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Perception in Climate Smart Agriculture Practices among Pastoral and Agro-pastoral community towards Resilience to Eccentricities of Climate Change and Climate Variability in Shabelle Woreda, Fafan Zone, Somali Region, Ethiopia: A Study

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A B S T R A C T

In Ethiopia agriculture is highly vulnerable to climate variability. This is mainly due to its mere dependence on rainfall and low level of technology adoption. Thus, the aim of this study was to investigate farmers' resilience to climate variability and their perception towards adoption of climate smart agricultural practices in the study area. A multistage sampling technique was employed to select sample households. Accordingly, 204 sample households were selected using simple random sampling technique. Both quantitative and qualitative data were collected from primary and secondary sources. The primary data were collected from sampled households using interview schedule, Key informant interview and Focused group discussion. Descriptive statistics and a multivariate probit model were employed to analyze the sample households' socio-demographic, economic and institutional characteristics. Resilience Capacity Index (RCI) based on absorptive, adaptive and transformative capacities was used to measure households' resilience to climate variability. The model results also found out that sex, literacy of households, livestock owned, farm distance from residence, extension contact, access to credit, membership to social organization, market distance, weather information and experience were significantly associated with adoption of CSA practices in the study area. Thus, to increase the demand and implementation of CSA practices, farmers should be motivated to join and participate in different training and demonstration areas so that they could share farming information and increase their knowledge.

Key Words: Resilience, Perception, Adoption, Multivariate, Climate Smart Agriculture.

1. Introduction

Climate change has been identified as a global challenge facing humans and their socio-economic activities, health, livelihood, and food security (Amjath-Babu et al., 2016). The impacts of climate change are being felt in many developing countries, majorly in the decline of agricultural productivity, resulting in decreased national and household food security status. The Horn of Africa countries are the most vulnerable people to climate change because of the low adaptive capacity of the African population. This low adaptive capacity is owing to the extreme poverty situation of various Africans and recurrent natural disasters such as floods and droughts, and agriculture, which is critically dependent on rainfall. The main impacts of climate change are on food security and agriculture, the water resource, human health, natural resource management, and biodiversity (Huq et al., 2003).

Most of the people, particularly pastoral and agro-pastoralists in Ethiopia, are vulnerable to climate change due to their socio-economic conditions, besides other factors. They are nature lovers, and their livelihoods are fully dependent upon agriculture, rearing of livestock, and petty works that are badly affected by the whims of climate change and its vulnerability. Therefore, in sustaining their agriculture and related activities, climate-smart agriculture (CSA) practices are gaining momentum. As

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institutional support, the government of Ethiopia has initiated the development of policies and programs like the Climate-Resilient Green Economy (CRGE) to encourage CSA practices among the pastoral and agro-pastoral community, thereby protecting the country from the adverse effects of climate variability. The high sensitivity of the Ethiopian agricultural system and the low adaptive capacity of the country mean that even a slight change in climate will have a huge impact on the farming community and the socio-economic activities of the country. As such, the issue of climate change and the adoption of climate-smart agriculture is therefore a major concern in Ethiopia in general and Shebelle Woreda in particular, where the people, particularly pastoralists and agro-pastoralists, are fully dependent on agriculture and related activities. The eccentricities of climate change and climate variability have affected their life and livelihood in many ways.

Therefore, this study is an attempt to investigate the perception of Climate Smart Agriculture practices among the pastoral and agro-pastoral community towards resilience to the eccentricities of climate change and climate variability. Various studies, like Tewodros (2018), have found that the adoption of Climate Smart Agricultural (CSA) practices is needed and essential to achieve the aforementioned targets (Boka, 2017). Resilient households are those that are effectively adopting climate-smart agricultural practices and working themselves out of poverty and vulnerability for the long run, in spite of any immediate setbacks they may face. To enhance the resilience of farmers to climate variability and promote the adoption of CSA practices, examining farmers' perception about the adoption of CSA practices is also vital. Farmers could adopt CSA practices if there were perceived benefit; there would be a CSA reinforcement which results in continuing with the CSA practices and can also consider and adopt more CSA technologies. In this regard, Carolina (2016) viewed that if there are perceived constraints, there would be a CSA rejection or partial adoption; some CSA technologies may be abandoned or other alternatives may be considered (Tewodros, 2018). Identifying key determinants that are influencing the adoption of CSA practices helps to reinforce the resilience of farmers to climate variability. However, few studies have addressed these issues under study, which shows the research gaps and necessitates undertaking this study.

2. Materials and Methods

2.1. Description of the Study Area

Shebelle (South Jijiga) Woreda is found in Fafan zone, can be divided into three separate food economy zones (FEZs), namely, sedentary agriculturalists, agro pastoralists and pastoralists. Jijiga is bordered on the south by KebriBeyah, on the southwest by Gursum, on the north by the Tuligulid, and on the northeast by Haroresa Woreda. Agropastoralism is a dominant production system in Shebelle Woreda.

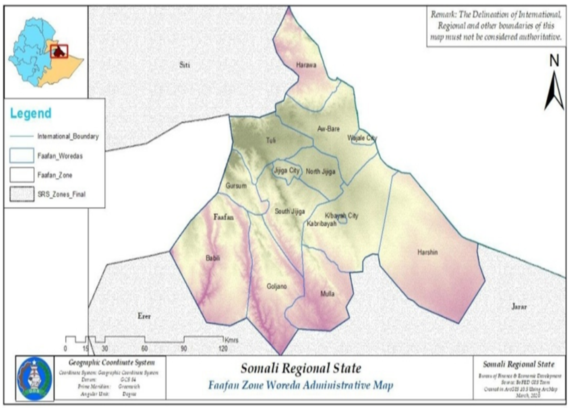

Figure 1: Fafan Zone Woreda Administrative Map

Source: www.google.com.

Figure 2: Shabele Woreda Administrative Map (Northern Jijiga)

Source: www.google.com.

2.2. Research Approach

This study was used both quantitative and qualitative method. The use of these two methods in one study is communally referred to mixed method approach. The purpose of this particular mixed design was to use quantitative data and results to assist in the importance of qualitative findings.

2.3. Study Design

The researcher adopted mixed method involving both quantitative and qualitative research method. This research method facilitated triangulation and dovetailing of the findings and helped to offset the weaknesses of either of the two approaches (Bryman, 2008).

2.4. Sample and Sampling Techniques

2.4.1. Sampling Targets

Sampling is one of the methods, which allows the researcher to study a relatively small number of units representing the whole population (Saranakos, 1998).The sample size of this study was determined by the following formula (Kothari, 2004).

$$n = \frac{Z^2pq}{d^2}$$

Where: n is the sample size, z is the Z-value for the 95% confidence level ($\alpha = 0.05$), where $Z^2 = (1.96)^2 \approx 4$, p is the estimated proportion of the population of interest (smallholder farmers in the study area), q is the complement, computed as $1 - p$, and d is the acceptable margin of error (precision). p was set to 0.5 because, statistically, a proportion of 0.5 yields a sufficient and reliable sample size when the population proportion is not known with certainty. This led to a q of $0.5(1 - 0.5)$. An error of less than 10% is usually acceptable according to Kothari (2004). Thus, the study used an error (d) of 0.07 to approximate the sample size of respondents. $\frac{4 \times 0.5 \times 0.5}{0.07^2} = \frac{1}{0.0049} = 204$.

The study employed multistage sampling techniques. In the first stage, Fafan Zone was purposively selected since it is mainly characterized by dense population, declining soil fertility, severe land degradation, and recurrent weather-induced shocks such as drought, increased temperature (Tesfaye & Seifu, 2016). In the second stage, out of 20 districts in Fafan Zone, Shabelle district was purposively selected because it is one of the areas that manifest many problems concerning climate variability such as rainfall variability, drought, and food insecurity (Tesfaye & Seifu, 2016). Moreover, the district's potential in practicing climate smart agricultural practices compared to the remaining districts of the zone. In the third stage, four kebeleswere purposively selected based on their potentiality in adoption of CSA practices. In the fourth stage, sampling frame (completed village household lists) was taken from each kebeles administrative office. Then, members of each Kebeles were stratified into two groups as adopters and non-adopters. Then probability proportional to sample size was applied to draw the sample households from each stratum. Finally, 204 sampled households randomly

2.5. Tools and Method of Data Collection

To get more information from the selected sources, the researcher was using the following data collection.

2.5.1. Questionnaire

Close ended and open-ended format questions were prepared and distribute to the selected households to get information about the perception, attitude and practice of climate smart practices among small scale farmers and impact of climate change and variability on their livelihood and adaptations measure practice. The questionnaire wasprepared in English and translated in to Somali language and it was distributed to respondents. It will also be pretest (conduct pilot survey) with respondents, help to refine the questionnaires based on the experience gained during the pretest. The closed ended format questions enable the respondents to select one option that best meet there views, while the open ended question was include in order to give opportunity to the respondents to express their perceives, feeling and problems concerning the problem under study and often they are only feasible way to reach a number of reviews large enough to allow statistically analysis the result.

2.5.2. Focused Group Discussion

Focus group discussion (FGD) helps to generate data on group dynamics, and allows a small group of respondents to guide by a skilled moderator, to focus on key issue of the research topic. The researcher selects 204 respondents in kebeles based on socially respected within society and are known to have better knowledge on the present and past environmental, social and economic status of the study area. The focus group discussions were making with member of selected respondents. The main purpose of focus group discussion was understanding the level of perception of the people about the climate change risks, their effects on farming and influence on adoption of climate smart practices among small scale farmers in study area, its cause and their responses. The major discussion topics were on the local community understanding of climate change and the climate change risks, their effects on farming and influence on adoption of climate smart practices among small scale farmers in Shabelle Woreda.

2.5.3. Key Informant Interview

The study was use semi structured interview method because of its flexibility and makes clear anytime when there is ambiguity. The key informant interview was conduct from kebele Agriculture development agents, disaster prevention and preparedness office, local leaders, model farmers and Agriculture and Rural Development Office, about the the climate change risks, their effects on farming and influence on adoption of climate smart practices among small scale farmers and impact of climate change and the perception and attitude towards climate smart practices among small scale farmers in study area.

2.6. Data Analysis

Both qualitative and quantitative data analysis techniques were employed for this study. The use of both qualitative and quantitative methods led to cross-checking multiple data sources to increase trust and validity of the study results.

2.6.1. Qualitative Data Analysis

Qualitative data obtained from key informant interviews, focused group discussions and observations were analyzed using thematic analysis techniques. Thematic analysis is the process of identifying patterns or themes within qualitative data. Qualitative data was analyzed in three stages. First, the interview/FGD transcripts were transcribed in its original language Somali verbatim and then translated into English. Second, interview transcripts from KII and FGD was cleaned, reviewed and organized by question for each respondent. Third, the coded data was then categorized based on theme categories in line with the research questions. Accordingly, four major themes emerged during categorization based on the research questions. These themes included farmers' perception about adoption of CSA practices; factors influence adoption of CSA practices, farmers' resilience to climate variability and the role of CSA practices to farmers' resilience. Finally, results were interpreted by looking into patterns (similarities and differences) within the data.

2.6.2. Quantitative Data Analysis

Descriptive data was analyzed using descriptive statistics such as mean, percentage, frequency, standard deviation, minimum, and maximum. Inferential statistics such as chi-square and t-test were used to see the association between the existing relationship between independent and dependent variables. Moreover, multivariate probit model was applied to identify the major factors influencing adoption of CSA practices. RCI was used to measure level of farmers' resilience to climate variability.

2.7. Analysis of perception

To analyze farmers' perception towards adoption of CSA practices Likert-scale was employed. A set of perception statement was developed on the basis of perceived advantage or benefit and cost of the practices. The statements were posed to each sample households and their response was analyzed based on three point-likert scales (1 = disagree, 2 = not decided, 3 = agree). Cronbach's alpha was tested for internal consistency among scale scores, since in the absence of consisency it is impossible to have valid composite score.

2.7.1. Analytical Model for Adoption of Climate Smart Agriculture Practices

When there are more than two alternatives from which a decision-maker must choose, the appropriate regression models are the multinomial logit (MNL), multinomial probit (MNP), or multivariate probit. The first assumes independence across outcomes and requires the choice variables to be mutually exclusive (Cappellari & Jenkins, 2003). The MNP model does not require the assumption of the Independence of Irrelevant Alternatives. Its drawback, however, is the requisite evaluation of multivariate normal integrals to estimate the unknown parameters (Temesgen et al., 2009).

Farmers are likely to adopt different kinds of CSA practices to build their resilience to climate variability. This means there is a probability of adopting more than one CSA practice simultaneously. Therefore, the study employed a multivariate probit (MVP) model to simultaneously capture the influence of a set of independent variables on each of the different CSA practices adopted by a farmer. The multivariate probit model for this study is characterized by a set of m binary dependent variables y_{hpj} such that:

$$y^*_{hpj} = \mathbf{x}'_{hpj}\beta_j + u_{hpj}, \qquad j = 1, 2, \ldots, m. \quad (1)$$

$$y_{hpj} = \begin{cases} 1 & \text{if } y^*_{hpj} > 0, \\ 0 & \text{otherwise.} \end{cases} \quad (2)$$

Where $j = 1, 2, \ldots, m$ denotes the adoption of different CSA practices; $\mathbf{x}'_{hpj}$ is a vector of explanatory variables; β_j denotes the vector of parameters to be estimated; and u_{hpj} are random error terms distributed as multivariate normal with zero mean. It is assumed that a rational farmer h has a latent variable, y^*_{hpj}, which captures the unobserved preferences or demand associated with the j-th choice of CSA practice. This latent variable is assumed to be a linear combination of observed household and other characteristics that affect the adoption of CSA practices, as well as unobserved characteristics captured by the stochastic error term.

Estimation of the latent variable y^*_{hpj} is based on the observable binary variable y_{hpj}, which indicates whether or not a household adopts a particular CSA practice. As the adoption of several CSA practices is possible, the error terms in Equation (1) are assumed to jointly follow a multivariate normal distribution with zero conditional mean. The covariance matrix represents the unobserved correlation between the stochastic components of the j^{th} and m^{th} types of CSA practices. This assumption means that Equation (2) yields a multivariate probit model that jointly represents the decisions to adopt a particular set of CSA practices.

3. Results and Discussion

3.1. Socio-Economic and Demographics Characteristics of the Households

Dealing with the background information of the pastoralists was very useful before proceeding to the main body of the discussion part, since it supports the researcher to reach in sound conclusions as it can portray the capacity, ability and efficiency of the pastoralists under the climate change i.e. droughts. The following summarized the demographics of the surveyed pastoral households in Shebelle district.

3.1.1. Sex Structure of the Households

As indicated in Table 1: Sex of the Household Head Sex of the head of the household is believed one of the important factors that affected option of climate smart land management options. The sample respondents considered during the study was 204. According to the data in the Table 1 the majority of the respondents are 175(85.8%) male-headed households and the remaining 29 (14.2%) are female-headed households. The survey result showed that (29) 14.2% of the female sample households and (175) 85.8% of the male sample households were adopter of best CCI option to scale up CSA. According to focus group discussion of the study area there were limited participation of women in the farming practices and in the adoption of CCI CSA option and had limited access to information. However, they were highly involved in regular household activities than men. Eleni (2008) and Krishna et al. (2008) in their research stated that, male household heads had more chances to involve in SWC practices than female household heads. This is because most women in the study area spent their time in domestic responsibilities and activities.

Table 1: Sex-wise Distribution of the Households

	Category	Frequency	Percent (%)
Valid	Female	29	14.2
	Male	175	85.8
Total		204	100.0

Source: Own Survey.

3.1.2. Marital Status

As indicated in Table 2, the study has revealed that 74.5% out of the 204 respondents were married, while the widowed females and the men who has divorced their wives and husbands were 14.7% and 10.8% respectively. In spite of polygamy practice of marriage in Shebelle area, means one man may have married more than one wife, most of this households were male dominated, in terms of decisions of family affairs.

Table 2: Marital Status of the Respondents

	Category	Frequency	Percent (%)
Valid	Married	152	74.5
	Divorced	22	10.8
	Widowed	30	14.7
Total		204	100.0

Source: Own Survey.

3.2. Farmers' Perception towards Adoption of Climate Smart Agricultural Practices

Table 3 shows about the perception is one of the most important factors determining farmers' willingness to adopt CSA practices. Before adopting CSA practices, farmers should first perceive the benefit of CSA practices. Accordingly, sampled households were interviewed about their perceptions regarding to adoption of CSA practices using three points Likert scale (1 = Disagree, 2 = Undecided, 3 = Agree). Percentage, mean, and standard deviation were used to explain the perception of sample households towards each perception statements. FGD and KI employed regarding perception statements indicated that, farmers were willing to adopt the CSA practices in the study area. Those who were willing to adopt the practices indicated the benefit of CSA practices as it increasing adaptive capacity to climate variability, increasing yield, ensure food security, and soil fertility improvement as the main driving force for their adoption demand.

Likert scale results also revealed that 86%, 90% and 89% of adopter households agreed that using CSA practices increase yield, increase soil fertility and enable them to adapt to climate variability respectively. Thus, 79% and 87% of adopter sampled households agreed that they benefited from CSA adoption and their income and livelihood improved since they started adoption of CSA practices. Hence, 89% of adopter respondents agreed that priority should be given to promote CSA practices than conventional agriculture (see Table 3).

Even though high percentage of sampled households (86%) agreed on the benefit of climate smart agriculture in increasing yield and improve food security, adoption of CSA practices also require human and financial capital. Thus, 83% of adopters agreed that adopting CSA practices are expensive and need human capital, while 80.4% adopter households agreed upon adoption CSA practices are labor intensive. About 49.5% of adopter's households agreed that CSA need financial and material input which they cannot afford. Out of the total sampled households, 54.9% of respondents agreed that only small number of farmers benefited from adoption of CSA practices in the study area (Table 3).

3.3. The Role of Climate Smart Agriculture Practices in Building Farmers' Resilience to Climate Variability

Farmers need to adopt CSA practices in order to build their resilience towards different types of climate variability. Climate smart agriculture reduces climate risk (50.5%) by increasing responsiveness to unpredictable weather patterns (51.5%). Through interviews and focused group discussions, farmers identified various CSA practices they have adopted. The adoption of these practices was specifically undertaken to increase agricultural productivity and resilience to climate variability (Table 4).

Table 4 also shows that the major CSA practices adopted in the area include intercropping (67.7%), crop rotation (43.6%), soil and water conservation measures (soil bund, stone bund and terrace) (70.6%), drought resistance crop varieties (53.3%), and water harvesting (44.3%) for small scale irrigation. Among adopted CSA practices by farmers in the study area, soil and water conservation, drought resistance crop varieties, and intercropping play an important role in increasing resilience of farmers to climate variability.

Soil and water conservation measures like soil bund, stone bund, and terraces were adopted to reduce soil erosion, increase agricultural productivity, yield, and overcome challenges of food insecurity (51.9%). Intercropping is also the second most CSA practice adopted in the study area. Since farmers owned small size of farm lands, they adopt intercropping rather than mono cropping (Table 4).

Thus, inter-cropping allows them to grow more than one crop at a time and this helps them in case of failure of one crop and it also improves soil fertility (50.8%) (Table 4). Moreover, when farmers faced climate variability (shortage of rainfall, drought), they use improved crop varieties like maize and sorghum that are more resilient to the adverse effects of climate variability.

Table 4 also shows that, from key informant's interviews (KIIs), water harvesting was also adopted by farmers to irrigate crops during dry spells to increase yield stability or for

Table 3: Distribution of Adopter Farmers' Responses to Perception Statements

S.no	Perception Statement	Three-Point Likert Scale (%)			Mean	SD
		DA	UD	AG		
	Statement for adopter only					
1.	Adoption of CSA practices enables me to adapt to climate variability	5	6	89	2.844	0.49
2.	Adoption of CSA practices increases yield and is important to secure food	2	12	86	2.84	0.42
3.	Priority should be given to promote CSA practices	10	8	82	2.72	0.64
4.	Soil fertility increases after I started adoption of CSA practices	6	4	90	2.95	0.29
5.	My income and livelihoods improved and diversified after I started to adopt CSA practices	10	3	87	2.77	0.62
6.	I and my family have benefitted in any way from adopting CSA practices	17	4	79	2.62	0.76
	Statement for both adopter and non-adopter					
7.	Adoption of CSA practices is expensive and needs human capital	11	6	83	2.72	0.65
8.	Adoption of CSA practices are labor intensive	9.8	9.8	80.4	2.74	0.61
9.	Adoption of CSA practices requires financial and material input, which I may not be able to afford	33.8	16.7	49.5	2.16	0.85
10.	Implementing CSA practices are difficult and boring	4	6	90	2.95	0.29
11.	Only small number of farmers benefit from CSA practices in my area	36.8	8.3	54.9	1.73	0.93
12.	CSA practices demand much knowledge and technical skill	6	18	80	2.77	0.47

Note: DA = Disagree; UD = Undecided; AG = Agree; SD = Standard Deviation.
Source: Own Survey.

Table 4: Contribution of CSA Practices in Building Farmers' Resilience to Climate Variability in the Study Area

Contributions of CSA Practices	Response	Freq.	Percent (%)
Increased yield and secure food	Yes	107	52.5
	No	97	47.5
Increased crop production	Yes	107	51.7
	No	97	48.3
Improved livestock production	Yes	114	55.9
	No	90	44.1
Reduced climate risk	Yes	103	50.5
	No	101	49.5
Increased responsiveness to unpredictable weather patterns	Yes	105	51.5
	No	99	48.5
Improved soil fertility status	Yes	104	50.8
	No	100	49.2
Improved income and livelihood of smallholder households	Yes	108	52.9
	No	96	47.1

Source: Own Survey.

planting off-season, to increase household income which in turn builds their resilience. This practice was adopted by relatively few farmers as it requires investment costs and knowledge which restrict widespread up-take by all farmers. The study results revealed that income and livelihood of farmers who adopt CSA practices were improved than their non-adopter's counterpart farmers (52.9%).

From FGD discussants' opinion, before starting CSA practices their production was only hand to mouth. However, after they started CSA practices their income and livelihood increased. Non-adopters of promoted climate smart agricultural practices gave several reasons that limited their uptake. In addition to crop production in the study area, farmers also reared improved livestock breeds to build their resilience. Thus, 55.9% of households reared improved livestock breeds. Even though adoption of CSA practices plays an important role in building resilience to climate variability, there were several problems which hinder small holder households to uptake CSA practices in the study area (Table 4). The major problems include shortage of finance (less access to credit) to purchase agricultural input, lack of improved agricultural inputs and equipment, lack of accurate and timely information, shortage of farming land, and lack of knowledge and skills.

4. Conclusion and Recommendations

4.1. Conclusion

Farmers' perceptions are also important in developing a feasible and appropriate practice of CSA to reduce hunger and improve food security. This means farmers could adopt CSA practices if there were perceived benefit; unless otherwise, they might be rejecting or not adopting the practices and focus on conventional agriculture. The study was conducted with the specific objective of analyzing the perception of farmers towards adoption of CSA practices, identifying factors influencing farmers' adoption of CSA practices, assessing farmers' resilience to climate variability, and examining the role of CSA practices in building resilience to climate variability in Shabelle district of Fafan zone. Four kebeles were purposively selected based on their potentiality in adoption of CSA practices. In the fourth stage, sampling frame (completed village household lists) was taken from each kebele's administrative office. Then, members of each kebele were stratified into two groups as adopters and non-adopters. Then, probability proportional to sample size was applied to draw the sample households from each stratum. Finally, 204 sampled households were drawn randomly. Both primary and secondary methods of data collection were employed. The analysis employed both descriptive statistics and an econometric model to analyze socio-demographic, economic, and institutional characteristics of sample households.

4.2. Recommendations

On the basis of major findings of the study, the following recommendations are made.

- Government should also allocate budget at district level to scale up CSA practice.
- The result of the study demonstrated that adoption of CSA practices is more likely scaled up among farmers when farmers have access to market. Thus, it is recommended that the government and other concerned bodies should enhance market access for farmers.
- Farmers should be able to access weather forecast information from credible sources which helps them to make decisions in agricultural production. Thus, meteorological agencies and other concerned bodies need to put more effort into providing farmers with accurate weather forecasts.

Conflict of Interest

Authors declare that there is no conflict of interest involve in publishing this research paper.

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