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Climate Change Adaptation Measures and Constraints among Smallholder Food Crop Farmers in Sayo and Dale Sedi District, Ethiopia

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ABSTRACT

Background: In contemporary world food crop production is under pressure due to change in climate. In developing nation climate change is a treat both in food crop production and food security. Analysing farmers' climate change adaptation measures and understanding the barriers provides clear guidance to address constraints that impede food crop producers' adaptation.

Methods: A stratified random sampling technique was used to sample 200 food crop producers for primary data gathering. The multinomial logit model was used to determine the factors that affect the selection of adaptation measures to climate change and factor analysis was used to identify factors that impede food crop producers' ability to adapt to climate change.

Result: The result of the multinomial logit model shows that various socio-economic factors (family size, education, climate change awareness, farming experience, nonfarm income, farm size, distance to farmland, extension services and access to credit) influence farmers' choices regarding climate change adaptation strategies in the study area. The result of the varimax rotate principal component analysis found four factors that are detrimental to food crop producers in adapting to climate change. These principal constraints are institution and government, technology and inputs, information and knowledge and belief, culture and participation as factors that hinder farmers from adapting to climate change. Thus, there is room for government and development partners to strengthen the adaptive capacities of farmers by resolving problems related to institutions, government policy, technology, inputs availability and information regarding climate change to minimize the potential impact and loss in the future.

Key words: Adaptation, Barriers, Climate change, Factor analysis, Multinomial logit.

INTRODUCTION

Climate change encompassing mostly hydro-meteorological hazards is a reality affecting the world in diverse ways and manifesting in various ways such as increases in frequency and intensity of floods, droughts and extreme temperatures (Mushore *et al*., 2021). It is endangering the world's environment, agricultural productivity and human well-being (Umunakwe *et al*., 2015) and already having a significant impact particularly in developing countries and on most ecosystems.

Widespread poverty which is a limitation to adaption capabilities to climate change has made Africa the foremost vulnerable continent to the impacts of anticipated climate alter (Boko *et al*., 2007). Agricultural sensitivity to climate change has become a dominant area of research and frequently quoted as vulnerable sector due to climate change (Parry and Carter, 1985; Rosenzweig and Parry, 1994). Food crop production which is characterized as a predominantly rain fed agriculture mainly depends on climate conditions for the developing nations and scarceness of capital for adaptation measures has made food crop production more vulnerable (Nhemachena and Hassan, 2007). As a result of climate change there is variability both in rainfall patterns and altering of temperatures and further incidence of extreme events (IPCC, 2013). Thus, recent studies (Attiaoui and Boufateh, 2019; Chandio *et al*., 2020) showed that climate change is affecting negatively and increasingly the cereal output. Different studies also point out that climate change alters the mean yields of crops (Ali *et al*., 2017; He *et al*., 2018; Ray *et al*., 2019; Sultan *et al*., 2019; Zhao *et al*., 2017).

Agriculture is the key pillar of the Ethiopian economy. Despite tremendous efforts, (agricultural development led industrialization policy, sustainable development and poverty reduction program, program for accelerated and sustained development to end poverty and growth and transformation plan I and II) that have been made for years, transforming the sector is still a big challenge. Several reasons can be cited; one of them being the environmental problem as agriculture is highly linked with and dependent on nature. The biggest resultant effect is it's through impact on food crop production and thereby food insecurity. Today, climate

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change in Ethiopia particularly in the study area is a serious problem especially the increased variability in rainfall and rsing temperatures. This has resulted in declining agricultural productivity and rural poverty (Awraris *et al*., 2014).

In Ethiopia where the majority of its population is engaged in traditional agriculture and which remains the core sector of the economy and provides employment for the majority of the population, a slight change in climate brings a major danger to their livelihoods.

Premeditated responses to climate change can reduce the potential damage in food crop production. Though food crop famers try to adopt climate change adaptation measures they would face challenges in using different adaptation strategies; labour constraints as in (Guodaar and Asante, 2018; Ifeanyi-Obi and Issa, 2013; Ozor *et al*., 2010) land constraints (Ifeanyi-Obi and Issa, 2013; Ozor *et al*., 2010) poor agricultural extension service delivery and information regarding change in climate (Ifeanyi-Obi and Issa, 2013; Ozor *et al*., 2010; Silva and Broekel, 2016) and farming practices and traditional belief (Ifeanyi-Obi and Issa, 2013; Silva and Broekel, 2016). Analyzing adaptation strategies and factors that constraints is important to find new production methods, improve productivities and reduce risk of climate change in food crop production. It also comes up with a tactical ways of resolving the determinant and barriers that limit the adaptive capacity of food crop farmers. Thus, this study intended to assess determinant of climate change adaptation measures and constraints.

MATERIALS AND METHODS

This study was conducted in Seyo and Dale Sedi district of Kellem Wollega Zone found in the Western part of Oromia Regional States of Ethiopia. In this study, a multistage sampling technique was used. First two districts namely Seyo and Dale Sedi were purposively selected based on their potential food crop production. From each district, 5 wards were randomly selected to make 10 sample wards in total. In each sample ward, with the support of agricultural development extension workers, a list of food crop farm households in 2019/2020 production year was compiled and then 20 food crop farmers were randomly chosen from the list. Totally 200 sample of food crop farmers were selected for an in-depth interview.

Multinomial logit model

In multinomial logit model (MNL) relationship between the probability of choosing option A_i and the set of explanatory variables X can be specified for climate change adaptation choice (Greene, 2003):

$$\Pr(Y_i = j) = \frac{e\ \beta_j\ 'ij}{\sum_{j=0}^{n} e^{\beta_j x_{ij}}},\ j = 0, 1, 2, ..., n \quad (1)$$

Where

$Y_i = j$ is probability of choosing a climate change adaptation strategy.

β_j = A vector parameter.

X_i = Socioeconomic, farm and institutional characteristics variables.

$$P_j \equiv \Pr(Y_i = j) = \frac{e^{\beta_j} X_{ij}}{1 + \sum_{m=0}^{n} e^{\beta_m} X_{ij}},\ j = 1, 2, 3, ..., n \quad (2)$$

$$P0 \equiv \Pr(Y_i = 0) = \frac{1}{1 + \sum_{m=1}^{n} e^{\beta_m} X_{ij}} \quad (3)$$

Examining the derivation of the probabilities concerning the k^{th} element of the vector of explanatory variables helps to see the effect that the explanatory variables have on the climate change adaptation strategies decision (Greene, 2000). These derivatives are defined as:

$$\frac{\partial \Pr(Y_i = j)}{\partial X_{ik}} = P_j \left[\beta_{jk} - \sum_{m=0}^{n} \Pr(Y_i = m)\ \beta_{jk}\right] \quad j = 0, 1, 2, ..., n;\ k = 1, 2, ..., k \quad (4)$$

Factor analysis model

Factor analysis is an appropriate method of answering the basic question of what are the factors that are constraining food crop farmers in adopting climate change adaptation measures.

The factor analysis model can be expressed in matrix form as:

$$x = \Lambda f + e$$

Where

x = Vector of *n* observable variables.

f = Vector of *m* unobservable factors.

Λ = Called the loading matrix of the order *n by m.*

e = Error vector of *nx1.*

Variables used in the empirical analysis and the expected sign

Household size

Household size is the total family member of the household. In this study, it is expected that family size would have a positive influence on the adoption of labor-intensive climate change adaptation measures especially in small-scale farming which involves household labor (Yong, 2017).

Years of education

Years of education is the number of years spent by the head of the household for acquiring formal education. Studies have shown that improving education is an important policy measure for stimulating farmers to adopt a new strategy to climate change (Adeoti *et al*., 2016; Fadina and Barjolle, 2018; Tanko and Muhsinat, 2014; Vijayasarathy and Ashok, 2015). In this study, it was expected that improved knowledge through education will positively influence farmers' decisions to take up adaptation measures.

Farm size

Farm size is the total landholding of the farmers for farming activities that are measured in a hectare. The empirical literature shows mixed impacts of farm size on farmers' climate change adaptation strategy choices. A farmer with big farmland has a high probability of using a climate change adaptation strategy (Fadina and Barjolle, 2018). Other adoption studies, however, have found that farm size was not a significant factor (Adeoti *et al*., 2016). In this study, it is hypothesized that farm size would have a positive influence on the adoption of climate change adaptation measures.

Extension service

Extension service is an important source of information on agronomic practices as well as on climate change. Extension education was found to be an important factor in adopting climate adaptation measures (Tanko and Muhsinat, 2014; Vijayasarathy and Ashok, 2015; Yong, 2017). The availability of better climate and agricultural information helps farmers to make comparative decisions among alternative climate change adaptation strategies. This study hypothesizes that extension services would have a positive influence on the adoption of climate change adaptation measures.

Credit availability

Credit availability is the cash constraint and allows farmers to purchase inputs. Studies have shown that access to credit is an important determinant enhancing the adoption of various adaptation strategies (Obayelu *et al*., 2014; Vijayasarathy and Ashok, 2015; Yong, 2017). In this study, it is expected that credit availability would have a positive influence on the adoption of climate change adaptation measures.

Distance to farmland

Distance to farmland is walking time (in a minute) from farmers' residence to their farmland. It is considered a possible factor in farmers' decision to undertake adaptation to climate change. It is believed that farmer whose farm is far from his residence is less likely to continuously follow up his farm as compared to those whose farm nearer to their home. In this study, it is expected that the long distance between the farmland and residence of the farm household would have a negative influence on the adoption of climate change adaptation measures.

Awareness of climate change

Awareness of climate change is important for the adaptation decision farmers make. Climate change awareness was found to be an important factor affecting the adoption of climate change adaptation measures (Obayelu *et al*., 2014; Vijayasarathy and Ashok, 2015). In this study, it was expected that knowledge of climate change will positively influence farmers' decisions to take up adaptation measures.

Farming experience

Farming experience is a **y**ear of farming experience associated with increased knowledge of farming and climate change awareness and it is import factor influencing the choice of climate change adaptation decisions of farmers (Adeoti *et al*., 2016; Fadina and Barjolle, 2018; Yong, 2017). In this study, it was expected that the farming experience will positively influence farmers' decisions to take up adaptation measures.

Nonfarm Income

Nonfarm Income is an income of a household obtains from non-farming activities. It is believed that nonfarm activities in rural areas are not sufficient and there is less opportunity to have such activities to generate income. Thus it reduces the proper follow-up of farmers for their main activity, farming. This study hypothesized that nonfarm income would have a negative influence on the adoption of climate change adaptation measures.

RESULTS AND DISCUSSION

Determinants of farmers' adaptation to climate change

In this study Hausman test (Hausman and McFadden, 1984) was used to check for the validity of the independence of irrelevant alternatives (IIA) assumption and the study failed to reject the null hypothesis (Table 1). As to Roco *et al*., (2014) the difference between the alternatives, which is distributed as chi-square with degrees of freedom equal to the rows in restricted model if IIA is true. Significant χ^2 values indicate violation of the assumption that the difference between the alternatives is not equal to zero (Sofoluwe *et al*., 2011).

The result of multinomial logit model shows that family size as in (Enete *et al*., 2015) farm size (Fadina and Barjolle, 2018) climate change awareness and farm experience (Gadédjisso-Tossou, 2015; Yong, 2017) were variables significantly increasing the probability of adoption of multiple crop type adaptation measure. A unit increase in family size, farm size, (Fadina and Barjolle, 2018) climate change awareness and farm experience would increase the probability of adoption of multiple crop type adaptation measure by 0.072, 0.0416, 0.0868 and 0.0344 respectively (Table 2 and 3).

Family size, year of education as in (Adeoti *et al*., 2016; Gadédjisso-Tossou, 2015), farm size, extension service (Kim *et al*., 2012; Vijayasarathy and Ashok, 2015), climate change awareness (Gadédjisso-Tossou, 2015; Obayelu *et al*., 2014) and nonfarm income were significant factors that determine the probability of adoption of planting improved crop varieties measure to change in climate (Table 2). A unit increase in family size, year of education, farm size, extension, climate change awareness and nonfarm income would increase the choice of planting improved crop varieties by 0.0104, 0.022, 0.0384, 0.014, 0.0174 and 0.0042 respectively (Table 3).

Table 1: Hausman tests of IIA assumption (MNL Model).

Omitted	Chi^2	df	$p>Chi^2$	Evidence
Multiple crop type	0.000	17	1.000	for Ho
Improved crop varieties	0.000	17	1.000	for Ho
Adjusting planting dates	0.000	16	1.000	for Ho
Land fragmentation	0.000	17	1.000	for Ho
Irrigation practices	0.000	16	1.000	for Ho
Soil conservation	0.000	16	1.000	for Ho

Adjusting planting dates as an adaptation strategy helps farms to adjust the timing of agricultural activity. Year of education as reported by (Adeoti *et al*., 2016; Obayelu *et al*., 2014), extension services (Gadédjisso-Tossou, 2015; Kim *et al*., 2012; Obayelu *et al*., 2014; Tanko and Muhsinat, 2014), climate change awareness (Gadédjisso-Tossou, 2015; Obayelu *et al*., 2014; Swai, 2017) and farming experience and (Adeoti *et al*., 2016; Gadédjisso-Tossou, 2015; Kim *et al*., 2012; Yong, 2017) were found factors that would increases the probability that farmers will chose adjusting planting dates adaptation measures. A year increase of education, climate change awareness and farming experience and a unit increase in extension contact would increase the choice of adjusting planting dates as a climate change adaption strategy by 0.0264, 0.037, 0.094 and 0.063 respectively (Table 2 and 3).

The analysis of land fragmentation climate change adaptation strategy show that family size (Enete *et al*., 2015) and farm size (Adeoti *et al*., 2016) were a positive and significant factor that determine the probability of adoption of land fragmentation measure and the marginal effect shows that a unit increase in family size and farm size would increase the adoption of land fragmentation adaptation strategy to climate change by 0.0448 and 0.0308 respectively. Distance to farmland was found negatively significant factor in adoption of land fragmentation measure to change in climate. Thus a unit increase in farmland would decrease the adoption of the land fragmentation strategy for climate change (Table 2 and 3).

Irrigation practices were one of the adaptation strategy farmers adopted in the study area. The result shows that family size, farm size and nonfarm income were identified

Table 2: Parameter estimates of the multinomial logit adaptation model.

Explanatory variables	Multiple crop type		Improved crop varieties		Adjusting planting dates		Land fragmentation		Irrigation practices	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
Family size	1.81**	0.043	1.41*	0.08	0.812	0.37	0.524**	0.036	0.881*	0.056
Years of education	-0.042	0.62	0.79*	0.07	0.073***	0.004	0.662	0.42	0.47	0.7
Farm size	0.82***	0.005	0.927**	0.03	0.0027	0.612	0.0014*	0.07	0.0084**	0.031
Extension services	1.743	0.83	1.241*	0.08	2.18***	0.07	0.971	0.72	1.326	0.409
Credit availability	0.839	0.4	0.87	0.83	0.166	0.74	0.764	0.506	0.134	0.9
Distance to farmland	0.714	0.52	0.094	0.4	0.37	0.49	-0.77*	0.085	0.79	0.6
Climate change awareness	1.06***	0.003	1.87***	0.006	1.073***	0.001	0.91	0.43	1.326	0.27
Farming experiences	1.91**	0.035	0.704	0.4	1.03**	0.052	1.881	0.7	1.008	0.37
Nonfarm income	0.058	0.17	0.0892***	0.001	1.272	0.89	1.141	0.31	0.0255*	0.074
Constant	23.021***	0.002	26.247**	0.013	20.142***	0.000	27.099***	0.001	25.372	
Base category	Soil conservation									
Prob > χ^2 =	0.000									
Pseudo R^2 =	0.21									
LR chi-square (53)	136.68									
Log-likelihood =	-188.742									

***p<0.01, **p<0.05, *p<0.1.

Table 3: Marginal effects from multinomial logit model.

Explanatory variables	Multiple crop type		Improved crop varieties		Adjusting planting dates		Land fragmentation		Irrigation practices	
	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value	Coef.	p-value
Family size	0.072**	0.042	0.104	0.37	0.0242	0.7	0.0448***	0.002	0.027	0.2
Years of education	0.168	0.436	0.022	0.34	0.0264	0.74	0.00725	0.16	0.0325	0.254
Farm size	0.0416*	0.066	0.0384	0.26	0.0655	0.182	0.0308***	0.004	0.0492	0.144
Extension services	0.993	0.25	0.014***	0.052	0.037	0.28	0.0375	0.251	0.002*	0.081
Credit availability	0.73	0.8	0.0664	0.27	0.00772	0.23	0.052	0.31	0.062	0.71
Distance to farmland	0.293	0.18	0.035	0.26	0.018	0.147	0.00472	0.709	0.065	0.46
Climate change awareness	0.0868***	0.003	0.174**	0.037	0.094**	0.026	0.0272	0.16	0.0436*	0.082
Farming experiences	0.0334	0.32	0.0294	0.49	0.063**	0.027	0.00079*	0.072	0.0164	0.36
Nonfarm income	0.003	0.68	0.0042*	0.068	0.006	0.86	0.032	0.47	0.071	0.58
Base category	soil conservation									

***p<0.01, **p<0.05, *p<0.1.

as significant factors that determine the probability of choice of irrigation practice as a climate change adaptation strategy (Table 2). A unit increase in family size, farm size and nonfarm income would increase the adoption of irrigation practices by 0.027, 0.0492 and 0.071 respectively (Table 3).

Constraints to climate change adaptation

The varimax-rotated factor analysis of major factors that constrain food crop farmers in adapting to change in climate in the study area is presented in Table 4. The data indicate that four (4) factors were identified as constraints to adaption to the changing climate. To select the principal factors explaining the data, the Kaiser criterion was employed. These factors are institution and government, technology and inputs, information and knowledge and belief, culture, participation. After rotation, the first factor reported 18.32 percent, the second factor reported for 14.73 per cent, the third factor reported for 11.3 per cent and the fourth factor reported for 6.94 per cent of the variance in the 28 constraining components.

Under factor 1 lack of training on adaptation by extension personnel (0.671), lack/inadequate credit facilities (0.642), lack government policies in empowering food crop farmers (0.573), lack extension programs directed to CCA strategies (0.549), lack of awareness about NGO's program on adaptation to climate change (0.498), Government unresponsiveness to climate risk management (0.435) and poor agricultural extension services (0.427) were variables that leaded high. Similarly (Ifeanyi-Obi and Issa, 2013; Otitoju and Enete, 2016; Ozor *et al*., 2010) found that the poor agricultural extension service delivery and the incapability of extension workers to capacitate farmers on

Table 4: Varimax rotated factors constraining climate change adaptation.

Constraints	Components			
	Factor 1	Factor 2	Factor 3	Factor 4
Lack of government policies to empower food crop farers	0.573			
Lack of access to awareness about NGO's program on climate change adaptation	0.498			
Government unresponsiveness to climate risk management	0.435			
Lack/inadequate credit facilities	0.642			
Lack of training on adaptation by extension personnel	0.671			
Lack extension programs directed to CCA strategies	0.549			
Poor agricultural extension services	0.427			
Poor access to improved crop varieties		0.792		
The high cost of improved crop varieties		0.496		
Non-availability of fertilizer and farm input		0.473		
The high cost of fertilizer and farm input		0.465		
Lack of access to irrigation facility		0.532		
The high cost of irrigation facility		0.466		
Lack of functional irrigation scheme		0.471		
Poor water harvesting technology		0.563		
The high cost of using new technologies		0.642		
Lack of adequate technical knowledge about new technology		0.633		
Unavailability of access to climate or weather information			0.491	
Inadequate knowledge in coping with climate variability			0.682	
Poor information on early warning systems			0.631	
Poor access to CCA measure information			0.547	
Inadequate knowledge on climate variability			0.428	
Lack of adequate information sources on new technology			0.493	
Norms, customs, culture and traditional belief				0.492
Religious belief/holidays/festivals of the farming households				0.475
Traditional practices on the commencement farming seasons				0.587
Multiple domestic responsibilities of farmers				0.531
Involvement in off-farm activities				0.633
Percentage variance	18.32	14.73	11.3	6.92
Eigen value	3.928	2.814	1.871	1.173

*Factor 1: Institution and government; Factor 2: Technology and Inputs; Factor 3: Information and Knowledge Factor 4: belief, culture, participation

* Constraints that is loaded under more than one factor is rejected.

* Only variables with factor loadings of ±0.4 and above at 10% overlapping variance were considered.

climate change were identified as a factor that constraints to adaption to the changing climate.

The government can play a great role by making development policies that will empower farmers, climate risk management and strategy in coping with the changing climate. Availability of credit facilities will provide the farmers financial support to adopt climate change adaptation strategy. Since banks look for collateral the appreciation of small and microfinance could be a source of finance to the farmers. The extension program in the area was intended to help farmers in solving farming-related problems. The constraint regarding the extension program was that there is no specific program or training regarding climate change and coping mechanism. Thus, improvement in credit facility and extension program would help farmers to make the right decision regarding the changing climate.

Under factor 2 variables that loaded high were poor access to improved crop varieties (0.792), high cost of using new technologies (0.642), lack of adequate technical knowledge about new technology (0.633), poor water harvesting technology (0.563), lack of access to irrigation facility (0.532), high cost of improved crop varieties (0.496), non-availability to fertilizer and farm input (0.473), lack of functional irrigation scheme (0.471), high cost of irrigation facility 0.466, high cost of fertilizer and farm input, (0.465). These results are consistent with findings by (Guodaar and Asante, 2018) that the high cost of fertilizer and farm input; (Ifeanyi-Obi and Issa, 2013; Ozor *et al*., 2010) high cost of irrigation facility was identified as a factor that hinders farmers from using adaptation to changing climate.

It is clear that innovation plays an important role in agricultural transformation and climate adaptation planning. In the study area, farmers identified constraints related to technology and inputs. Crop varieties that can adapt to changing climate would help farmers to increase their productivity but they maintained the problem of availability and high cost of improved varieties as a constraint. Fertilizer and other farm inputs that can help farmers to adapt to the changing climate were also identified as a constraint both in availability and cost-wise. Technology regarding irrigation and water harvest was also another constraint. The respondents identified the cost of technology and knowhow was hindering them to adapt to changing climate. Government and concerned bodies can influence constraints of technology and inputs through the development of research and institutions.

Under factor 3 the main constraints were inadequate knowledge in coping climate variability (0.682), early warning systems (0.631), poor climate adaptation measures information (0.547), lack of adequate information sources on new technology (0.493), unavailability of access to climate or weather information (0.491) and inadequate knowledge on climate variability (0.428) were factor loaded higher.

Information and knowledge gap was also identified as one factor hindering the farmers to adapt to change in climate. Availability of information regarding climate variability and early warning would help farmers to adjust their activity to reduce the risk of climate change. But in the study area, the responders have identified poor climate information, early warning and knowledge of climate variability as a constraint to the adaptation to climate change. Knowledge of climate change adaptation measures and the coping mechanism would help farmers to adapt to the changing climate. But in the study area farmers identified that they would have adjusted their farming to the changing climate if they would knew coping mechanisms. Thus providing them information regarding climate change and knowledge transfer on coping mechanisms would help them to reduce the climate risk.

Variables loaded high under factor 4 were involvement in off-farm activities (0.633), traditional practices on the commencement farming seasons (0.587), multiple domestic responsibilities of farmers (0.531), norms, customs, culture and traditional belief (0.492) and religious belief/holidays/ festivals of the farming households (0.475). These results confirm the findings of (Otitoju and Enete, 2016) that neighbourhood norms, customs, culture and traditional beliefs against adaptation and religious belief of the farming household identified as a factor that hinders farmers from using adaptation strategy. Norms, customs, culture and tradition and religion are variables that influence the activity/ action of the human being. In the study area, these variables were identified as a factor that constraints the adaptation to changing climate. The other factors are the multiple domestic responsibilities by farmers and participation in a nonfarm activity to generate income.

CONCLUSION

The study analysed the factor determining the choice of adaptation measures and barriers to food crop farmers' adaptation measures to change in climate. The study identified different socio-economic factors (family size, farm size, year of education, climate change awareness, farming experience, extension service and nonfarm income) that affect farmers' climate change adaptation measures choice in the study area. This, therefore, calls for policy/decision-makers to consider integrating such factors in climatic adaptation interventions at the household level.

The major barriers that hinder food crop farmers' adaptive practices were institution and government constraints, technology and inputs constraints, information and knowledge constraints and belief, culture, participation constraints. The government can play a great role by making development policies that will empower farmers, climate risk management and strategy in coping with the changing climate. Improvement in credit facility and extension program (specific program or training regarding climate change and coping mechanism) would help farmers to make the right decision regarding the changing climate. Fertilizer and other farm inputs that can help farmers to adapt to the changing climate were also identified as a constraint both in availability and cost-wise. Technology regarding irrigation and water harvest was also another constraint. The respondents identified the cost of technology and knowhow was hindering them to adapt to changing climate. Government and concerned bodies can influence constraints of technology and inputs through the development of research and institutions. Availability of information regarding climate variability and early warning would help farmers to adjust their activity to reduce the risk of climate change. Thus providing them information regarding climate change and knowledge transfer on coping mechanisms would help them to reduce the climate risk.

Conflict of Interest: None.

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