RWHT is more labor demand	-	1.42(0.78)	1.52(0.85)	0.69 Ns
Q4.	RWHT structure need large area	-	2.56(0.79)	2.40(0.88)	1.02 Ns
Q5.	RWHT can cause malaria disease	-	2.42(0.84)	2.24(0.95)	1.13 Ns

Source: own survey 2014, ** & Ns; significant at less than 5% and non-significant respectively.

Most of the time farmers' perception on the use of RWH technology can be influenced by their perception on drought as problems of agricultural production. Eventually, this can influence the adoption rate of RWH technology. The output obtained from the table 1, reliability analysis showed that respondents' perception towards RWH technology is influenced by a set of perception items. Of the total adopters and non-adopters respondents 91.1% and 76.2% were strongly agreed on the importance of RWH technology in decrease of the effect of drought and also with both categories have positive perception towards RWH technology as a result of its advantage in mitigating the problems of rainfall shortage in area respectively. Of the total adopters' respondents, almost all (97.8%) agreed on the contribution of RWH technology in natural resource conservation. Similarly, 83.8% non-adopters showed their agreement concerning the contribution of RWH technology in natural resource conservation. With that both adopters and non-adopters have positive perception towards RWH technology as a result of its advantage in conserving natural resources in general. From the total of adopters RWH technology 88.9% indicated their agreement in RWH technology increases crop yield. Similarly, of the total adopters RWH technology 75.6% gave their support on RWH technology improved food security with positive relationship. Therefore, most of the adopters' respondents have shown that there is strong positive relationship between RWH technology in increasing crop yield and in turn improved food security as a result of its benefit in improving their livelihood. Logically, RWH practices need different labor forces for different agricultural activities. From the total respondents, more than half of adopters (64.4%) were disagree that RWH technology is much more labor demanding technology and in contrary 70.5% of non-adopters showed their agreement that RWH technology is much more labor demanding technology. The mean value for adopters 1.42 and non-adopters 1.52 clearly indicated their negative perception towards RWH technology due to high labor demanding for using the technology. However, only adopters 22.2% of respondents disagreed that RWH technology is much labor demanding technology.

Regarding to the land area requirement for RWH technology, that RWH technology structure need a large area was presented for both categories. Of the total respondents, 73.3% adopters and 59.0% non-adopters of the respondents showed their strong disagreement on the statement provided and the mean value for adopters 2.56 and non-adopters 2.40 clearly indicate their negative perception towards RWH technology due to that RWH technology structure need a large area for RWH Technology. Of the total adopters and non-adopters respondents 95.6% and 76.2% were strongly agreed on the importance of RWH technology in RWH technology cause malaria disease and also with both categories have negative perception towards RWH technology.

Generally, as presented in Table 6 of the total five perception statements provided for adopters and non-adopters of RWH technology two of them that Q1 and Q2 were significantly different at less than 5%. This indicates that Q1 and Q2 are potential perception statements resulted in perception difference between both groups. However, for both adopters and non-adopters categories it found that there is no significant difference on their response on Q3, Q4 and Q5 with their regard to farmer's perception on the RWH technology.

3.3. Determinants of Adoption of RWH Technology

Socio-economic characteristics of household

Table 5. *Summary Statistics and Distribution of Continues Variables (N=150).*

Variables	Adopters		Non-adopters		Total		t-value
	Mean	SD	Mean	SD	Mean	SD	
Farm exp	24.64	9.62	14.1	6.24	17.31	8.82	7.95***
Education	3.51	3.05	1.67	2.46	2.22	2.77	3.91***
Family size	8.53	1.47	6.23	1.85	6.92	2.04	7.40***
Labour	4.85	1.902	2.48	1.07	3.19	1.75	9.64***
Landholding	0.91	0.46	0.60	0.28	0.69	0.37	5.01***
TTLU	7.93	2.96	4.63	2.98	5.62	3.33	6.22***
Market dist	6.11	4.46	7.74	4.84	7.25	4.77	-1.94*

*** & *, significant at less than 1% and 10% probability level respectively.

Source: Own survey result/2014

Farming experience was found to have different value for the adopters and non-adopters. The farm experience of the sampled households' was found to be within the range of 3 to 45 years. While, the average years of farm experience was 17.31 with standard deviation of 8.82. When the sample households considered independently into adopters and non-adopters of RWH technology, the average years of farm experience of adopters was higher (24.64 years) than that of non-adopters (14.16). The statistical t-test analysis revealed that there is significant difference in farming experience between RWH adopters and non-adopters group at probability level of less than 1%. The average education level of sample households was 2.22 with standard deviation of 2.77. Independently, the mean for adopters and non-adopters households were found to be 3.51 and 1.67 respectively, which implies that the years of schooling increases the probability of the farmer to be in adopter category increases. The difference between the adoption groups with regard to education was found to be statistically significant at less than 1% probability level. The implication is that adopters of RWH technology have better education status than their counterpart. Family size is significant at probability level less than 1% with average of 8.53 and 6.23 for adopters and non-adopters respectively. Labour availability is also significant at probability level less than 1% with average of 4.85 and 2.48 for adopters and non-adopters respectively. Both family size and labour availability average of adopters were higher than the counterpart. The mean of landholding size and TTLU were 0.91 and 7.93 for adopters 0.60 and 4.63 for non-adopters respectively. Both variables revealed that there is significant difference between adopters and non-adopters at less than 1% probability level with relatively high mean in landholding size and TTLU of adopters than non-adopters. Market is the main place where rural households exchange not only their output but also share whatever information they have. If farmers are closer and have access to market services, they can easily purchase improved agricultural inputs and sell their agricultural outputs without moving long distances. This particular study revealed that the minimum and maximum distance to reach at the nearest local market center is 1 and 25 kilometers respectively. From the result showed that on average the total distance from market was expected to walk 7.25km to arrive at the nearest local market canter. The result reported that there is a significant relationship at less than 10% among them. This indicates that market distance from dwelling did have potential relation with RWH adoption.

3.4. Results of Econometric Model

In the Logit model, a farmer who used any type of small catchment underground RWH technology is considered to be "an adopter". In a discrete adoption, a farm household has either adopted RWH technology or has not adopted. Dependent variable is either adopter or non-adopter. In order to explain this binary variable, it is necessary to construct a model that relates the dependent variable to a vector of independent variables. The logit model was employed in this study to estimate the effects of the hypothesized independent variables on adoption of RWH technology.

Table 6. *The Maximum Likelihood Estimates of the Binomial Logit Model (N=150).*

Variables	Estimated Coefficient (B)	Odds Ratio (S.E)	Wald Statistics	Sig. Level	Exp(B)
SEXHH	-2.269	3.266	0.483	0.487	0.103
FRMEXP	0.453	0.167	7.370	0.007***	1.572
EDUHH	0.581	0.295	3.874	0.049**	1.788
FMLYSZ	1.143	0.622	3.379	0.066*	3.137
LABAVA	1.271	0.507	6.271	0.012**	3.564
LNDHSZ	1.957	1.958	0.999	0.317	7.077
SLOPLND	1.889	2.741	0.475	0.491	6.613
TTLU	0.447	0.256	3.058	0.080*	1.563
CRDTSRV	0.421	1.206	0.122	0.727	1.524
EXTSERV	3.560	4.279	0.692	0.405	35.172
TRNGSRV	2.062	1.576	1.711	0.191	7.858
MKTDIS	-0.649	0.247	6.898	0.009***	0.523
OFFARM	3.224	2.027	2.530	0.112	25.122
PRCEPT	7.929	3.153	6.325	0.012**	27.877
EXTSUPT	6.133	2.260	7.365	0.007***	46.633
Constant	-38.897	13.546	8.245	.004	.000

Pearson- $\chi 2$ value = 151.311***
-2 Log Likelihood = 31.232
Correctly Predicted (%) = 94.6
Significant at 1% probability level ***
Significant at 5% probability level **
Significant at less than 10% probability level *
Source: Model output

Farm experience of household head was positive and statistically significant at less than 1% probability level to influence adoption of RWH technology. This implies that farmers who have longer years of experience in farming have adopted RWH technology than those who have the lower years of experience in farming activities. Moreover, the longer years experienced farmers may use their experience of using and taking the advantages obtained from new agricultural innovation technologies utilization. The odds ratio of 0.167 indicated that keeping other factors constant, the decision in favor of the use of RWH technology increases by a factor of 1.572 as farm experience increases by one year. This study was agreement with Aziz and Tesfaye (2013), Melaku and Molla (2005) that had been reported positive and significant relationship of farm experience with adoption of RWH technology. Education level of household head was positive and statistically significant at less than 5% probability level to influence adoption of RWH technology. This implies that farmer's access to education increased the ability of farmers to acquire important RWH technology information as well as other related agricultural information which in turn increases farmer's ability to choose the best RWH technology for its product. Therefore, the probability of adopting RWH is increased as the farmer's education level is increased by one year. Moreover, the odds ratio of 0.295 indicated that keeping other factors constant, the decision in favor of the use of RWH technology increases by a factor of 1.788 as education level increases by one year. This study was agreement with Aziz and Tesfaye (2013) that the result of the t-test showed significant association between the education level of the household and adoption of RWH technology at less than 1% probability level (t= 5.295). And also same study by Kansana, 1996 and Tesfaye, 2001 have reported positive and significant relationship of education with adoption. Family size was positive and statistically significant at less than 10% probability level to influence adoption of RWH technology. This means that as farmers own larger family size, the probability to use RWH technology increases. This is due to that may occur when there is a larger active worker in large family size. The odds ratio of 0.622 indicated that keeping other factors constant, the decision in favor of the use of RWH technology increases by a factor of 3.137 as family size increases. Labour availability was found statistically significant at less than 5% probability level and positively related with adoption of RWH technology and it agrees with the prior expectation. This showed that households with high labour availability in man equivalent are more likely to adopt RWH technology than households with low labour availability in active workers equivalent. This tells that households that have larger number of working group members were more likely engaged in RWH technology. The odds ratio of 0.507 indicated that keeping other factors constant, the decision in favor of the use of RWH technology increases by a factor of 3.564 as labour availability increases by one man equivalent unit. This result was an agreement with the findings of Jafar and Aman (2014) in their study of impacts of RWH technology in eastern Ethiopia that showed positive and significant relation with adoption of RWH technology. TTLU was statistically significant at less than 10% probability level and positively related with adoption RWH technology. This means that Farmers with larger number of livestock tend to use RWH technology than those who have smaller number of livestock. The odds ratio 0.256 for this variable indicated that the probability of using RWH technology increases by a factor of 1.563 as livestock ownership increased by one tropical livestock unit. This result is consistent with the finding of Mesfin (2005) have witnessed the positive influence of livestock holding on adoption of improved agricultural technologies. Distance from market center was negatively and significantly related with adoption of RWH at 1% significance level. This implies that the probability of adopting RWH technology decreased as distance market center increased by 1 kilometer from resident of farmers. The odds ratio 0.247 for market distance indicated that keeping the influence of all other factors constant, being an adopter of RWH technology will decreases by a factor 0.523 as the distance increases by a single kilometer. Molla (2005) reported similar relationship between market distance and use of RWH technology in Dejen district, Ethiopia. Perception was statistically significant at less than 5% probability level and positively related with adoption RWH technology and congruent with the prior expectation. This showed that households with higher the favorable RWH technology are more likely to adopt RWH technology than households with lower favorable to it. The odds ratio 3.153 for farmer perception indicated that keeping the influence of all other factors constant, being an adopter of RWH technology will increases by a factor 27.88 as the favorability technology increases. External support was positively and significantly associated with use of RWH technology at less than 1%. This implies that the probability for adoption of RWH increases as the external support increases. The odds ratio of 2.260 indicated that keeping other factors constant, the decision in favor of the use of RWH technology increases by a factor of 46.633 as external supports increases. This study was in agreement with the finding of Aziz and Tesfaye (2013) that showed positive and significant association at less than 1% between having external support on RWH practice and the adopting of RWH technology. Here under below some picture captured during field survey by enumerators (data collectors), author and the major RWH technology structure that adopted in the study area.

Figure 1. *Some pictures taken by author during data collection.*

Figure 2. *Some pictures of RWH technology structures adopted by farmers.*

4. Conclusion and Recommendations

This study has tried to look into the household socio-economic, institutional, technical, physical, and psychological and other related factors, which can affect farmers' perception toward adoption of RWH technology. In this study, twelve perception statement were used and seven are found to be reliable to analyses farmers' perception towards RWH technology. The perceived advantages of RWH technology in decrease the effect of drought, natural resource conservation, increasing crop yield and improved food security of RWH technology influenced farmers' perception positively towards the technology. However, RWH technology demand more labor, structure need large area, and it can cause malaria disease were potential factors which influenced their perception negatively towards RWH technology.

Moreover, descriptive and econometric analyses were used to analyze socio-economic, institutional, technical, psychological and physical factors affecting adoption of RWH technology. Evidences from the descriptive analysis indicate that adopters of RWH technology farmers have longer farming experience and wide knowledge and skills, have better education, large family size that in turn have relatively large man equivalent labour force, own large livestock resource, positive perception toward RWH technology. Most adopter farmers have exposures to external support from Government Organizations (GOs) and Non-government Organizations (NGOs), and participated in training, field visits, and other water harvesting related matters, which made them aware of the means and uses of water harvesting. Most of non-adopter farmers do have less access to market information to purchase inputs and sale their produce and their residence is at far distance than adopter farmers from the market center. Therefore, it is suggested to be further research to be done on determinants of level of adoption and the extent to which socio-economics, institutional, physical, technical and psychological and other factors affect the intensity of adoption decision using time series data.

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