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Full Length Research Paper

Determinants of Farmers Adaptation to Climate Change: A Case From Syangja District of Nepal

[1]Nirmal Regmi, [2]Dinesh Dhakal and [3]Binod Ghimire

[1]Crop Development Officer, Ministry of Agricultural Development (MoAD), Government of Nepal. Email:regminirmal5@gmail.com
[2]Assistant Professor, Department of Agricultural Economics, Institute of Agriculture and Animal Sciences (IAAS), Tribhuvan University, Nepal. Email:dhakaldinesh@hotmail.com
[3]Agriculture Extension Officer, Ministry of Agricultural Development (MoAD), Government of Nepal, Nepal. Email:binodghim@gmail.com

Corresponding Author's Email:regminirmal5@gmail.com

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Climate change is set to hit the agricultural sector the most and cause untold suffering particularly for smallholder farmers. The study investigated the factors influencing the choice of adaptation methods to climate change. Farm level data were collected randomly from 100 households of Arukharka and Bhatkhola VDCs (50 respondents from each VDC) in Syangja district of Nepal. Data was collected using semi-structured questionnaires and focus group discussions (FGDs). A logit regression model was employed in the study to access the result. The study used a binary dependent variable taking the value 1 if the farmer adapted to climate change and 0 otherwise.Training ($P<0.01$), livestock holding unit ($P<0.05$), family type ($P<0.05$) economically active member ($P<0.01$) and farm size ($P<0.05$), were the determinants of respondents decision to adapt adaptation measures. The study showed that training, livestock holding unit and family type were positively significant whereas farm size and economically active member were negatively significant to climate change adaptation. Logit regression analysis indicated the good explanatory power of model with overall predictive power of model as 64.0235% at 1% level with pseudo R^2 value 0.2517.Agricultural policies should promote farmer to farmer extension services to support farmers to adapt to climate change.

Keywords: Climate change, Adaptation, Logit, Variable, Nepal

INTRODUCTION

Climate change is a natural phenomenon and its challenges are clearly visible in recent days. It is a pertinent issue affecting the livelihoods and food security in both developing and developed countries. Food and Agricultural Organization (FAO, 2008) argues that many countries worldwide are facing food crises due to conflict and disasters There have been changes in rainfall patterns (high, low, and intensive rainfall) and seasons due to climate change. These have direct and indirect impacts on water resources and agriculture.

Climate Change Vulnerability Index 2011 has illustrated Nepal in 4th vulnerable position to potential negative impacts of climate change. Nepal has experienced an average maximum annual temperature increase of 0.060C. Changes in the annual rainfall cycle, intense rainfall and longer droughts have been observed. Similarly, both days and nights are presently warmer. The trend analysis in study area showed that maximum temperature and minimum temperature increased by 0.029 and 0.044 degree per year respectively and total rainfall was decreased with rate of 11mm per year (DHM, 2015).This situation will eventually affect agriculture, the environment, and human livelihoods. In particular, it is anticipated that adverse impacts on the agricultural sector will exacerbate the incidence of rural poverty. Adaptation practices are therefore needed to help agrarian community's better face extreme weather conditions associated with climate variations.

Adaptation seems to be the most efficient and friendly way for farmers to reduce the negative impacts of climate change (Fussel et al., 2006). This can be done by the smallholder farmers themselves taking adaptation actions in response to climate change or by governments implementing policies aimed at promoting appropriate and effective adaptation measures. Nepal has considered climate adaptation as a national agenda and has taken several initiatives for implementing different programme for risk reduction in the recent years. In recent time national government has prioritized climate change adaptation strategies for the promotion of sustainable agriculture and as a means to increase agriculture production and productivity to meet present needs, which could be seen in recently endorsed twenty year plan (ADS, 2015).

There are number of factors that govern the farmers to adopt the coping mechanism. This study examines the different factors that govern the decision of farmers to adopt the coping mechanism of climate change.

Objectives

- To derive socio-economic characteristics of farmers
- To draw perception of farmers regarding climate change
- To quantify the determinants factors affecting adaptation to climate change

MATERIALS AND METHODS

Sample and sampling method

A total of 100 farming households were randomly selected for the interviews from two Village Development Committees in the Syangja district of the Western Development Region Nepal. Primary data was collected through pre-tested interview schedule; focus group discussions, key informant interview, direct observation and semi-structured questionnaires. The information collected from the field survey was coded first and entered in computer and analysis was done by using Statistical Package for Social Science (SPSS 16 version), STATA 12 and Microsoft Excel. Both descriptive and analytical methods were used to analyze the data.

Logit Regression Model

The decision of farmers to practice different adaptation strategies were estimated through logit regression to derive the several factors governing the probability of adaptation strategies (Y_i = 1). The logistic model was used to analyze the binary or dichotomous response and allows examining how a change in any independent variable changes all the outcome probabilities (Hosmer and Lemeshow, 2000). In this model, Y_i the binary response of the farmers take two possible values; Y = 1, if farmer practicing different stronger adaptation strategies and Y = 0 for practicing few (poor) adaptation strategies. The probability of binary response was defined as follows:

If Yi = 1; $P(Y_i = 1) = P_i$

$Y_i = 0$; $P(Y_i = 0) = 1-P_i$

Where, $P_i = E(Y = 1/x)$ represents the conditional mean of Y given certain values of X.

Therefore, probability of practicing stronger adaptation strategies was expressed as (Hosmer and Lemeshow, 2000);

$$P(Y_i = 1) = P_i = \frac{1}{1+\exp^{-z}}$$

$$Z = \alpha + \sum \beta_i x_i + €_i$$

The logit transformation of the probability of the practicing stronger adaptation strategies by farmers was represented as follows (Guajarati, 2003);

$$L_i = \ln\left[\frac{Pi}{1-Pi}\right] = z_i = \alpha + \sum_{i=1}^{n} \beta i\, xi + €i$$

Where Y_i = a binary dependent variable (1, if farmers practicing stronger adaptation practices, 0 otherwise), x_i includes the vector of explanatory variables used in the model, β_i = parameters to be estimated, $€_I$ = error term of the model, exp (e) = base of the natural logarithms, L_i = Logit and $\left[\frac{Pi}{1-Pi}\right]$ = Odd ratios.

Thus, the binary logit regression model was expressed as;

$Y_i = f(\beta_i\ x_i)$ = f (Economically active family members, family type,Farm size, Training Extension and Information, LSU, Credit accessibility, Climate change information, Membership of organization etc).The way a positive and significant variable is interpreted the variable has a higher chance of being in that choice group relative to the reference group. This means that changes in the variable will increase the probability of a farmer to adapt to climate change. A negative and significant sign will mean that the probability of a farmer adapting to climate change is lower than that of the reference point.

Variables used in the logit model

Table 1 describes the variables used in the logit model. The variables in the logit regression model are economically active family members, age of household head, education of household head, farm size, training extension and information, gender, livestock holding unit, family type, climate change information, distance of agriculture office, membership of any organization and credit.

Conceptual framework of the study

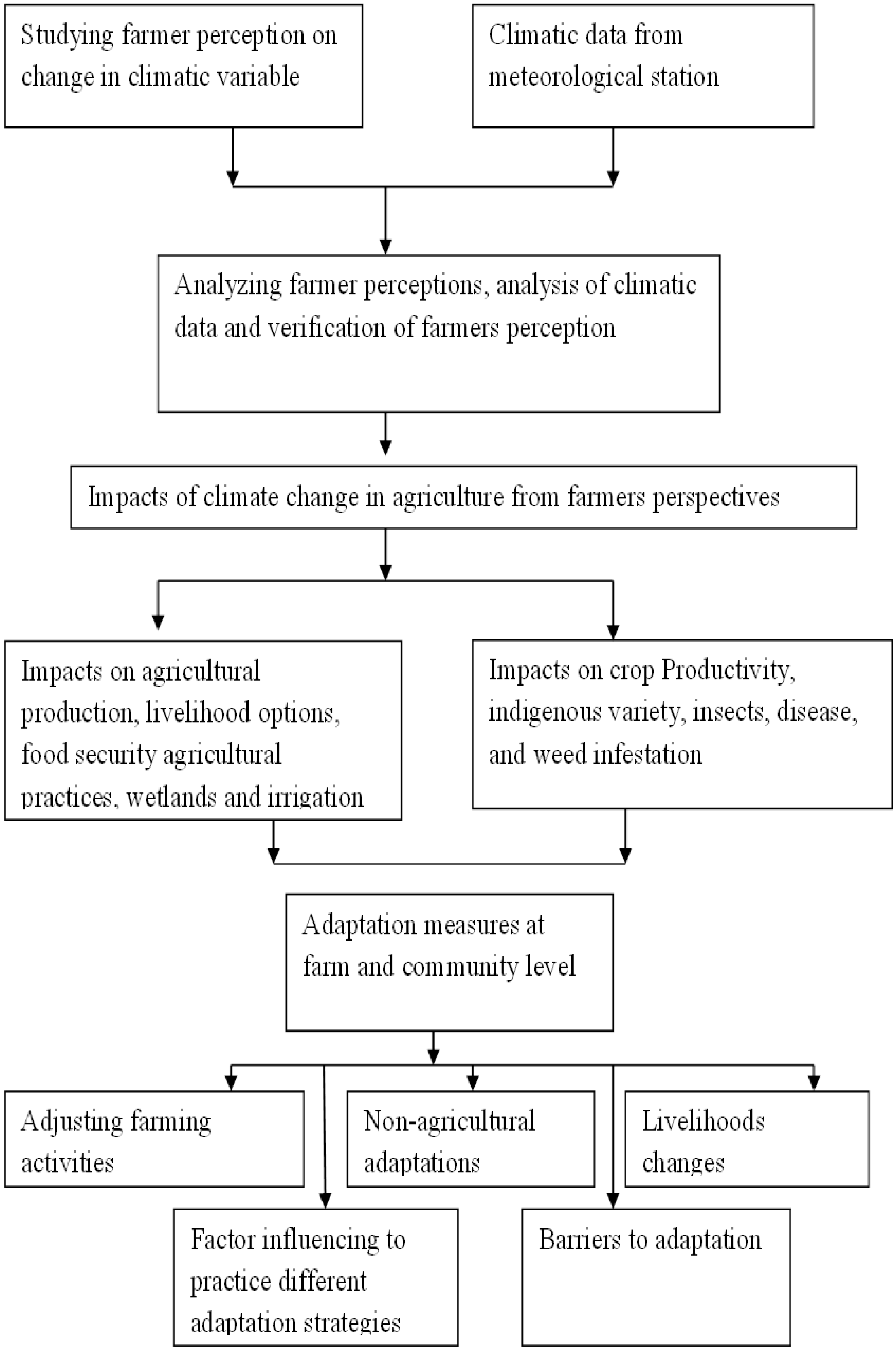

Figure 1: Conceptual framework of the research

Table 1: Variables used in the Model

Variables	Description	Value	Expected sign
Economically active members	Number of economically active(15-59) years family members in the household	Number	+
Education	Education of the household head	Number of Years	+
Farm size	Total size of cultivated land	Hectare	+
Experience	Experience of household head in agricultural activities	Year	+
Gender	Gender of the household head(1/0)	= 1 if male; 0 = otherwise	+/-
Training	Whether farmers received training from different governmental and non-governmental organization about climate change adaptation strategies(1/0)	= 1 if farmers received training and extension; 0 = otherwise	+
Membership	Whether the respondent is member of any organization	=1 if yes; 0= No	+
LSU	Number of livestock reared		+
Family type	Nuclear or joint	1=Joint, otherwise 0	+
CC information	Whether farmers know or receive information about climate change	1=yes; 0= No	+
Distance Ag office	Distance of extension office from resident area	Distance in KM	+
Credit access	HH acess to credit	1 if yes; 0 if No	+

RESULTS AND DISCUSSION

Socioeconomic characteristics

Socioeconomic characteristics of the local communities in the study areas relate to the vulnerability and adaptation capacity at the household level. Socioeconomic characteristics includes variables as age of respondents, respondent status as household head, ethnicity, family size, land ownership, livestock holding unit and, occupation of respondents in study area. The study revealed that the average age of respondents was 43.93 years ranging from 14 to 85 years with average respondents aged as 44.90 in Arukharka and 42.96 in Bhatkhola. All of the respondents in the study area were Hindus. The study also revealed the average family size to be 5.59, ranging from the size 16 to 1 which is greater than the district average of Syangja, i.e. 4.19 (CBS, 2011). Majority of households have economically active population having major occupation as agriculture i.e. 81.00 percent. Among 81 percentage of agriculture dependent respondents 45 (55.60 percent) were from Arukharka VDC and 36(44.40 percent) from Bhatkhola VDC. The mean land holding of Arukharka and Bhatkhola VDC was 9.76 and 9.36 ropani respectively. Similarly average livestock holding of total households was 9.06 LSU with Arukharkha VDCs 1.06 and Bhatkhola VDC 7.43. Among 100 respondents, 36 percent of the respondents were household head with 38 percent from Arukharka VDC and 34 percent from Bhatkhola VDC (table 2).

Perception of Respondents regarding climate change

The study revealed that 87% of the respondents knew about climate change and 13% of the respondents were unaware about climate change (Figure 2). This result indicates that most of smallholder's farmers were aware about climate change and its implication on their farming system. Albeit, most of farmers did not know term "climate change" but they were experiencing the impacts of climate change and climatic hazards in their daily lives.

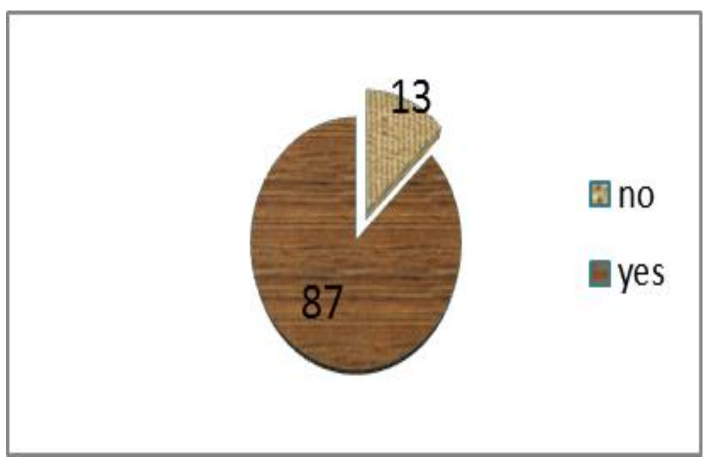

Figure 2: of climate change on respondents (2015)

Determinants of Climate change adaptation practices using Binary logistic regression

Table 3: Factors affecting the adoption of climate change adaptation strategies

Variable	Coefficients	P>|z|	Standard error	dy/dx[b]	S.E[b]
Age of HH (years)	0.004785	0.833	.0227494	0011021	.00524
Education of HH (Years)	0.551334	0.506	.08298	.0126991	.01907
Membership	0.798148	0.166	.5761147	.1751825	0.11797
Training (Dummy)	2.037394	0.001***	.6282871	.460653	.12526
Gender (Dummy)	0.1690068	0.260	.6913324	.0394773	.1636
Farm size (Dummy)	-.0660339	0.073*	.0367822	-.015209	.0084
LSU (Dummy)	0.1564514	0.072*	.0870012	.036036	.01995
Economically active (Dummy)	-.844373	0.009***	.3227914	-.194487	.0729
Family type	1.481845	0.020*	.6393523	.3089725	.11479
CC information	.3912288	0.602	.749494	.0931327	.18274
Distance Ag office	-.0142074	0.783	.0514968	-.003272	.01186
Credit access	-.7258231	0.202	.5688042	-.165790	.12742

Number of observation(N)	100
Log likelihood	-50.362633
LR chi^2(8)	33.88 (Prob>chi^2 = 0.000)
Pseudo R^2	0.2517
Cases predicted correctly (%)	64.023
Goodness of fit test	Pearson chi^2 (86) = 110.50 Prob> chi^2 = 0.0388

Constant	-.0894274	0.962	1.869566	-	-

*** Significant at P = 0.01; ** significant at P = 0.05; * significant at P ≥ 0.1 [b] Marginal change in probability (marginal effects after logit) evaluated at the sample means.

Source: Field survey, 2015

Logit regression analysis shows that five variables were statistically significant for practicing adaptation strategies. Among them Training, LSU, and family size were positively significant whereas economically active member and farm size were negatively significant. While variables namely age of HH, education, membership of organization, gender, credit accessibility, distance to agriculture office, and farm size were not significant (Table 3).

The training of the household head was positively significant (P<0.1) on the practicing adaptation strategies to climate change. According to the findings, keeping other factor constant, a unit increase in number of training would result in 46.053 % increase in the probability of adapting climate change. This suggests that trainings helps farmers to take climate changes and weather patterns into account and help them on how to tackle to climatic variability and change. This might be due to improving skills, increasing awareness and realization of positive benefits from practicing different adaptation strategies after receiving formal and informal trainings. Deressa et al. (2009), and Maddison (2006) reported that provision training on crop and livestock increases the probability of practicing different adaptation strategies by farmers. Similar results have been reported by provision of support services, as training and extension services, to increase adoption (G. Paudel and G. Thapa, 2004).

Livestock holding was positively significant (P<0.5) and a unit increase in the livestock standard unit would increase the adoption level to climate change adaptation measures by 3.6 percent. Similar findings were reported by Legesse et. al., and Temesgen et al. (2010).

The study revealed that family type was positively significant (P<0.5) on adaptation decision which implies that changing of family type from nuclear to joint family would increase the likeliness of adaptation practice. This result is in harmony with the findings of Belay et.al (2017) and Bonabana- Wabbi (2002) who explain that larger family have capacity to relax the labor constraints required during introduction of new technology.

There is a negative and significant (at 5% level) relationship between farm size and adaptation to climate change effects. Specifically, results show that increasing size of a farm operation decreases the probability of farmers' adoption of adaptive strategies to climate change. The reason behind this result may be that the large farmers were deployed traditional technologies rather modern technologies to climate change adaptation. Moreover, large farms require greater levels of investment to implement adaptive strategies to climate change, therefore, big farmers in terms of land size failed to do that compared to small farmer. Moreover, larger farms require inputs such as seeds, fertilizer, pesticides, irrigation facilities, and more at rates which are stressors on farm budgets. For adaptation behaviors it may be that these inputs were not available or are too expensive in the study area at sufficiently large quantities. Another potential explanation may be that all inputs were available but, due to a lack of proper management capacity in relation to farm size, large farms fail to adapt efficiently. Scarcity of labor may be the determining factor for farmer not engaging in adaptive strategy option.

There is significant (P<0.1) and negative relationship between economically active member and adaptation to climate change which implies that with a unit increase in economically active member the adaptation to climate change would decreases by 19 percent. This may be due to deviation of economically active family members to off-farm activities for earning more income.

The Wald test (LR chi 2) for the model indicates that the model has good explanatory power at the 1 % level of significance. The Pseudo R^2 was 0.2517. The overall predictive power of the model was 64.023%.

CONCLUSIONS AND RECOMMENDATIONS

Agriculture was the major source of livelihood for majority of the people in the study area. Results indicated that most of smallholder's farmers were aware about climate change and its implication on their farming system. Logit regression analysis showed training, LSU, and family size were positively whereas economically active member and farm size were negatively significant determinants of farmers adaptation to climate change and per unit increase in these variables would increase the probability of practicing different adaptation strategies in the study area. This leads to the suggestion that there is need for government to develop and strengthen institutional mechanisms that support the farmers to adapt to climate change. These include access to credit through micro financial institutions and other formal channels, adult literacy support on climate change issues and increased exposure to information on climate change through extension services and improved climate change forecasting. Agricultural policies should promote farmer to farmer extension services through farming cooperatives in order to harness the farming experience in some of the farmers.

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REFERENCES

Belay A., Recha, J.W., Woldemanuel, T. & Morton, J.F (2017). Smallholder farmers' adaptation to climate change and determinants of their adaptation decisions in the Central Rift Valley of Ethiopia. Agriculture and Food Security (2017) 6:24.

CBS, (2011). National Population Survey. Thapathali, Kathmandu.

Deresa, T.T, Hassan, R.M. Ringler, C. Alemu, T. & Yesuf M. (2009) "Determinants of Farmers' Choice of Adaptation Methods to Climate Change in the Nile Basin of Ethiopia" Global Environmental Change, Vol. 19, pp. 248-255

FAO (Food and Agriculture Organization) (2008). Climate Change Adaptation And Mitigation In The Food and Agriculture Sector, Technical Background Document FromThe Expert Consultation Held On 5 To 7 March 2008, Rome, Food And Agriculture Oganisation Of The United Nations.

Füssel, H-M., & Klein, R.J.T. (2006) "Climate Change Vulnerability Assessments: An Evolution of Conceptual Thinking" Climate Change, Vol.75: pp. 301-329

Gujarati, D.N. (2003). Basic Econometrics. New York: McGraw Hill Book Co.

Hosmer D.W., & Lemeshow S. (2000). Applied Logistic Regression. Second edition. A Wiley Interscience Publication, Canada.

Legesse, B., Ayele, Y. & Bewket, W. (2010). Smallholder farmer's perception and adaptaion to climate variablility and climate change in Doba district, West Hararghe, Ethiopia. Asian Journal of Empirical Research 3(3):251-265

Maddison, D. (2006). The Perception and Adaptation of Climate Change in Africa. CEEPA Discussion Paper No: 10, Special Series on Climate Change and Agriculture in Africa.

MoAD (Ministry of Agriculture Development). (2015). Agriculture Development Strategy (ADS).

Paudel G.S & Thapa, G.B. (2004). Impact of social, institutional and ecological factors on land management practices in mountain watersheds of Nepal. Applied Geography 24: pp 35-55.

Tadesse T., Ringler, C & Hassan, R. (2010). Factors affecting the choices of coping strategies for climate extremes: the case of farmers in the Nile Basin of Ethiopia. University of Pretoria, Pretoria.

Wabbi, J.B. (2002). Assessing Factors Affecting Adoption of Agricultural Technologies: The Case of Integrated Pest Management (IPM) in Kumi District, Eastern Uganda