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Perception of Farmers towards Climate Change Impact on Agriculture Production and Adaptation Practices in Pokhara

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ABSTRACT

Climate change has become serious problem which has threatened human civilization in many ways. Although adaptation practices against climate change impact have been explored into practice in massive scale, the impact of climate change in agriculture production is challenging. This study aims to explore the farmers' perception towards climate change impact on agriculture production and adaptation practices in Pokhara. For this purpose, two wards (30 and 33) of Pokhara were selected purposively. Out of 3,982 households in these wards, 216 households (at 6.5% margin of error and 5% level of significance) were selected for the information collection. Then the information was collected by using structured questionnaire through interview techniques with household head or a household member having age 40 years and over and residing in that locality for last 10 years. A systematic sampling technique was carried out to select the samples. Chi-squared test was applied to find the factors associated with farmers' adaptation practices for the climate change impact on agriculture production. Rice, maize, wheat, mustard and millet are the major crops in the study area. Majority of the respondents perceived increase in rice production, decrease in maize, wheat and millet production, and no change in mustard production. Majority of the respondents increase the use of improved seeds, chemical fertilizer and pesticides, do not change the cropping pattern and cropping altitude for the adoption of climate change in agriculture production. Use of seeds that can be cultivated in any seasons, fertilize of compost manure production on own field, water collection through pond, water and tank, tunnel crop, practice of off seasons crops are some adoption practices that they could not apply or they did not apply. Agriculture skill and the major occupation of the respondents are the common major factors associated with adaptation practices for climate change impact on agriculture production.

KEYWORDS: Adaptation practices, agriculture production, climate change, farmer, perception

INTRODUCTION

The scientific evidence has shown that climate change is a global challenge facing humans and their socio-economic activities, health, livelihood, and food security (Romieu, Welle, Schneiderbauer, Pelling, & Vinchon, 2010; Amjath-Babu, Krupnik,

Aravindakshan, Arshad, & Kaechele, 2016). Agriculture is one of the main economic activities of Nepal and about two-thirds of the population employs on it (CBS, 2017). In Zimbabwe, maize productivity in some agricultural production zones may decrease primarily as a result of temperature increases (Makadho, 1996; Jones & Thornton, 2003). The projected mean change in yield of all crops is -8% by the 2050s in Africa and South Asia. Across Africa, mean yield changes of -17% (wheat), -5% (maize), -15% (sorghum) and -10% (millet) and across South Asia of -16% (maize) and -11% (sorghum) were estimated. No mean change in yield was detected for rice (Knox, Hess, Daccache & Wheeler, 2012).

Nepal is no exception in being country vulnerable to the impacts of climate change due to its fragile mountain ecosystem, weak geological condition and diverse nature climate. Nepal may experience a great impact even with the slight changes over the natural climate system. Moreover, being a developing country, Nepal has low adaptive capacity to cope with the effects of climate change. Different sectors, directly linked to livelihoods of Nepalese people such as agriculture, health, water resources, biodiversity and forest, and natural disasters are destined to bear the brunt of climate change irrespective of fact that Nepal has negligible share in global emission of green house gases (GHG). This clearly indicates that country like Nepal needs to be prepared for adopting changing climate. The policy and action should focus to adopt a combined strategy of reducing GHG emission and adaptation to the impacts of climate change consistently at global, regional, national and local level (NAST, 2013).

Though climate change is a global phenomenon, it has highly localized impacts and needs adaptation at the local level (Agrawal, Perrin, Chhatre, Benson & Cononen, 2009; UNCDF, UNDP & UNEP, 2010).

In countries like Senegal, China, Ghana, Nepal, Bangladesh, Nigeria, United States of America, farmers have been mentioned to perceive and even adapt to changes in the climate (Mertz, Mbow, Reenberg, & Diouf, 2009; Byg & Salick, 2009; Fosu-Mensah, Vlek, & Manschadi, 2010; Maharjan, Sigdel, Sthapit, & Regmi, 2011; Haque, Yamamoto, Malik, & Sauerborn, 2012; Salau, Onuk, & Ibrahim, 2012; Arbuckle, Morton, & Hobbs, 2013). Socioeconomic and environmental factors have been demonstrated in various studies to influence farmers' perception and adaptation to changes in the climate (Deressa, Hassan, & Ringler, 2011), those include education, household size, livestock ownership, agro-ecological zone, farm size and access to credit among others.

As previous authors have found, perception and coping strategies to climate change are influenced by a number of socioeconomic and environmental factors (Nhemachena & Hassan, 2007; Deressa, Hassan, Ringler, Alemu, & Yusuf, 2009; Nhemachena, 2009). Overall impacts of climate change on both crops and livestock appear to be highly negative, much more on maize (62.8%), yam (52.2%), poultry (67%) and cattle (63.2%). Smallholder farmers are particularly vulnerable to climate change since the majority of them do not have enough resources to cope (Ayanlade, Radeny, & Morton, 2017).

Khanal, Wilson, Hoang and Lee, (2018) found that the adaptation strategies employed by farmers significantly increase rice yields. Furthermore, results indicate that both adapters and non-adapters would benefit from the adaptation of the identified strategies. This study, therefore, provides supportive evidence for policy makers to take into consideration farmers' existing knowledge and skills in adapting to climate change. The findings show that it is imperative to involve farmers in climate change adaptation planning processes if the full benefits of such policy action are to be realized.

While this information on farmers' perceptions towards climate change impact on agriculture production and adaptation practices have been more evident, there have not been done sufficiently such type of study in the particular area of mid hill part of Nepal. In overall climate change trend, Kaski has been identified as very high risk (0.580-1.00) (NAPA, 2010). Therefore, this study aims to fill the gap for exploring the perception of people towards climate change impact on agriculture production and adaptation strategies for climate change impact on agriculture production in Pokhara.

DATA AND METHODS

As this study aims to explore the farmers' perception towards climate change impact on agriculture production and adaptation practices in Pokhara, exploratory type of research design was applied for this study. Further it also found the factors associated with some adaptation practices of farmers against climate change impact on agriculture production. Multistage sampling technique was applied for choosing the study units. In overall climate change trend Kaski have identified as very high risk (0.580-1.00) (NAPA, 2010). So, at first mid hill part of western Nepal i.e. Kaski District is selected purposively. At second stage, as ward number 33 of Pokhara Metropolitan City (which was previously rural VDC) which is still rural setting of Kaski and ward number 30 which is semi-urban setting are selected purposively. From 3,982 households of these wards, 216 households (at 6.5% margin of error and 5% level of significance) were selected for the information collection. At final stage, a household head or a household member having age 40 years and over and residing in that locality for last 10 years were considered as an ultimate respondent for interview and were selected by using systematic sampling techniques in the interval of eighteen households. If the criteria of the respondent for the selected household did not meet, the respondent from next household was selected. Both descriptive as well as inferential statistics were used for this study. Chi-squared test was applied to find the factors associated with some adaptation practices for the climate change impact on agriculture production.

FINDINGS

Based on the information collected from 216 respondents, this study has the following findings regarding farmers' perception towards climate change impact on agriculture production and adaptation practices against climate change impact on agriculture production as well as the factors associated with some adaptation strategies.

Farmers' Perception towards Climate Change Impact on Agriculture Production

Here, farmers' perception towards climate change impact on agriculture production is explored. For this, the respondents were asked to mention any four major agriculture productions and their situation as increase, decrease, do not know and no change. The major crops of the respondents in the study area are rice, maize, wheat, mustard and millet. All the respondents are aware about the climate change impact on agriculture production.

Perception towards Major Production

Rice is one of the major crops of all the respondents in study area. Out of these 216 respondents, majority (56.96%) of the respondents' perception about rice production is that it is increased followed by no change (29.6%), and decrease (13.4%). Further, maize is another major crop of 98 percent respondents in the study area. Among 210 respondents, majority (41.9%) of the respondents' perception about maize production is that it is decreased followed by increase (30%) and no change (28.1%). Similarly, wheat

is another major crop of more than one third (36.1%) respondents. Out of 78 respondents, majority (48.7%) of the respondents' perception about wheat is that it is decreased followed by no change (32.2%) and increased (19.2%). Millet is the fourth major crop of around one third respondents. Among 73 respondents, majority (39.7%) of the respondents' perception about millet is that it is decreased followed by increase (34.2%) and no change (26%). Finally, mustard is another major crop of more than one fifth respondents. Out of 50 respondents, majority (42%) of the respondents' perception about mustard is that there is no change in the production followed by increased (34%) and decrease (24%).

Table 1: Perception on major crops production

Crops	Increase		Decrease		No change		Total	
	N	%	N	%	N	%	N	%
Rice	123	56.9	29	13.4	64	29.6	216	100
Maize	63	30	88	41.9	59	28.1	210	97.2
Wheat	15	19.2	38	48.7	25	32.2	78	36.1
Millet	25	34.2	29	39.7	19	26	73	33.8
Mustard	17	34	12	24	21	42	50	23.1

Source: Field Survey, 2018

Perception on Climate Change as a Problem in Agriculture Production and Reduction

In this section, perception of the respondents on climate change as a serious problem in agriculture production and its reduction is explored. The perception is explored with some scale as strongly agree, agree, neutral, and strongly disagree. Almost three fifth (74.1%) of the respondents are strongly agree with the statement that climate change is a serious problem in agriculture production. Further one fourth of the respondents are agreeing with the above statement. Very few of the respondents are neutral with that statement.

Similarly, more than half (50.5%) of the respondents are strongly agree with the statement that climate change impact in agriculture can be reduced followed by agree (39.9%) and neutral (9.3%) respectively. Very few i.e. one of the respondents is strongly disagree about the statement that climate change impact in agriculture can be reduced. For that respondent, climate change is automatic process that nobody can stop it.

Table 2: Perception on climate change in agriculture production and its reduction

CC is a serious problem	Frequency	Percent
Strongly agree	160	74.1
Agree	54	25.0
Neutral	2	0.9
Climate change impact in agriculture can be reduced		
Strongly agree	109	50.5
Agree	86	39.8
Neutral	20	9.3
Strongly disagree	1	0.5
Total	216	100.0

Source: Field Survey, 2018

Adaption and Coping Strategies of the Respondents

There are different adaption and coping strategies of respondents for climate change. Here, adaptation and coping strategies towards irrigation facility, improved irrigation facility, use of water pumps, use of pond construction, use of well construction, use of improved seeds, use of compost fertilizer, use of chemical fertilizer, use of pesticides, use of cropping pattern and use of cropping altitude are explored.

Irrigation Facility

More than one third of the respondents (36.6%) have increased the irrigation facility for the adaption of climate change impact on agriculture production. More than one fifth (27.3%) of the respondents has decreased the irrigation facility. Almost one third of the respondents responded that there is no change in irrigation facility.

Table 3: Irrigation facility

Irrigation Facility	Frequency	Percent
Increase	79	36.6
Decrease	59	27.3
No change	67	31.0
Do not know	11	5.1
Total	216	100.0

Source: Field Survey, 2018

Improved Irrigation Facility

Almost two third of the respondents have never used the improved irrigation facility where around one third have always used the improved irrigation facility and very few of the respondents have sometimes used the improved irrigation facility.

Table 4: Improved irrigation facility

Improved Irrigation Facility	Frequency	Percent
Never	142	65.7
Sometimes	5	2.3
Always	69	31.9
Total	216	100.0

Source: Field Survey, 2018

Use of Improved Seeds and Compost Fertilizer

Almost all the respondents have increased the use of improved seeds for the adaption of climate change for agriculture production. Very few have decreased the use of improved seeds. Almost half of the respondents replied that there is decrease in the use of compost fertilizer for agriculture production. More than two fifth of the respondents have increased the use of compost fertilizer for agriculture production.

Table 5: Use of improved seeds and compost fertilizer

Use of Improved Seeds	Frequency	Percent
Increase	211	97.7
Decrease	2	0.9

No change	3	1.4
Use of Compost Fertilizer		
Increase	96	44.4
Decrease	104	48.1
No change	14	6.5
Do not know	2	0.9
Total	216	100.0

Source: Field Survey, 2018

Use of Chemical Fertilizer and Pesticides

Almost nine tenth (88.4%) of the respondents have increased the use of chemical fertilizer for the adaption of climate change for agriculture production. Almost one tenth of the respondents have not changed the use of chemical fertilizer for the adaption of climate change for agriculture production. Very few have decreased the use of chemical fertilizer. More than half of the respondents have increased the use of pesticides for the adaption of climate change for agriculture production. Almost one third of the respondents do not know about the use of pesticides for the adaption of climate change for agriculture production. More than one tenth of the respondents do not change in the use of pesticides for agriculture production. Very few of the respondents have decreased the use of pesticides for agriculture production.

Table 6: Use of chemical fertilizer and use of pesticides

Use of Chemical Fertilizer	Frequency	Percent
Increase	191	88.4
Decrease	6	2.8
No change	18	8.3
Do not know	1	0.5
Use of Pesticides		
Increase	115	53.2
Decrease	8	3.7
No change	24	11.1
Do not know	69	31.9
Total	216	100.0

Source: Field Survey, 2018

Use of Cropping Season and Cropping Altitude

More than half of the respondents do not change the cropping season whereas almost forty six percent of the respondents change the cropping season for adaptation of climate change for agriculture production. Similarly almost two third of the respondents do not change the cropping altitude whereas more than one third of the respondents change the cropping altitude for adaptation of climate change for agriculture production.

Table 7: Use of cropping season and cropping altitude

Use of Cropping Season	Frequency	Percent
Change	98	45.4

Perception of Farmers towards Climate Change Impact

No change	118	54.6
Use of Cropping Altitude		
Change	73	33.8
No change	143	66.2
Total	216	100.0

Source: Field Survey, 2018

Knowledge about any Adoption Practice that did not or could not Apply

More than four fifth of the respondents are not familiar with other adoption practice that they did or could apply. Whereas more than one tenth of the respondents are familiar with some adoption practices that they did not or could not apply. Use of seeds that can be cultivated in any seasons, Fertilize of compost manure production on own field, water collection through pond, water and tank, tunnel crop, practice of off seasons crops are some adoption practices that they could not apply or they did not apply.

Table 8: Knowledge about any adoption practice that did not or could not apply

Knowledge	Frequency	Percent
Yes	26	12.0
No	190	88.0
Total	216	100.0

Source: Field Survey, 2018

Factors Associated with Use of Cropping Season and Use of Cropping Altitude

Among the different adaptation practices for climate change impact on agriculture production by the farmers, this section shows the different factors associated with use of cropping season and use of cropping altitude to adapt the climate change impact on agriculture production. For this, chi-squared test was applied.

It is found that there is significant association of use of cropping season with age, educational status, major occupation, agriculture skill and location of the respondents at one percent level of significance ($P < 0.01$). However there is no any significant effect of sex, caste/ethnicity, and farming experience in the use of cropping season of the respondents for the adaption of climate change impact on agriculture production.

Similarly there is significant association of use of cropping season with location of the respondents at one percent level of significance ($P < 0.01$). Further there is significant association of use of cropping altitude with educational status, caste/ethnicity and major occupation of the respondents at five percent level of significance ($P < 0.05$). However there is no any significant effect of sex, age, agriculture skills and farming experience in the use of cropping altitude of the respondents for the adaption of climate change impact on agriculture production. It shows that age, agriculture skill, education, major occupation and location of the respondents are the major factors associated with use of cropping season for the adaptation of the climate change impact on agriculture production. Further agriculture skill, caste/ethnicity and major occupation of the respondents are the major factors associated with use of cropping altitude for the adaptation of the climate change impact on agriculture production.

Table 9: Factors associated with the use of cropping season and the use of cropping altitude

Variables	Use of Cropping Season				Use of Cropping altitude			
	Change		No Change		Change		No Change	
	No.	%	No.	%	No.	%	No.	%
Age								
Upto 60 years	65	30.1	97	44.9	48	22.2	114	52.8
> 60 years	33	15.3	21	9.7	25	11.6	29	13.4
	P=0.007				P=0.025			
Sex								
Male	67	31.0	80	37.0	49	22.7	98	45.4
Female	31	14.4	38	17.6	24	11.1	45	20.8
	P=0.929				P=0.834			
Educational Status								
No Formal Education	40	18.5	11	5.1	33	15.3	18	8.3
Primary	29	13.4	52	24.1	21	9.7	60	27.8
Lower Secondary	15	6.9	16	7.4	12	5.6	19	8.8
Secondary and above	14	6.5	39	18.1	7	3.2	46	21.3
	P=0.000				P=0.000			
Caste/Ethnicity								
Brahmin	46	21.3	50	23.1	27	12.5	69	31.9
Chhettri	11	5.1	27	12.5	9	4.2	29	13.4
Dalit	7	3.2	13	6.0	5	2.3	15	6.9
Janajati	34	15.7	28	13.0	32	14.8	30	13.9
	P=0.058				P=0.006			
Major Occupation								
Agriculture	36	16.7	65	30.1	23	10.6	78	36.1
Non-agriculture	62	28.7	53	24.5	50	23.1	65	30.1
	P=0.007				P=0.001			
Agriculture Skill								
Yes	71	32.9	58	26.9	52	24.1	77	35.6
No	27	12.5	60	27.8	21	9.7	66	30.6
	P=0.001				P=0.014			
Farming Experience(Years)								
10- 20	51	23.6	61	28.2	43	19.9	69	31.9
21-30	32	14.8	37	17.1	23	10.6	46	21.3
31 and above	15	6.9	20	9.3	7	3.2	28	13.0
	P=0.942				P=0.133			
Location								
Ward 30	69	31.9	13	6.0	52	24.1	30	13.9
Ward 33	29	13.4	105	48.6	21	9.7	113	52.3
	P=0.000				P=0.000			

(P-value is based on chi-squared test)

Source: Field survey, 2018

CONCLUSION

Based on the information collected from two hundred and sixteen respondents, rice, maize, wheat, mustard and millet are the major crops in the study area. All the respondents are aware about the climate change impact on agriculture production.

Majority of the respondents perceived increase in rice production, decrease in maize production, wheat production and millet production, no change in mustard production. Majority of the respondents increase the use of improved seeds, the use of chemical fertilizer and pesticides, do not change the cropping pattern and cropping altitude for the adoption of climate change in agriculture production. Use of seeds that can be cultivated in any seasons, fertilize of compost manure production on own field, water collection through pond, water and tank, tunnel crop, practice of off seasons crops are some adoption practices that they could not apply or they did not apply. Agriculture skill and the major occupation of the respondents are the common major factors associated with adaptation practices for climate change impact on agriculture production.

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