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Determinants of Households' Adaptation Practices against Climate Change Impact on Off-farm Activities in Nawalpur District, Nepal

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Abstract

Climate change is one of the serious concerns which have a significant impact in all areas of human civilization. Among these areas, agriculture is the worst hit sector. This study aims to analyze the determinants of households' adaptation practices against climate change impact on off-farm activities in Nawalpur District, Nepal. It utilizes the data collected from two Village Development Committees (VDCs) of Nawalpur district of Nepal, i.e., Tamsaria and Jaubari. Out of 3106 households, 433 households were chosen for the survey. A systematic random sampling technique was used to select the respondents. The information was collected using pre-tested structured questionnaire through face to face interview technique with household head or a household member having age 45 years and over residing in that locality since last 15 years. Binary logistic regression analysis has been carried out.

Age does not matter for determining the households' adaptation practices towards all selected off-farm activities. Female in compared to male and single people in compared to married are less likely to adapt off-farm activities. Literate people have more chance to have adaptation (changed food consumption habit) as compared with illiterate people. Females in compared to male, non-Hindu people, joint family and Janajati with compare to so-called upper caste are more likely to adapt off-farm activities (shift to non-agricultural activities). Non agriculture as the major occupation of household has significant impact on adaptation towards off-farm activities. Household size is also the determining factor for the adaptation practices.

Keywords: Adaptation; Climate change; Determinants; Off-farm activities; Nawalpur district

Introduction

Climate change is a global critical development issue affecting many sectors in the world and is considered to be one of the most serious threats to sustainable development. Globally, an unprecedented increase in greenhouse emissions has led to increase climate change impacts [1]. Agricultural risks, such as climate risks are dominant in both developed and developing countries, although the major sources and consequences may differ across countries, most farmers in these countries largely experience them.

Nepal is one of the most vulnerable countries with respect to climate change, due to greater warming in recent years than that of the global average. While there was 0.6°C global mean surface temperature rise, from 1975 to 2005, Nepal experienced a considerably higher temperature rise of 1.5°C (0.06°C per year) during a similar duration of time, from 1982 to 2006 [2]. Similarly, the rainfall pattern is also becoming more erratic [3]. As a result, mean rainfall has been decreasing by 3.7 mm (-3.2%) per month, per decade [4]. These conditions have created a drought especially for the rain-fed hill farming system, where people depend on summer and winter rainfall for their major agricultural activities [5]. Moreover, the mean annual temperature is predicted to be increased between 1.3°C to 3.8°C by the 2060s, and 1.8°C to 5.8°C by the 2090s while annual precipitation reduction could be within the range of 10% to 20%, across the country [4].

Agriculture is still a key economic activity for people in the rural area, and more than two-thirds

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of rural people depend on agriculture for their livelihood [5]. Crops and livestock farming, in different combinations, form a major way of life sustenance in the rural communities. Cereals crops, including rice, wheat, maize, millet, barley, and buckwheat, are the foundations of Nepal's agriculture, especially in western Nepal [6]. The agriculture sector accounts for almost one third of Nepal's GDP. Sixty percent of the farm land is rain-fed in nature, without any alternative irrigation measures [5,7]. And over 50 percent of Nepalese farmers are smallholders, cultivating less than 0.5 hactor of agricultural land; [8]. Eighty percent of Nepalese people live in rural areas [5]. Increase in the occurrence of drought can result in agriculture becoming less stable, and have significant implications for crop productivity, food security, and the overall livelihood of people who are dependent on these resources [9]. The investigations reported in the 2013 IPCC report come to central conclusion about the south Asian region under global climate change models: "normal" monsoon seasons are seen as less likely, leaving uncertainty about the extremes to be experienced in the region [10]. The prediction of climatic changes has the potential to severely affect countries highly dependent upon agrarian livelihoods, resulting in food shortages, among other consequences. Therefore, people who depend on farming activities will require a variety of adaptation strategies to mitigate the negative effects of climate change and maintain the livelihoods of farming families.

Government of Nepal (GoN) has emphasized on adaptation in the national and local plans and priorities [11] which require consolidated efforts of all the stakeholders at all levels including the farmers, poor and marginalized people, though their contributions to the climate change is minimal. A study conducted by Dixit emphasized on the plural institutions and incremental solutions at the local, regional and national scales [12]. There are multiple factors including the policy and institutional, socio-economic, physical, natural and human capital that have been directly or indirectly supporting or influencing and also restraining climate change adaptation [13]. Regmi et al., emphasized on analysis of such influencing factors at the farm or household level [11]. Piya, Maharjan and Joshi highlighted the bottom-up assessment of these factors or determinants based on actual and direct interaction with the affected people and communities [14].

Adaptation refers to an adjustment in natural or human systems in response to actual or expected climatic conditions or risks and can be regarded as a policy option to contain the negative effects of climate change [15]. Adaptation is the most efficient way out for them to face the extreme weather conditions associated with climate variations and to minimize the negative impacts of climate change [10]. The adaptation strategies of farmers employed to mitigate the effect of climate change include varying land size, sales of crops; varying the planting and harvesting dates; soil conservation techniques and mulching. Other adaptation strategies include, livestock rearing; mixed cropping, mono-cropping and no adaptation. Other socioeconomic adaptation measures, which help to combat the underlying causes of vulnerability and improve the adaptive capacity of farmers, must be considered. The measures taken, aimed at reducing the vulnerability of agricultural areas, depend on the resources and features of each area, as indicated so far. There will be a need to shift from certain crops to others that are more resistant and better adapted to the 'new' climate, or to abandon agricultural production in the more exposed areas in favor of other economic activities. In the latter case, the management of diversification off-farm needs to be managed as part of a broader economic transition. Off-farm activities involve participation in remunerative work

outside the participant's own farm and have been recognized to play an increasingly essential role in sustainable development and poverty reduction particularly in rural areas [16]. It may serve as a safety net for the poor whereas for the rich it may be a means of accumulation. It can create opportunities to explore different adaptations strategies like change in food consumption habit, off-farm activities, off-farm job and temporary migration that are suitable in such changing circumstances. However, despite the growing body of knowledge attached to climate change adaptation strategies very few of such studies have analyzed the factors influencing adaptation in Nepalese context but there is no research on participation in off-farm activities as an adaptation strategy against climate change by farmer in the Nepal [17]. As such, a clear understanding of the factors that influence farmers' adaptation decisions is essential to the designing of appropriate policies to promote effective adaptation in the agricultural sector [18]. That might be forwarding to wider the eyes of policy maker as well as farmer who are really victimized. Therefore, this study aims to identify the factors that determine the household adaptation strategies of climate change impact on off-farm activities.

Materials and Methods

This study is based on primary data collected from two Village Development Committees (VDCs) of Nawalpur district of western Nepal, i.e., Tamsaria and Jaubari. Out of 3106 households 433 households were selected for data collection. A systematic random sampling technique was used to select the respondents. The information was collected using pre-tested structured questionnaire through face to face interview with household head or a household member having age 45 years and over residing in that locality since last 15 years at the time of survey. A rigorous literature review was done for developing research instrument and also consulted with experts for maintaining the validity. Similarly, pre-testing was done and few modifications were made before finalizing the instrument. Cronbach alpha was also computed (found to be 0.75) to check the reliability. Change on food consumption habit; shifting to non-agricultural activities; shifting to non-agricultural employment; and temporary out-migration have been chosen as off-farm activities among participants. Age, sex, marital status, educational status, caste/ethnicity of the respondents, religion, family type, household size, major occupation of the household, agriculture skill, years of experience in agricultural sector and land ownership have been considered as the set of independent variables. Binary logistic regression analysis has been carried out to find the determinants of adaptation practices towards off-farm activities.

Results and Discussion

Background characteristics of the respondent

Sex of the respondent, caste/ethnicity, marital status, religion, types of family, family size, age, educational status, farming experience, agriculture skill, major occupation of household, land ownership for agriculture production are the main socio-economic and demographic variables considered for the analysis. Nearly three-fifth of the respondents (57.3%) are male whereas female accounts just more than two-fifth of the total samples (42.7%). Minimum age of the respondents is 45 years, maximum age is 86 years and the range is 41 years following the average age as 55.54 years with standard error as 0.441 years and standard deviation as 9.1 years. Almost three fourth (74.6%) of the respondents are from age group (45-60) years. Only just over one fourth of the respondents are above sixty years. Nearly nine-tenth of the respondents are married followed by divorced

Table 1: Respondents classified according to selected background characteristics.

Background Characteristics	Number	Percent
Age		
45 to 60 years	323	74.6
Above 60 years	110	25.4
Minimum= 45 years , Maximum = 86 years, Average = 55.54 years with S.D. = 9.1		
Sex of the Respondents		
Male	248	57.3
Female	185	42.7
Marital Status		
Unmarried	7	1.6
Married	388	89.6
Divorced	38	8.8
Family Size		
Up to 4.6	117	27.0
Above 4.6	316	73.0
Minimum= 1 , Maximum = 36, Average = 6.22, with S.D.=3.26		
Caste/Ethnicity		
Brahmin	135	31.2
Chhetri	36	8.3
Janajati	226	52.2
Dalit	27	6.2
Others	9	2.1
Family Type		
Joint	279	64.4
Nuclear	154	35.6
Religion		
Hindu	417	96.4
Buddhist	8	1.8
Christian	8	1.8
Agriculture Skill		
Yes	95	21.9
No	338	78.1
Farming Experiences(years)		
15- 24	136	31.4
25-34	126	29.1
35 to 44	90	20.8
45 and above	81	18.7
Min= 15 years, Max.=65 years, Mean = 31.99 years, with S.D.= 12.4 years		
Educational Status of respondent		
Illiterate	130	30.0
Informal Education	119	27.5
Basic Education	136	31.4
Secondary Education	45	10.4
Higher Education	3	0.7
Major Occupation of the household		
Agriculture	408	94.2
Government Service	8	1.8

Private services	1	0.2
Business	8	1.8
Others	8	1.8
Land ownership		
Own Land	368	85.0
Lease/Profit Sharing	25	5.8
Both	40	9.2

Table 2: Adaptation practices towards off-farm activities.

Characteristics	Number	Percent
Change in Food Consumption Habit		
Yes	222	51.3
No	211	48.7
Involvement in non-agricultural activities		
Yes	128	29.6
No	305	70.4
Involvement in non-agricultural employment		
Yes	74	17.1
No	359	82.9
Migration of any member of HH to another place within 15 years		
Yes	49	11.3
No	384	88.7
Total	433	100

(8.8%) and unmarried (1.6%). Minimum family size is one and the maximum is 36 with average household size 6.22 following standard error as 0.156 and standard deviation 3.26. More than half (53.2%) of the households exceed national average of household size (4.88). More than half (52.2%) of the respondents are Janajati followed by Brahmin (31.2%), Chhetri (8.3%), Dalit (6.2%) and others (2.1%). Almost all (96.4%) follow Hindu religion followed by Buddhist (1.8%), and Christian (1.8%) respectively. More than 78.0 percent of the respondents do not have any skill of agriculture. The minimum farming experience of the respondents is 15 years and maximum is 65 years with mean 31.99 years, standard error 0.595 years and standard deviation 12.4 years. Further, almost one- third (31.4%) of the respondents have farming experience of 15 to 24 years followed by 25 to 34 years (29.1%), 35 to 44 years (20.8%) and above 45 years (18.7%) respectively. Almost one third (31.4%) of the respondents have basic education followed by illiterate (30%), informal education (27.5%), secondary education (10.4%) and higher education (0.7%) respectively. Slightly more than 94 percent of the respondents are employed in agriculture as a major occupation followed by business (1.8%), government services (1.8%), others (1.8%) and private sectors (0.2%) respectively. Further, most of the respondents (85%) have their own land for agriculture production. Nearly six percent of the respondents have lease/ profit sharing land for agriculture production whereas nearly ten percent of the respondents have both own and lease/profit sharing land for agriculture production (Table 1).

Adaptation practices toward off-farm activities

Among the various off-farm strategies adapted by the households, only four strategies: change in food consumption habits, involvement in non-agricultural activities, involvement in non-agricultural employment and migration of any household members to another place within 15 years have been considered as non-farm activities for

Table 3: Odds ratio from logistic regression model of change of the food consumption habits (n=433).

Characteristics	Odds Ratio	Significance	95% CI	
			Lower	Upper
Age	1.020	0.183	0.991	1.049
Sex				
Male (R)	1	-	-	-
Female	1.754	0.015	1.115	2.760
Marital Status				
Married(R)	1	-	-	-
Single	0.442	0.025	0.216	.905
Religion				
Hindu(R)	1	-	-	-
Non-Hindu	2.264	0.172	0.701	7.312
Education				
Illiterate(R)	1	-	-	-
Literate	1.902	0.022	1.096	3.301
Basic	2.057	0.017	1.139	3.713
Secondary and above	2.001	0.083	0.913	4.386
Caste/Ethnicity				
Upper Caste(R)	1	-	-	-
Janajati	1.128	0.599	0.721	1.764
Others	1.006	0.988	0.466	2.172
Major Occupation of HH				
Agriculture(R)	1	-	-	-
Non-agriculture	2.204	0.116	.822	5.906
Household Size				
	0.911	0.013	0.846	0.981
Family Type				
Nuclear(R)	-	-	-	-
Joint	0.741	0.209	0.464	1.182
Agricultural Skill				
Yes(R)	1	-	-	-
No	0.866	0.572	0.527	1.425
Land Ownership				
Own Land(R)	1	-	-	-
Lease/Profit Sharing	1.696	0.241	0.702	4.097
Both	1.364	0.387	0.675	2.757
Years of experience on agriculture				
	0.984	0.098	0.965	1.003

Final -2log likelihood=566.141; Hosmer and Lemeshow-Chi-square value=6.762 (P=0.563); Nagelkerke R²=0.100; Cox-Snell R²=0.075

analytical purpose. More than half of the respondents changed their food consumption habit for the adaptation of climate change. About 30 percent of households have shifted to non-agricultural activities and only less than 18 percent of households have shifted to non-agricultural employment. Similarly, just over one tenth of HHs have migrated temporarily from that place for the adaptation of climate change (Table 2).

Determinants of households' adaptation practices against climate change impact on off-farm activities

To find the determinants of households' adaptation practices against climate change impact on off-farm activities, change on

Table 4: Odds ratio from logistic regression model of shifting to non-agricultural activities (n=433).

Characteristics	Odds Ratio	Significance	95% CI	
			Lower	Upper
Age	0.989	0.523	0.958	1.022
Sex				
Male (R)	1	-	-	-
Female	2.105	0.003	1.281	3.461
Marital Status				
Married(R)	1	-	-	-
Single	0.784	0.546	0.355	1.729
Religion				
Hindu(R)	1	-	-	-
Non-Hindu	3.324	0.041	1.050	10.520
Education				
Illiterate(R)	1	-	-	-
Literate	0.569	0.073	0.307	1.054
Basic	0.592	0.113	0.310	1.132
Secondary and above	0.976	0.954	0.425	2.238
Caste/Ethnicity				
Upper Caste(R)	1	-	-	-
Janajati	0.403	0.000	0.244	0.667
Others	0.453	0.072	0.191	1.074
Major Occupation of HH				
Agriculture(R)	1	-	-	-
Non-agriculture	1.185	0.720	0.468	2.999
Household Size				
	1.042	0.290	0.966	1.124
Family Type				
Nuclear(R)	1	-	-	-
Joint	2.530	0.000	1.514	4.228
Agricultural Skill				
Yes(R)	1	-	-	-
No	1.104	0.729	0.630	1.937
Land Ownership				
Own Land(R)	1	-	-	-
Lease/Profit Sharing	1.098	0.851	0.416	2.900
Both	0.902	0.800	0.406	2.002
Experience on agriculture				
	1.011	0.335	0.989	1.034

Final -2log likelihood=476.603; Hosmer and Lemeshow-Chi-square value=8.203 (P=0.414); Nagelkerke R²=0.153; Cox-Snell R²=0.107

food consumption habit; shifting to non-agricultural activities; shift to non-agricultural employment; and temporary out-migration have been considered as dependent variables while age, sex, marital status, religion, household size, family type, educational status, caste/ethnicity, major occupation of household, agricultural skill, land ownership and years of experience in agricultural sector are considered as independent variables.

Change of food consumption habit

Table 3 shows the adjusted odds ratio (from logistic regression analysis) with their *p*-values and confidence intervals. From the model it is clear that females are more likely to change the food

Table 5: Odds ratio from logistic regression model of shifting to non-agricultural employment (n=433).

Characteristics	Odds Ratio	Significance	95% CI	
			Lower	Upper
Age	0.983	0.423	0.942	1.025
Sex				
Male (R)	1	-	-	-
Female	1.416	0.262	0.771	2.602
Marital Status				
Married	1	-	-	-
Single	0.522	0.329	0.142	1.923
Religion				
Hindu	1	-	-	-
Non-Hindu	1.422	0.594	0.390	5.185
Education				
Illiterate(R)	1	-	-	-
Literate	1.617	0.263	0.697	3.754
Basic	2.114	0.083	0.906	4.929
Secondary and above	2.419	0.099	0.847	6.911
Caste/Ethnicity				
Upper Caste(R)	1	-	-	-
Janajati	1.211	0.540	0.656	2.237
Others	1.133	0.818	0.390	3.291
Major Occupation of HH				
Agriculture(R)	1	-	-	-
Non-agriculture	3.651	0.009	1.377	9.676
Household Size				
	1.076	0.099	0.986	1.173
Family Type				
Nuclear(R)	1	-	-	-
Joint	1.802	0.060	0.975	3.330
Agricultural Skill				
Yes(R)	1	-	-	-
No	1.659	0.153	0.828	3.323
Land Ownership				
Own Land	1	-	-	-
Lease/Profit Sharing	0.243	0.179	0.031	1.910
Both	0.343	0.096	0.097	1.210
Years of experience on agriculture				
	0.988	0.406	0.961	1.016

Final -2log likelihood=354.798; Hosmer and Lemeshow-Chi-square value=6.148 (P=0.631); Nagelkerke R²=0.152; Cox-Snell R²=0.091

consumption habit than male. Further, single people are less likely to change food consumption habit than married people. With reference to illiterate, literate and educated people are more likely to change food habit. Similarly as household size increases, there is less likely to change food consumption habit.

Shifting to non-agricultural activities

Shifting to non-agricultural activities has two responses yes and no. No is taken as reference category for finding the determinants of adaptation practices. Table 4 shows the odds ratio from logistic regression analysis of shifting to non-agriculture activities with

Table 6: Odds ratio from logistic regression model of adapting temporary migration of any member to HH to another place within 15 Years (n=433).

Characteristics	Odds Ratio	Significance	95% CI	
			Lower	Upper
Age	0.997	0.908	0.955	1.042
Sex				
Male (R)	1	-	-	-
Female	0.817	0.588	0.393	1.698
Marital Status				
Married(R)	1	-	-	-
Single	0.963	0.950	0.296	3.137
Religion				
Hindu(R)	1	-	-	-
Non-Hindu	0.693	0.690	0.114	4.212
Education				
Illiterate(R)	1	-	-	-
Literate	0.992	0.985	0.420	2.342
Basic	0.630	0.347	0.241	1.648
Secondary and above	1.409	0.557	0.448	4.429
Caste/Ethnicity				
Upper Caste(R)	1	-	-	-
Janajati	0.752	0.421	0.375	1.507
Others	0.822	0.749	0.248	2.727
Major Occupation of HH				
Agriculture	1	-	-	-
Non-agriculture	2.886	0.069	0.920	9.059
Household Size				
	1.101	0.037	1.006	1.205
Family Type				
Nuclear	1	-	-	-
Joint	0.507	0.094	0.229	1.122
Agricultural Skill				
Yes(R)	1	-	-	-
No	2.130	0.082	.909	4.992
Years of experience on agriculture				
	0.991	0.572	0.961	1.022

Final -2log likelihood=279.282; Hosmer and Lemeshow-Chi-square value=2.294 (P=0.971); Nagelkerke R²=0.117; Cox-Snell R²=0.059

p-values and confidence intervals. From the fitted model, female are more likely to shift to non-agriculture activities than their male counterparts. Further, with reference to Hindu, non-Hindu farmers have more chance to shift to non-agriculture activities. Similarly, Janajati people are less likely to adapt non-agriculture activities than upper caste. With reference to the people with nuclear family, joint family are more likely to shift from agriculture to non-agriculture activities (Table 4).

Shifting to non-agricultural employment

The dependent variable shifting to non-agricultural employment has two responses i.e., yes and no assuming no as reference category. Table 5 shows the odds ratio from logistic regression analysis. People with major non-agriculture occupations are more likely to shift into non-agriculture employments as compared to people with major agriculture occupations of household (Table 5).

Adapting temporary migration of any member of HH to another place within 15 years

The dependent variable; temporary migration has two responses yes and no. No has been taken as reference category for finding the determinants of adaptation practices. Table 6 shows the odds ratio of logistic regression coefficients with their p-values and 95 percent confidence interval. Analyses reveal that, as household size increases, there is less likely to have adaptation practices (Table 6).

Conclusion

Most of the respondents are male of age 45-60 years, from Janajati, joint family, with basic education, Hindu, married and without agriculture skill. Age does not matter for determining the households' adaptation practices towards all selected off-farm activities. Female in compared to male and single people in compared to married are less likely to have adaptation practices towards off-farm activities and with reference to illiterate, people literate and basic education have more chance to have adaptation (changed food consumption habit). Females in compared to male, non-Hindu people, joint family and Janajati with compare to upper caste are more likely to have adaptation practices towards off-farm activities (shifted to non-agricultural activities). The respondents with major occupations of household as non-agriculture have more chance to have adaptation practices (shifted to non-agricultural employment). Household size is the determining factor for the adaptation practices (changed on food consumption habit and temporary out-migration).

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