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## **A Study on Perception and Adaptation of the Farmers toward Climate Change in the Western Region of Nepal**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. Author SG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PP and ES managed the analyses of the study. Author ST managed the literature searches. All authors read and approved the final manuscript.*

### **Article Information**

DOI: 10.9734/AJAEES/2020/v38i130292

Editor(s):

(1) Dr. Adesoji Solomon Adedapo, Obafemi Awolowo University, Ile - Ife, Nigeria.

Reviewers:

(1) Christopher Kalima Phiri, Lilongwe University of Agriculture and Natural Resources, Malawi.

(2) Narendra Kumawat, College of Agriculture Indore, India.

(3) Juan M. Pulhin, University of the Philippines Los Baños, Philippines.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/53888>

**Original Research Article**

**Received 20 November 2019**

**Accepted 25 January 2020**

**Published 05 February 2020**

### **ABSTRACT**

**Aims:** This study was undertaken to identify the perception of farmers towards climate change and their adaptation towards the change. The study also identified the sources of climate change information at the local level and their expectation from concerned authorities regarding the agriculture-related issues pertaining to climate change.

**Study Design:** The study was conducted in two different geographical region Arghakhanchi (hilly) and Kapilvastu (terai) to represent the major farming region of the country.

**Place and Duration of Study:** This study was conducted in two districts which are Arghakhanchi and Kapilvastu, of western Nepal. A total of 120 samples such that 60 samples each were taken from both districts in the month of September and October of 2018.

**Methodology:** A semi-structured questionnaire was designed to collect data from participants.

**Results:** The study has revealed that the majority of the farmers have perceived an increase in temperature, a decrease in rainfall and late on-set of the rainy season. Similarly, radio was found to be the primary source of climate change information, followed by television. Change in planting

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season and decrease in the farm size under cultivation were found to be the most adapted practices among farmers against climate change. Furthermore, it was found that majority of the farmers expect to have crop insurance and availability of improved variety seeds as support from government and concerned authorities.

**Conclusion:** Most of the respondents made the accurate assumptions regarding climate change. Understanding the relationship between the climate change and agriculture and perception of people towards those changes is essential. It helps to evaluate possible impacts that may result from further changes in climate and plan suitable adaptation practices. Knowledge about these findings can be useful for making various plans and policies for mitigating the impacts of climate change on agriculture in the studied area.

**Keywords:** Climate change; perception; adaptation; information; Western Nepal.

## 1. INTRODUCTION

Nepalese economy is highly dependent on agriculture with 65% of its population employed in this sector and contributing about 26.2% of GDP [1]. Development of this sector can play a great role in fulfilling the food requirement of its population, creating employment in rural areas, and increasing its export earnings with the help of commercialization. As the agricultural sector is highly dependent on climatic factors, climate change will have a major effect on it [2-4]. As per the "Intended Nationally Determined Contributions" report from the Ministry of Population and Environment, Nepal, the country is continuously becoming warmer. When we look at the chronological data, we can see that the temperature has been increasing continuously at the rate of 0.06°C annually in between 1975 to 2005. While on the other hand, the precipitation is in decreasing trend with an average of 3.7 mm reduction per month per decade and assumed to reduce by further 10-20% in the near future. Keeping these things in consideration, it has been projected that the temperature is going to increase further in the future and is projected to increase by 1.8-3.8°C and 1.8-5.8°C by the year 2060s and 2090s respectively [5]. Severe reduction in the production of the major food crops has create an alarming threat challenging the food security world-wide [6]. Nepal being a least developed and mountainous country with difficult topography, the vulnerability of the country toward such effects is quite high [3,7]. Similarly agriculture in Nepal is very much rain dependent with about 65% of the total cultivated area falling under rainfed cultivation [8]. Various studies show that in the last few decades there is an increase in the average temperature and change in precipitation [9-11]. Such changes are supposed to have a harmful effect on Nepalese agriculture

in the long run [3]. Climate change will have a serious effect on the livelihood of the farming communities.

Temperature and rainfall are the important meteorological parameters directly influencing the agriculture. So all these vagaries brought about by the climate change has direct impact on agriculture and allied sectors. But are the farmers really concerned about this change? The perception of the farmers towards this change has not been studied in the study areas we selected. Very less is known about how the farmers are tackling against the changing climate and what modifications has they adapted at their farm level. To fill this gap, two districts of Nepal has been selected as the region of investigation and a study has been conducted. The objectives of this study were (i) to determine how correctly are the farmers of the study areas grasping those subtle changes in the climate. (ii) to identify the major sources to which farmers rely upon to get information pertaining to those changes. (iii) to analyze the perception and adaptation of farmers against climate change. This study also focuses on the expectation of the farmers from concerned authorities regarding the agriculture-related issues due to climate change.

This paper aimed to address these important queries using the survey data collected from the farmer households in Western region of Nepal using structured questionnaire. It is important to know how they are perceiving the change in climate over past years and how they are adjusting with changing climatic situation so that policies can be framed to cope with the changing climate and reducing its effect on agriculture [12]. The findings would also allow to categorize the best adaptation practices and disseminate those practices to other climate change prone regions. Similarly knowing the best source for the

dissemination of the information, it would be really helpful to reach out to the larger section of the community.

## 2. RESEARCH METHODOLOGY

### 2.1 Study Site

This study is based on the farming household survey conducted in the western part of Nepal. Arghakhanchi and Kapilvastu districts were purposively selected for the study, such that Arghakhanchi represents hilly area and Kapilvastu represent the southern plain of western Nepal. The description of the region of the investigation are (i) Kapilvastu district (27.5N, 83.45E) with an elevation ranging from 93 to 1491 meters above mean sea level. The district comprises of an area of 1738 square kilometers with the population of 571,936. (ii) Rupandehi district (27.533333N, 83.05E) with an elevation ranging from 100 m to 1229 m from sea level occupying an area of 1360 square kilometers and population of 880,196.

### 2.2 Data Collection

Data was collected from farming households by using the semi-structured questionnaire in the month of September and October of 2018. Applying simple random sampling approach, 60 farming families with one sampling unit from individual household were taken from each of the two districts and pooled making a total sample size of 120. Data were collected under various variables, which includes socioeconomic characteristics such as gender, age, education, family size, involvement in the off-farm jobs, farm size, recipients of training and extension, and their involvement in local level, perception to changes in climate, source of climate change information, their adoption practices in agriculture against climate change and their expectation regarding the agriculture-related issues due to changing climate.

### 2.3 Statistical Analysis

Collected raw data were coded and entered into the computer. Thereafter, the data was analyzed using Ms Excel and SPSS v25.0. The output of analysis were presented using descriptive statistics such as mean, frequency and percentage.

## 3. RESULTS AND DISCUSSION

### 3.1 Socioeconomic Characteristics of the Respondents

Majority of the respondents in the study was found female, corresponding to 70.83% which is nearly same as the country's percentage of 79.8% [13] which shows women as the major work force in agriculture due to out-migration of the men for taking up off-farm activities. Women-headed households is on increasing trend [14] which supports our finding.

In terms of age, the majority of respondents belonged to the 45-54 age group, representing 33.33% of the total sample. This was followed by the age group of 55-64 (29.17%), more than 64 (15.83%), 35-44 (12.50%) and below 35 years age (9.17%), respectively (Table 1). It showed the involvement of more middle-aged people in the agriculture while the youths do not seem to be interested in farming enterprise. It was found that 77.50% of the farming household have some level of literacy, whereas remaining (22.50%) of them were illiterate. Education plays important role in agriculture by improving the decision making ability as well as uplifting their technical know-hows [15]. In the study, the family size was divided into three categories based on the number of family member viz. small (below 5 members), medium (5 to 10 members) and large (more than 10 members). It was found that the majority of them (i.e. 47.50%) belong to medium family size, followed by small family size (46.67%) and large family size (5.83%), respectively (Table 1).

Similarly, respondent farmers were classified into three categories based on the size of landholding viz. marginal farmer (less than 0.5 Ha), small farmer (0.5 Ha to 2.0 Ha) and large farmers (more than 2.0 Ha). It was found that the majority of the farmers were marginal farmers, corresponding to 52.5%. This was followed by small (39.17%) and large (8.33%), respectively (Table 1). The average landholding was found to be 0.79 Ha, which is lower than the average farm size of 0.8 Ha [16]. One of the major reason for decline in the average landholding is the division of the land among the heirs after the death of the owner causing the land to be sub-divided and fragmented generation after generation. From a study on relation between the landholding and educational and occupational structure, shows people with large landholdings have better access to the education and more of these

people are involved in off-farm activities while farming is mostly taken up by the landless and marginal landholders [17]. Small and marginal land holding is the major constraints for the agricultural mechanization [18].

Furthermore, it was found that 64.16% of the farming households were involved in the off-farm job. It was found that 82.50% of the farming households have not received any training and extension services in last one year. Furthermore, it was found that studied farming households have very low local involvement in their area, only 25% of them have active involvement in the local area. The socioeconomic characteristics of the studied population are presented in Table 1.

### **3.2 Farmer's Perception about the Changing Climate**

It was found that the majority of the respondents (83.33%) had perceived that there is an increase in temperature in the last 20 years. It is also evidenced that there is an increase in annual average temperature in Nepal in the past few decades [3,19]. Similarly, 7.5% and 4.17% of the respondents perceived decrease and no change, respectively in temperature (Table 2). 5% of them reported that they were unaware of changes in temperature. Our finding is similar to the study done in Gulmi district in the same region [20]. A trend analysis in the nearby districts pertaining seasonal precipitation and temperature shows the similar results that temperature is increasing and rainfall is in decreasing trend [21,22].

Similarly, it was found that the majority of the respondents (97.5%) have perceived a decrease in rainfall in the last 20 years. Very few of them (1.67%) reported that there has been no change in rainfall and 0.83% of them were unaware of the change in rainfall. None of the respondents had perceived increase in rainfall (Table 2). The respondent's perception coincides with the finding by Subba et al. [23] which was further supported by TRMM 3B42 V7 precipitation data product.

The rainfall has not only decreased over these years but has become more erratic and unpredictable as there has been continuous shift in the monsoon. About 73.33% of the respondents reported that they have perceived a change in the rainy season, which was followed by 11.67% and 10% reporting early cessation of rainfall and no change in the rainy season,

respectively. 5% of them reported that they were unaware of change in rainy season (Table 2). The study findings were similar to the other studies conducted in the same region [20,24]. As per the weather experts the fluctuation in the onset of the monsoon has become fairly high in past several years [25] which coincides with the perception of the respondents. Perception of respondents regarding changing climate is presented in Table 2.

### **3.3 Sources of Climate Change Information**

It was found that the majority (91.67%) of the respondent farming families have received information about climate change through radio. This shows that radio can be a powerful communication tool for reaching climate change information to the farmers. Similarly, TV was reported as the second source of climate change information, which was reported by 90.83% of the respondents (Table 3). These findings coincide with the report documented by Colom and Pradhan [26]. Radio being cheaper and portable was the most desired communication means for getting information. This was followed by neighbors (70.83%), relatives (40.83%), newspapers (19.17%) and extension workers (9.17%), respectively (Table 3). Findings suggest that there is no proper extension of climate change information in the studied area. Sources of climate change information are presented in Table 3.

### **3.4 Adaptations in Agriculture**

It was found that changing in the planting season to be the most adapted practice to mitigate the effect of changing climate in the area. 40.83% of farmers reported that they have changed planting season of major crops such as rice, wheat, maize, etc. Similarly, 31.67% of them have reported that they had decreased the size of farm under cultivation as production is not remunerative which force them to take off-farm activities. Reducing the farm area required less area to be taken care of and they could spend more of their time in other money earning enterprises. 30.83% of them have reported that they have changed the crop under cultivation and have gone for improved varieties that are more resistant to changing climate, less water requiring and were of shorter duration. 23.3% of them reported that they had left farming and opted for off-farm jobs for livelihood. Farmers had also reported that they have increased the

size of the farm under cultivation (10.83%), started planting improved varieties (8.33%) and crop diversification (5.83%) (Table 4). The adaptation practices adopted by the farmers are similar with those adopted by farmers in other study areas [27-30]. On the other hand, 29.17% of farmers reported that they have not practiced any particular adoption practices against climate change. This may be due to the resource constraint limitation of the farming household. Institutional support from the government that includes access to credit, adult literacy and increased exposure to information to the changing climate via different forecasting and

extension activities could promote the farmers adaptation [31].

Adaptation of farmers against climate change in the studied area is presented in Table 4.

### 3.5 Farmers Expectation of Support Regarding Climate Change

During the survey, it was found that majority of the farmers, who were aware of the impact of climate change in agriculture, have some expectation from concerned authorities regarding the agriculture-related issues due to climate change. It was found that the majority (78.33%)

**Table 1. Socioeconomic characteristics of the respondent**

Socioeconomic variables	Particulars	Frequency	Percentage
Gender	Male	35	29.17
	Female	85	70.83
Age (in years)	Below 35	11	9.17
	35 – 44	15	12.50
	45 – 54	40	33.33
	55 – 64	35	29.17
	More than 64	19	15.83
Education	Literate	93	77.50
	Illiterate	27	22.50
Family size	Small (0-5)	56	46.67
	Medium (5-10)	57	47.50
	Large (10 +)	7	5.83
Involvement in off-farm jobs	Yes	77	64.16
	No	43	35.33
Farm Size	Marginal ( up to 0.5 Ha)	63	52.5
	Small ( 0.5 to 2 Ha)	47	39.17
	Large (2.0+ Ha)	10	8.33
	Average farm size	0.79 Ha	
Recipient of Training and Extension	Yes	21	17.50
Involvement in local level	No	99	82.50
	Yes	30	25.00
	No	90	75.00

Source: Household Survey, 2018

**Table 2. Farmer's perception about climate change**

Particular	Perceived change	Frequency	Percentage
Change in temperature during the last 20 years	Increase	100	83.33
	Decrease	9	7.5
	No change	5	4.17
	Don't know	6	5
Change in rainfall during the last 20 years	Increase	0	0.00
	Decrease	117	97.5
	No change	2	1.67
	Don't Know	1	0.83
Change in the rainy season	Late-onset of the rainy season	88	73.33
	Early cessation of the rainy season	14	11.67
	No change	12	10.00
	Don't Know	6	5.00

Source: Household Survey, 2018

**Table 3. Farmers sources of climate change information**

Source	Frequency	Percentage
Radio	110	91.67
Television	109	90.83
Neighbours	85	70.83
Relatives	49	40.83
Newspaper	23	19.17
Extension worker	11	9.17

Source: Household Survey, 2018

**Table 4. Adaptation in agriculture against changing climate**

Adoption Practices	Frequency	Percentage
Change in the planting season	49	40.83
Decrease of the size of the farm under cultivation	38	31.67
Change in crop	37	30.83
Off-farm jobs	28	23.33
Increase in size of the farm under cultivation	13	10.83
Planting of improved varieties	10	8.33
Crop diversification	7	5.83
Other	2	1.67
No adoption practices	35	29.17

Source: Household Survey, 2018

**Table 5. Expectation of farmers regarding climate change as a support**

Particulars	Frequency	Percentage
Crop insurance	94	78.33
Availability of improved variety seed	87	72.5
Cheap and easy irrigation facility	80	66.67
Extension and training on improved practices	47	39.17
Better climate information	39	32.5
Creation of off-farm job opportunities	11	9.17
Other	4	3.33

Source: Household Survey, 2018

of them want insurance of their crop against climate risk. Crop insurance plays an important role in securing poor farmers' livelihood as an adaptation strategy during climate extremes [32].

66.67% of them wanted to have cheap and easy crop irrigation services. Similarly, 72.5% of them expected availability of improved variety seeds. 39.17% wanted to have extension and training on improved agricultural practices (Table 5). The role of extension could be made more effective if it focused on on-field demonstration, training on adaptable strategies and farmers field schools rather than farmers meetings and distribution of printed materials [33]. 32.5% and 9.17% of them were in need of better climate information and off-farm jobs, respectively. The expectation of farmers regarding climate change is presented in Table 5.

#### 4. CONCLUSION

Development and welfare of the country like Nepal is based on agriculture. The primary focus of the government and concerned authorities should be to mitigate the harmful impact of climate change in agriculture by incorporating various climate change adaptation policies. To instigate the execution of various plans and policies, it is mandatory to know the perception of farming communities about changing climate.

The study shows that farmers in the study areas are well aware of climate change and they make accurate assumption about the changes. Most of the farmers have good perception of its impact on farming and thus have adopted various strategies against those climate related changes. It is found that the majority of the farmers have perceived an increase in temperature, a

decrease in rainfall and late on-set of the rainy season. Similarly, radio is found to be the primary source of climate change information, which is followed by television. Change in planting season and decrease in the farm size under cultivation were found to be the most adapted practices among farmers against climate change. Furthermore, it was found that majority of the farmers expect to have crop insurance and availability of improved variety seeds as support from government and concerned authorities. The finding of this study can be useful for making effective strategy, policy and plan to mitigate impact of climate change on agriculture.

## CONSENT

As per international standard, participants' written consent has been collected and preserved by the author(s).

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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