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Farm Households Choices of Adaptation Strategies to Climate Variability Challenges in Benishangul Gumuz Regional State, Western Ethiopia

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Abstract

Climate variability and change are a serious threat to the livelihoods of rural communities because they are very sensitive to such changes. This study assesses the major adaptation strategies pursued by farm households to climate variability and change impact in Benishangul Gumuz regional state, western Ethiopia which is harshly affected by climate change stresses. The data were collected from a randomly selected 385 sample households through interview using field-based questionnaires and focus group discussions and analyzed using descriptive statistics. The results pointed out that the likelihood of households to adopt crop diversity, soil and water conservation practice, small scale irrigation, crop rotation, adjusting planting date and improved crop varieties were 54.2%, 49.8%, 47.3%, 45.3%, 44.4% and 43.5% respectively. Moreover, the results indicated that the joint likelihood of using all adaptation strategies was only 1.64% and the joint likelihood of failure to adopt all of the adaptation strategies was 2.92%. Therefore, future policy should focus on towards supporting improved extension service, offer climate related training and information especially to adaptation technologies to increase the farm households experience in adopting different strategies to the negative effects of climate variability which is a global problem of this century.

Keywords: adaptation strategies, choices, climate change, descriptive statistics

1. Introduction

Climate change is one of the swiftly spread phenomena across the globe since last century and livelihood of residents of the planet is at risk (He *et al*., 2020). One-third of the world population is directly or indirectly facing the heat of the climate change variations (Schattman *et al*., 2020). Increased temperature extremes affect agricultural productivity and increase the risk to global food security (Tai *et al*., 2014).

Adaptation to climate change has been recognized as a crucial response to climate change; even the mitigation strategies have been designed to stabilize earth's climate (IPCC 2001). Climate change refers to the changes in the mean and/or variability of climate state, and adaptation refers to adjustment, moderation, or changes to socio-economic and ecological systems in order to avoid and recover from the adverse impacts of climate change and to glean benefits from it (IPCC, 2007).

The Western part of Ethiopia is indicated with the most significant climate change impact due to drought and flood (Temesgen *et al.,* 2008). This initial potential together with the current global climate change aggravates the vulnerability of the community to climate change impacts.

To attain a sustainable level of output, farmers are expected to take adaptation measures to cope with risks posed by climate change on their productive activities (Ojo and Baiyegunhi, 2020). At farm level, there are several types of adaptation strategies available to different farmers, with the level of perception of climate change determining the type and extent to which the strategies are employed (Khan *et al*., 2020; Ojo and Baiyegunhi, 2020).

However, most climate change adaptation strategies are location specific. Therefore, there is the need to understand location-specific choices of adaptation to climate change among farm households is crucial.

Therefore, the objective of this study is to assess the choice of adaptation strategies pursued by farm households in the Benishangul Gumuz regional state of Western Ethiopia in order to guide policymakers and other stakeholders on ways to promote adaptation.

2. Methodology and Data

2.1 Description of the Study Area

Benishangul Gumuz Regional State which is the study area, is located in Western Ethiopia. According to the projected population of Ethiopian of 2019, the total population of the region is 1,125,999 of which 571,000 (50.7%) are male (CSA, 2019). The total area of the Region is estimated to be about 50,380Km^2. Mixed farming (crop production and livestock rearing) is the predominant sources of livelihood for the majority of the population in the area. The crop production is dominated by rain fed agriculture while irrigation is practiced on small-scale level (BGRANRB, 2021).

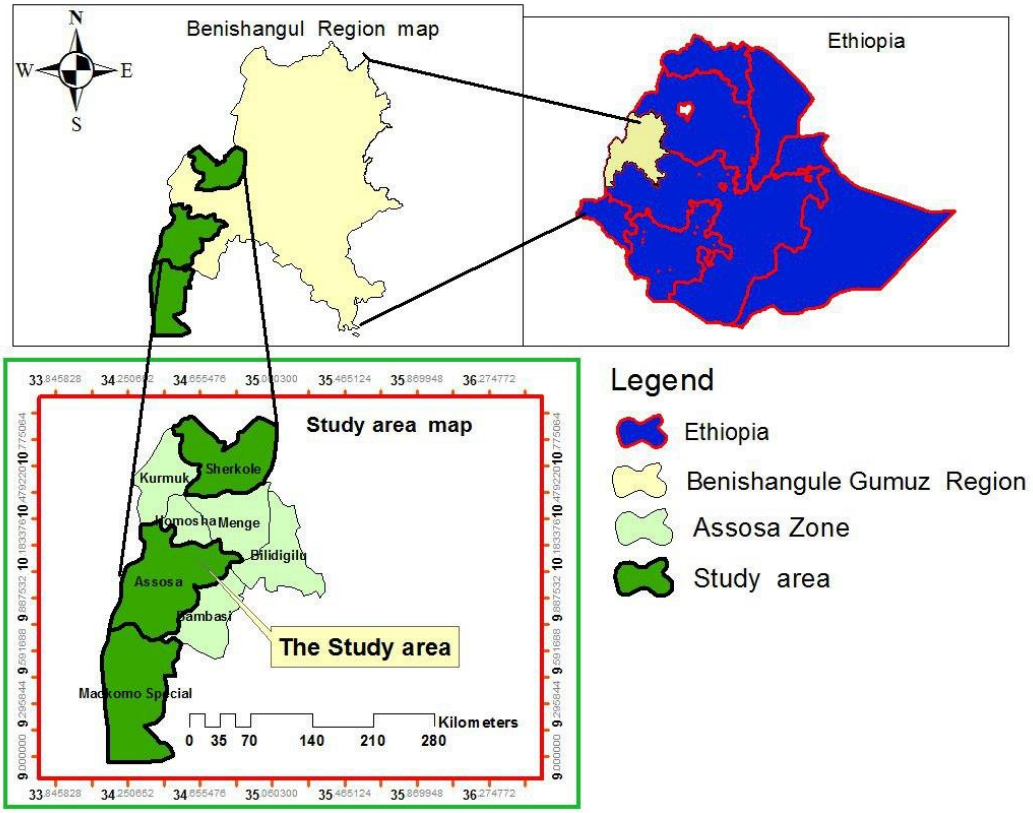

Figure 1. Geographical location of the study area

Source: GIS, 2022

2.2 Sampling Procedure and Method of Data Collection

The multistage sampling procedure was employed in selecting the sample households for this study. In the first stage, one zone (Assosa) and one special district (Mao Komo) were purposively selected based on main farming practices and socio-economic status. In the second stage, the districts were categorized based on agroecology and three districts (Mao Komo special district from the highland; Assosa district from midland and Sherkolle district from the low land climate zone were taken purposively based on agroecology of the districts. In the third stage, two kebeles were randomly selected to make a total of six kebeles. In the last stage, sample size of households at kebele level was determined based on probability proportion to size and the households were identified using simple random sampling technique.

For the household survey, sample size of respondents was determined following Kothari's (2004) formula given as:

$n = \frac{Z^2pqN}{e^2(N-1)+Z^2pq} = \frac{(1.96)^2(0.5)(0.5)226{,}966}{(0.05)^2(226{,}966-1)+(1.96)^2(0.5)(0.5)} = \frac{217{,}978.1464}{568.3729} = 383.5126 \approx 384$ + 10% compensate for more nonresponses and/or incomplete information = 422

Where n is the required sample size, Z is the inverse of the standard cumulative distribution that correspond to the level of confidence, e is the desired level of precision, p is population reliability (or frequency estimated for a sample of size n), which is 0.5 and p + q = 1. N is size of population which is the number of households in the region.

Both primary and secondary data were used for the study. Primary data were collected from a randomly selected sample households through interviewed using field-based questionnaires and focus group discussions.

Relevant secondary data were also obtained from Benishangul Gumuz region Agriculture and Natural resource Bureau, national meteorological agency and different reports and farmers' adaptation strategies to climate change were analyzed using descriptive statistics.

2.3 Data Analysis Method

The data collected were analyzed using descriptive statistics method using percentages, mean, standard deviation, and econometric model of multivariate probit of the joint probabilities for the success and failures of adapting different strategies to climate variability and change.

3. Results and Discussion

3.1 Descriptive Result

The distribution of adaptation strategies against climate variability and change pursued by farm households in the study area were given in table 1 as follow.

Table 1. Distributions of Adaptation Strategies Employed by Farm Households in Benishangul Gumuz Regional State, Western Ethiopia

Adaptation Strategies	Mean	Standard Error
Mulching	0.42	0.494
Soil conservation practices	0.50	0.501
Planting trees	0.39	0.489
Small scale irrigation	0.47	0.500
Crop diversification	0.54	0.499
Improved crop varieties	0.44	0.497
Applications of Agrochemicals	0.43	0.496
Crop rotations	0.45	0.499
Adjusting planting date	0.44	0.498
Switching to short maturing crops	0.41	0.493

Source: Own computation result based on survey data, 2021

Table 1 shows the distribution of adaptation strategies pursued by farm households sampled households. The result confirms that the most frequently adopted strategies includes crop diversification, soil conservation practice, small scale irrigation, crop rotation, improved crop varieties, and adjusting planting date and farm households respond to climate change stresses by using mutually inclusive adaptation strategies

Farm households in the study area from their indigenous knowledge adopted strategies such as changing planting dates and using different variety of seeds to make yields less susceptible to climate variability. Since climate variability may affect communities differently, they tend to possess different adaptive capabilities and strategies.

The author identified that choice of drought-resistant varieties, high-value crops, irrigation efficiency improvement and using better water technologies are methods that have been tried by smallholders as adaptation strategies to combat climate variability in some African countries. Different communities depending on their adaptive capacities developed their own coping strategies (Stephen, 2009) to reduce effect of climate variability. Previous studies argued that asset-holding improvement would be associated with better adaptation potential (Stephen *et al.*, 2014). Farm households in the study area practiced crop rotation based on their traditional knowledge to adapt climate variability.

The data collected in 2021 showed that some households adopt two or more strategies in one season to acclimatize climate variability. Rainfall shortage in grain filling stage of crops was critical problem that resulted

in serious damage as to households' response. Rainfall instability at the beginning time was also a threat to crop production and respond for late start of rain by changing sowing season and crop type. If there was no rain at the right time, most of the sample households shift sowing time, or change the crop.

3.2 Predicted and Joint Probability

Result of multivariate probit model showed that the predicted probabilities to adopt crop diversification (54.2%) the most frequently adopted strategies to climate variability challenged which is followed by soil conservation practice (49.8%). Small scale irrigation, crop rotation, improved crop varieties and adjusting planting date were 47.3%, 45.3%, 44.4% and 43.5%, respectively. Moreover, farmers of the study area can be succeeded in adapting all adaptation strategies and fail to adapt all strategies at a time is probably 2.13% and 2.82% respectively (Table2).

Table 2. The joint and predicted probability for adaptation strategies

SC Practice	Crop Diversity	SS Irrigation	Improved Varieties	Agrochemical	AP Date
Marginal probability to					
0.647	0.704	0.655	0.642	0.636	0.589
Joint probability (success) = 0.0162			Joint probability (failure) = 0.0296		

Source: Survey result, 2021

4. Conclusion and Policy Implications

Climate variability and change is a serious threat to the livelihoods of rural communities because they are very sensitive to such changes. It is, therefore, essential to understanding the various strategies used by farmers to mitigate the adverse impact of climate change.

Farm households adopt different kinds of adaptation strategies to reduce the negative consequences of climate change so as to maintain and/or to improve their livelihood.

Farm households in the study area from their indigenous knowledge adopted strategies such as changing planting dates and using different variety of seeds to make yields less susceptible to climate variability. Since climate variability may affect communities differently, they tend to possess different adaptive capabilities and strategies.

The data collected in 2021 showed that some households adopt two or more strategies in one season to acclimatize climate variability.

Result of the predicted probabilities to adopt shows that crop diversification (54.2%) is the most frequently adopted strategies to climate variability challenged which is followed by soil conservation practice (49.8%). The other strategies pursued by farm households in the study area includes small scale irrigation, crop rotation, improved crop varieties and adjusting planting date which contributed to 47.3%, 45.3%, 44.4% and 43.5% respectively. Moreover, farmers of the study area can be succeeded in adapting all adaptation strategies and fail to adapt all strategies at a time is probably 2.13% and 2.82% respectively.

Thus, future policy should focus on towards supporting improved extension service, offer climate related training and information especially to adaptation technologies to increase the farm households experience in adopting different strategies to the negative effects of climate variability which is global problem of this century.

Moreover, encouraging informal social net-works and environmental settings enhance the adaptive capacity of smallholder farmers to reduce the adverse effects of climate change and to help economic development and food security status.

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Reference

He, R., Jin, J., Kuang, F., Zhang, C., & Guan, T. (2020). Farmers' Risk Cognition, Risk Preferences and Climate Change Adaptive Behavior: A Structural Equation Modeling Approach. *Int. J. Environ. Res. Public Health, 17*(1), 85. https://doi.org/10.3390/ijerph17010085

IPCC (Intergovernmental Panel for Climate Change). (2001). *Climate change 2001:- The scientific basis.* Contribution of working group I to the Third assessment report of IPCC. UK: Cambridge University Press:

Cambridge.

IPCC (Intergovernmental Panel for Climate Change). (2007). *Climate change 2007: Impacts, adaptation and vulnerability*. Contribution of working group II to the Fourth assessment report of the IPCC: Cambridge University Press: Cambridge.

Khan, M. H. R., Rahman, A., Luo, C., Kumar, S., Islam, G. M. A., & Hossain, M. A. (2019). Detection of changes and trends in climatic variables in Bangladesh during 1988-2017. *Heliy on, 5*, e01268. https://doi.org/10.1016/j.heliyon.2019.e01268

Kothari, C. R. (2004). *Research methodology: Methods and Techniques* (2nd ed.). New Delhi: New Age International Publishers.

Ojo, T. O., & Baiyegunhi, L. J. S. (2020). Determinants of climate change adaptation strategies and its impact on the net farm income of rice farmers in south-west Nigeria. *Land Use Policy, 95*, 103946. https://doi.org/10.1016/j.landusepol.2019.04.007

Schattman, R. E., Hurley, S. E., Greenleaf, H. L., Niles, M. T., & Caswell, M. (2020). Visualizing climate change adaptation: An effective tool for agricultural outreach? *Weather, Climate, and Society, 1*2(1), 47-61. https://doi.org/10.1175/WCAS-D-19-0049.1

Stephen, A., Wood, A. S., Jina, M. J., Patti, K., & Ruth, S., & De, F. (2014). Smallholder farmer cropping decisions related to climate variability across multiple regions. *Global Environmental Change, 25*, 163-172. https://doi.org/10.1016/j.gloenvcha.2013.12.011

Stephen, N. N. (2009). *Climate change adaptation strategies: Water resources management options for smallholder farming systems in Sub-Saharan Africa the Earth Institute at Columbia University.*

Tai, A. P. K., Martin, M. V., & Heald, C. (2014). Threat to future global food security from climate change and ozone air pollution. *Nature Clim Change, 4*, 817-821. https://doi.org/10.1038/nclimate2317

Temesgen, T., Hassan, R., Ringler, C., Alemu, T., & Yusuf, M. (2009). Determinants of farmers' choice of adaptation methods to climate change in the Nile Basin of Ethiopia. *Global Environmental Change, 19*(2), 248-255. https://doi.org/10.1016/j.gloenvcha.2009.01.002