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Major Cereal Crop Production in Kabhrepalanchok

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Abstract

Agriculture is one of the most vulnerable sectors to climate change impact. The main purpose of the study is to find the recent production of major cereal crops as rice, maize, and wheat per unit area in Banepa municipality, as a case study to the local trends and adaptation. The study was conducted among the household of ward No. 1, 3, 4, 5, 7, 8, 9, 10, and 11 in the Municipality. Field observation, in-depth interview, focus group discussion, Questionnaire survey methods were adopted for information collection, cross-validation with verification and using a secondary source of the information. Monthly precipitation and monthly minimum and maximum air temperatures data of Dhulikhel station were used to study their annual and seasonal trends.

Time-series annual yield data in rice, maize, and wheat were collected from the Ministry of Agriculture and Livestock Development. Production was also accessed from the local level in a cross-sectional survey. Temperature and precipitation were collected from the Department of Hydrology and Metrology. The Survey indicated that yields have increased for major cereal crops and this led to an increase in the use of chemical fertilizer, chemical

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pesticides, improved seed, and improved management practices. The impacts of these changes have resulted in an increased attack of white grub in roots and maize smut in cobs, rice blast in panicle and stem, rust and blight disease and grain borer in wheat. The major issues for farmers were found to be a deficit of inorganic fertilizers, an insufficient supply of quality seeds and an unsystematic market. The coping mechanism for climate change in farming was not applied due to a lack of knowledge, facilities, and access to improved technologies. The farmers expected advanced technological know-how along with other facilities for climate-resilient farming.

This study concludes that change in climate is affecting the agriculture in Banepa Municipality of Kabhrepalancchok. The existing local and institutional strategies are not sufficient and sustainable to cope with climatic vagaries. It is very important to address the problems in this region with institutional support and through a long-term policy perspective.

Key Words: Climate change, Impacts, Cereal crops, Adaptation

1. Introduction

1.1. Background of the Study

The crops production system is very sensitive to short-term changes in weather and seasonal, annual and longer-term variations in Climate. The crop is itself affected by climate. Climate change is the most serious environmental threat that adversely affects agriculture sectors than the other sectors in the global context. Crop growth and development as well as different physiological processes are highly influenced by Climate. Land preparation, date of sowing, irrigation, harvesting, and other forms of activities are also affected by Climate.

In Nepal, a large population is engaged in agriculture. Many studies show that climate change is affecting agricultural production system in Nepal directly or indirectly. The

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livelihood of two-third of the labor force in rural areas of Nepal will be affected if the agriculture production is adversely impacted by climate change (Pant, 2012). Although the amount of precipitation varies significantly across the country, there is a shift in monsoon periods, intense and unpredictable rainfall patterns. The temperature across the country shows tendencies towards the increasing trend. Drying of water sources, erosion, and landslides in hills and mountain regions of Nepal while flooding of cultivated lands in low-lying areas of hills and Tarai regions are the direct impacts of climate change in Nepalese agriculture.

The general objectives of this study are to find out the effects of climate change on major cereal crops like rice, maize, and wheat in the study area. This research was conducted to study trends on climate variables and the impacts of climate variations in the major crop production systems. Cereals like rice, maize, wheat, millet, barley, etc. are the general production in Kabhrepalancchok district, especially in Banepa. Among them, rice, maize, and wheat are the major crops in this area and these have been chosen for the study.

Production of the major cereal crop, at the present scenario, most threats especially to the small, rural farmers of the poor nation depending upon the natural climatic cycle where there is no scientific irrigation system. This type of local study has not been carried till date since this is the gap in this study field.

This research finds data and knowledge on the production of the major crops: rice, maize, and wheat. This research will also cover knowledge and perception in production and adaptation practices in farm and off-farm.

2. Design and Results

2.1. Location of Study Area

In the boundary of three municipalities of Kabhrepalancchok District, namely: Banepa, Dhulikhel and Panauti, the country's only IT Park is being constructed. All the three cities have been declared as the 'Cyber City'.

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Banepa is a major trade route to Tibet, connected with Arniko Rajmarg /Highway, the first highway that connects Nepal and China (Tibet), running through this town. Furthermore, B.P. Koirala Highway also rises through Banepa/ Dhulikhel. Though it is a small town, it is well devolved and Banepa is the major economic center, the eastern valley to Kathmandu. Banepa is out of these 13 Palikas which are 6 municipalities and seven are rural municipalities.

The entire process of area selection started with the institution of an expert's panel. Communities' vulnerability from climate change perspective were the criteria for selecting the sites. Livelihood and hardship of the local community with the natural landscape were also kept in consideration.

2.2.Literature in the Context

Global adoption of organic agriculture (OA) has the potential to sequester up to the equivalent of 32% of all current man-made GHG emissions (**Robert, 2009**). OA is a production system that sustains the health of soils, ecosystems, and people. In OA, soil fertility is maintained mainly through farm internal inputs (organic manures, legume production, wide crop rotations, etc); energy-demanding synthetic fertilizers and plant protection agents are rejected; and there is less or no use of fossil fuel (**IPCC, 2007**). In relation, improved cropland management (lower use of synthetic fertilizers, reduced tillage), reducing industrial livestock production and improving feeding and grazing land management, restoration of organic soils and degraded lands to increase soil carbon sinks, improved water and rice management, land-use change and agro-forestry, Increasing efficiency in fertilizer production and behavioral changes of food consumers, reducing the meat content, could also be main climate change mitigation measures in the agriculture sector (**Paul, 2009**).

The agricultural sector has also the potential to adapt to climate change in many areas. Climate change adaptation is a continuous process requiring a location-specific response. Adaptation should enable agricultural systems to be more resilient to the consequences of climate change (**FAO, 2011**). Farming systems and farmers will differ enormously in their

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capacities to respond to climate change. Differentiated adaptation strategies and enhanced climate risk management support to agriculture and farming households are critical to counter the impacts of climate change (**Campbell, 2011**). These measures could include in particular the choice and change of species and varieties, the adaptation of the field works to the calendar, the adaptation of plant production practices (i.e. fertilization, plant protection, irrigation, etc.) or the adoption of plant production practices that increase the soil organic matter content of the soil coverage by plants, manure management, and agroforestry practices.

In South Asian countries, particularly India, Nepal, and Bangladesh, farmers are already adapting to changing conditions by using improved/hybrid seed practices **(Gautam et al., 2008)**. Farmers can also use their knowledge of abiotic stress tolerance and adaptability in their materials and work with plant breeders to develop varieties that are adapted to changing local conditions and possess improved yields and quality **(Jarvis et al, 2007)**.

2.3.Sample Population and Size

Research design is the plan or proposal to conduct and involves the interaction of philosophy, strategies of inquiry, and specific methods (Creswell, 2009). The population of the representative area was considered as the universe of the study and the sample was selected from that universe. The sample area was limited to the affected wards of the study area. For the effectiveness of the studies, multistage sampling was chosen. In such a procedure stratified municipality and wards were selected.

The sampling frame for this study was the data from the census population 2011 and wards of the municipality through which the samples were chosen. The sample of the population has been adopted from these wards and is presented the sample size in the following Table-1.

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Table 1: Number of Sample Selected wards on Banepa Municipality

SN	Ward No.	Census HH 2011	Census Pop. 2011	Adopted Sample
1	1	531	2482	12
2	3	771	3105	17
3	4	785	3802	17
4	5	1183	5336	26
5	7	1083	5433	24
6	8	1584	3802	35
7	9	1285	5253	29
8	10	1285	4758	29
9	11	488	3236	11
Total		8995	37207	200

Source: CBS, 2011; Field Survey, 2020

3. Results and Discussions

3.1. Gender Distribution by Respondents

The study carried out household surveys to the head of the family whether respondents were male or female. Table 2 shows that in total 61% male followed by 39% female had participated as the respondents in the study. The frequency of the respondent is mentioned in ward wise basis in the table. The highest percent of the male in ward No. 2 and the highest percent in females in ward No. 3 as the head of the family. In the lower headed households were vice versa.

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Table 2: Gender Distribution by Respondents

Gender distribution by respondents					
Ward Number	Number of Respondents	Male		Female	
		Frequency	Percentage (%)	Frequency	Percentage (%)
1	12	9	75	3	25
3	17	7	41.18	10	58.82
4	17	11	64.70	6	35.3
5	26	17	65.38	9	34.62
7	24	16	66.67	8	33.33
8	35	20	57.14	15	42.86
9	29	19	65.51	10	34.49
10	29	16	55.17	13	44.83
11	11	7	63.63	4	36.37
Total	200	122	61	78	39

Source: Field Survey, 2020

3.2.Major Crops and Crop Calendar

According to the questionnaire survey, the major cereals crop area was rice, maize, and wheat planted in the Banepa Municipality. Nowadays, the major cereals crop wheat was replaced by potato especially in ward numbers three and four. People used to grow a large amount of potato on commercial-scale but they get benefitted only for few years. New disease caused drying of root and production was decreased.

The crop plantation schedule adopted by the farmers of Banepa Municipality is shown in table 3.

Table 3: Crops Calendar in Banepa Municipality

Cereals Crop	**Plantation Time**	**Harvesting Time**
Rice	July	October
Maize	April	August
Wheat	November	March

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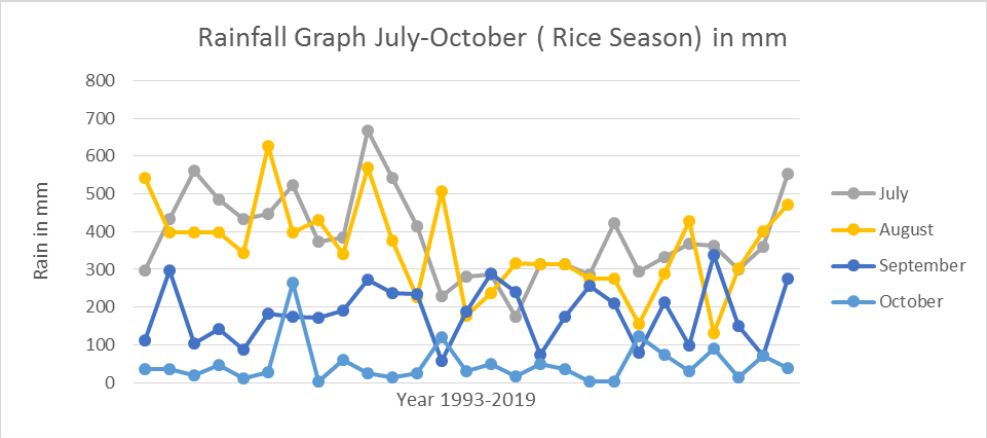
Source: Field Survey, 2020

3.3.Rice Season and Rainfall

The rainfall pattern of the study area during the rice crop season is presented in figure 1. In data analysis of rainfall of rice season months (July, August, September, October) high rainfall 668 mm was recorded in June whereas, 4 mm of minimum rainfall was recorded in October 2011 and 2012.



Source: DHM, 2020

Figure 1: Rice Crop Season and Rainfall Pattern of Dhulikhel Station

3.4. Maize Season and Rainfall

The rainfall pattern of the study area during the maize crop season is presented in figure 2. The rainfall pattern over the last twenty-seven years showed a decreasing trend, data analysis of rainfall of maize season months (April, May, June, July, and August) high rainfall 668.3 mm was recorded in July 2002 whereas, 0 mm of minimum rainfall was recorded in April 1999.

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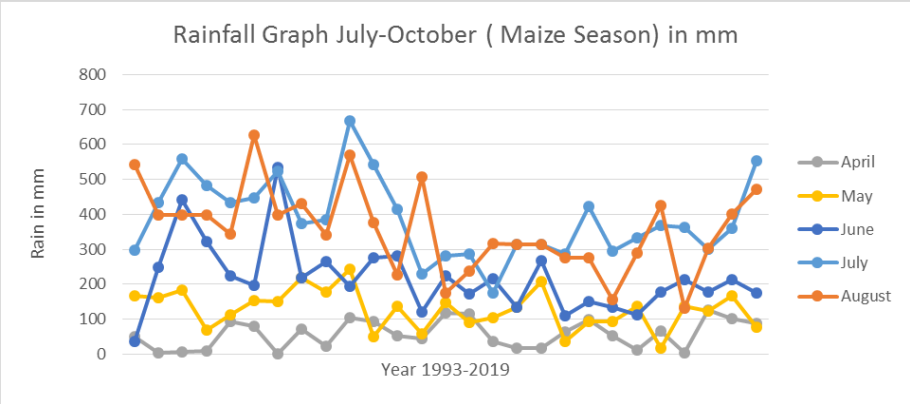
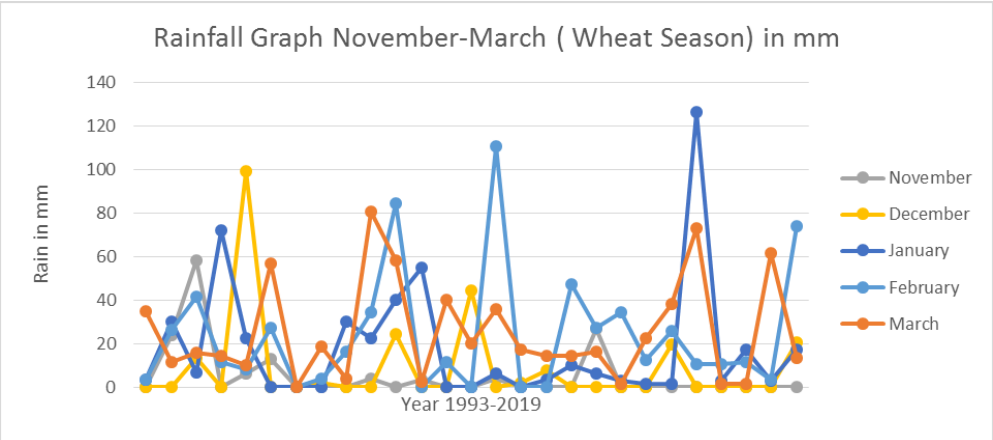


Source: DHM, 2020

Figure 2: Maize Crop Season and Rainfall pattern

3.5.Wheat Season and Rainfall

The rainfall pattern of the study area during the wheat crop season is presented in figure 3. The rainfall pattern over last twenty-seven years showed a decreasing trend, data analysis of rainfall of maize season months (April, May, June, July, and August) high rainfall 110.6 mm was recorded in February 2007 whereas, 0 mm of minimum rainfall was recorded in different months of many years.



Source: DHM, 2020

Figure 3: Wheat Crop season and Rainfall pattern

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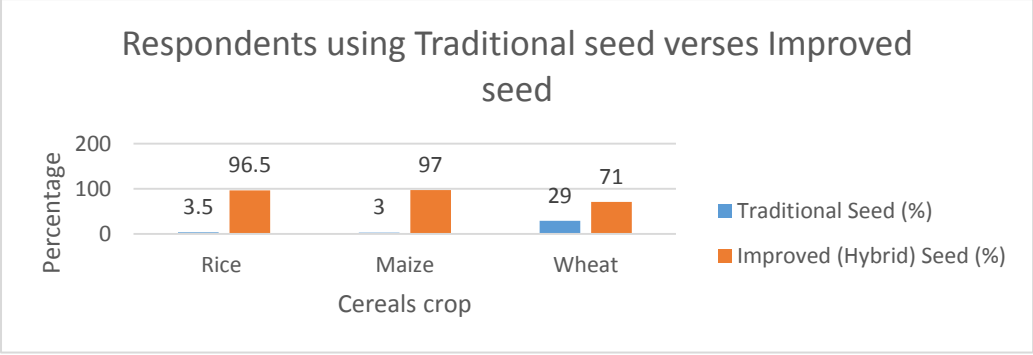
3.6.Quantity of Seed Used

Broadly, two types of seed are recognized, traditional and improved (hybrid). Traditional seeds are also known as farmers' seed because traditional seeds are producing by the farmers and preserving their seeds for subsequent planting. Improved crop varieties and quality seeds are the most viable ways of improving agricultural production and food security sustainably. Realizing the importance of seed system in increasing crop productivity, raising income and generating employment opportunities. This implies that a farmer does not buy food grain seeds but buys a better seed of a variety. Another notable aspect of such crops is that farmers may buy a small quantity of a new variety of seed to further multiply it over several generations. Both of these aspects affect the volume of sales and actual seed replacement rates (SRR). The use of hybrid seeds especially maize and rice are on the rise in Nepal.

The traditional types of seed may not have enough productivity in changing climate. So, the use of new seeds is one of the best methods to increase the productivity of the crops. According to the household survey and focus group discussion mostly farmers used improved seeds. From the figure 4, graph show 96.5% farmers' used improved seed and only 3.5% farmers' used traditional seed in case of rice followed by 97% farmers' used improved seed and only 3% farmers' used traditional seed of maize and 71% farmers used improved seed and only 29% farmers' used traditional seeds of wheat respectively.



Source: Field survey, 2020

Figure 4: Used of Seed

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3.7. Contribution of Temperature in Cereals Crop Production

Rise in Temperature and Production

The table 4 shows the respondents of wards number 1, 3, 4, 5, 7, 8, 9, 10, and 11 expressed 83.33%, 82.35%, 76.47%, 76.92%, 70.83%, 74.28%, 79.31%, 72.41% and 72.72% respectively rise in temperature increase the productivity of rice. It was found standard deviation of 3.12.

The respondents of ward number 1, 3, 4, 5, 7, 8, 9, 10, and 11 expressed 66.66%, 58.82%, 58.82%, 69.23%, 66.66%, 54.28%, 51.72%, 44.82% and 63.63% respectively rise in temperature increase the productivity of maize. It was found the standard deviation 2.64.

The respondents of ward number 1, 3, 4, 5, 7, 8, 9, 10, and 11 expressed 91.66%, 70.58%, 76.47%, 76.92%, 83.33%, 80%, 79.31%, 72.41% and 90.90% respectively rise in temperature increase the productivity of wheat. It was found the standard deviation 2.52.

Table 4: Rise in Temperature and Production

Ward No.	No. of Respondents	Rise in Temp. /increase in productivity					
		Rice		Maize		Wheat	
		Frequency	%	Frequency	%	Frequency	%
1	12	10	83.33	8	66.66	11	91.66
3	17	14	82.35	10	58.82	12	70.58
4	17	13	76.47	10	58.82	13	76.47
5	26	20	76.92	18	69.23	20	76.92
7	24	17	70.83	16	66.66	20	83.33
8	35	26	74.28	19	54.28	28	80
9	29	23	79.31	15	51.72	23	79.31
10	29	21	72.41	13	44.82	21	72.41
11	11	8	72.72	7	63.63	10	90.90

Source: Field Survey, 2020

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Rise in Rainfall and Production

From the table 5 data show the respondents of wards number 1, 3, 4, 5, 7, 8,9,10 and 11 expressed 91.66%, 94.11%, 76.47%, 88.46%, 87.50%, 91.43%, 89.66%, 86.21% and 90.91% respectively rise in rainfall increase the productivity of rice. It was found standard deviation of 3.02.

The respondents of ward number 1,3,4,5,7,8,9,10 and 11 expressed 83.33%, 88.24%, 82.35%, 80.77%, 87.50%, 74.29%, 82.76%, 72.41% and 81.82% respectively rise in rainfall increase the productivity of maize. It was found standard deviation of 2.84.

The respondents of ward number 1, 3, 4, 5, 7, 8,9,10 and 11 expressed 83.33%, 82.35%, 70.59%, 76.92%, 91.67%, 80%, 72.41%, 62.70% and 72.73% respectively rise in rainfall increase the productivity of wheat. It was found standard deviation of 2.60

Table 5: Rise of Rainfall verses Crops Productivity

Ward No.	No. of Respondents	Raise of Rainfall/ productivity increase		
		Rice%	Maize%	Wheat%
1	12	91.66	83.33	83.33
3	17	94.11	88.24	82.35
4	17	76.47	82.35	70.59
5	26	88.46	80.77	76.92
7	24	87.50	87.50	91.67
8	35	91.43	74.29	80
9	29	89.66	82.76	72.41
10	29	86.21	72.41	62.70
11	11	90.91	81.82	72.73
Total	200			

Source: Field Survey, 2020

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3.8.Crop Production Trend

In Banepa municipality agricultural land covers an area of 416 ha (63%). Rice, maize, and wheat are the major cereals crop produced by farmers in this municipality. The production rate of cereal crops is increasing due to the use of Improved Seed.

Crop production trend of the previous year and this year is given in table 6.

Table 6: Cereals Crop Productivity per Unit Area

Productivity Per Unit Area (Per Ropani)							
Ward Number	Number of Respondents	Previous Year (2018)			This Year (2019)		
		Rice (in Kg)	Maize (in Kg)	Wheat (in Kg)	Rice (in Kg)	Maize (in Kg)	Wheat (in Kg)
1	12	234.00	186.40	160.00	420.00	324.80	240.00
3	17	312.60	220.80	168.00	510.00	426.40	241.60
4	17	255.60	252.80	164.00	394.20	372.80	204.00
5	26	340.80	292.00	200.00	561.60	496.00	240.00
7	24	316.80	244.80	160.00	535.20	442.40	240.00
8	35	300.00	214.40	172.80	498.60	474.40	260.00
9	29	305.40	210.40	160.00	485.40	443.20	240.00
10	29	294.00	254.40	160.00	387.00	480.00	240.00
11	11	316.20	240.00	181.60	528.60	448.00	236.80
Mean		297.27	207.02	132.56	480.07	434.22	238.04

Source: Field Survey, 2020

In the last year 2018, table 7, data of productivity shows that the respondents of wards number 1, 3, 4, 5, 7, 8, 9, 10, and 11 expressed the productivity of rice 234 kg, 312.60 kg, 255.60 kg, 340.80 kg, 316.80 kg, 300 kg, 305.40 kg, 294 kg, and 316.20 kg respectively. The production of ward No. 1 the mean value of the production has found 297.27 and

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deviation from the mean is less by 63.27 Kg/R. Similarly, ward No. 3 is more production by 15.33 Kg/R and ward nos. 4, 5, 7. 8, 9, 10, and 11 found less 41.67, more 43.53, 19.53, 2.73, and 8.13, less 2.27 and more 18.93 Kg /R respectively from the mean value of the last year.

Similarly, the production of the year 2019, the productivity of rice of was 420 Kg/R different from mean value 480.07 was less by 60.07 Kg/R, 510 Kg/R more by 29.93 Kg/R, 394.2 Kg/R less by 85.87 Kg/R, 561.6 Kg/R more by 81.53 Kg/R, 535.2 Kg/R more by 55.13 Kg/R, 498.6 Kg/R ore by 18.53 Kg/R, 485.40 Kg/R more by 5.33 Kg/R, 387.00 Kg/R less by 93.07 Kg/R, and 528.60 Kg/R more by 48.53 Kg/R from the mean value in the year in ward numbers 1, 3, 4, 5, 7, 8,9,10 and 11 respectively.

The productivity of maize of wards number 1, 3, 4, 5, 7, 8,9,10 and 11 was 186.4 Kg/R different from mean value 235.11 less 48.71 Kg/R, 220.80 Kg/R less 14.31 Kg/R, 252.80 Kg/R more 17.69 Kg/R, 292.0 Kg/R more 56.89 Kg/R, 244.80 Kg/R more 9.69 Kg/R, 214.40 Kg/R less 20.71 Kg/R, 210.40 Kg/R less 24.71 Kg/R, 254.40 Kg/R more 19.29 Kg/R, and 240.00 Kg/R more 4.89 Kg/R from the mean value respectively in the year 2018.

The table of productivity shows that the wards number 1, and 3 found the productivity of maize was 324.8 Kg/R which was less than the mean value 434.22 Kg/R by 109.42 Kg/R and it was 426.40Kg/R which was less than the mean value by 7.82 Kg/R, next, wards 4, 5, 7, 8, 9, 10 and 11 the production has found 372.80 Kg/R, 496.00 Kg/R, 442.40 Kg/R, 474.40 Kg/R, 443.20 Kg/R, 480.00 Kg/R, and 448.00 Kg/R and deviation from the mean found less by 61.42 Kg/R, more by 61.78 Kg/R, more by 8.18 Kg/R, more by 40.18 Kg/R, more by 8.98 Kg/R, more by 45.78 Kg/R and 13.78 Kg/R respectively in the year 2019.

The production of wheat in wards 1, 3, 4, 5, 7, 8, 9, 10, and 11 is 160.00 Kg/R, 168.00 Kg/R, 164.00 Kg/R, 200.00 Kg/R, 160.00 Kg/R, 172.80 Kg/R, 160.00 Kg/R, 160.00 Kg/R and 181.60 Kg/R and found the difference from the mean value 169.60 Kg/R found less 9.60 Kg/R, 1.60 Kg/R, 5.60 Kg/R, and more 30.40 Kg/R and less 9.40 Kg/R, 9.40 Kg/R and more 12.00 Kg/R from the mean value respectively in the year 2018.

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In this year 2019, the production of wheat in wards 1, 3, 4, 5, 7, 8, 9, 10, and 11 is 240.00 Kg/R, 241.60 Kg/R, 204.00 Kg/R, 240.00 Kg/R, 240.00 Kg/R, 260.00 Kg/R, 240.00 Kg/R, 240.00 Kg/R and 236.80 Kg/R and found the difference from the mean value 238.04 Kg/R as found more by 1.96 Kg/R, 3.56 Kg/R, less by 34.04 Kg/R, more by 1.96 more 1.96 Kg/R, 21.96 Kg/R, 1.96 Kg/R, 1.96 Kg/R and less by 1.24 Kg/R from the mean value respectively.

3.9.Change on Agriculture

Research conducted in NARC revealed that an increased temperature potentially affects the physiological growth of crops across different stages especially panicle initiation, flowering, milking, and maturity reduced by 14, 5, 6, and 14 days, respectively. Though the flowering/fruiting period was not sensed by people, this increased temperature might have impacted their phonological behavior. These all research shows that temperature increase is responsible for decreasing in ripening/ harvesting days by a week or two weeks. Also, alteration in the sowing and harvesting period is not exactly known. People responded as unchanged sowing and harvesting time in the study site. This might be because crops like maize and wheat can grow with available soil moisture. Only rainfall dependent crops like rice have alteration in cropping time. If there is early monsoon, rice cultivation is done earlier and if the monsoon is late, cultivation will be late too altering in cropping time.

Based on the field survey, there is a slightly changing of environmental parameters on the study area. Cold and frosty days are decreasing, the rainy season is shifting and days are becoming hot. These parameters help to impact on the agricultural system of this region. According to respondents of the study area, there is change on the production system of agriculture. The production rate of cereal crops like rice, maize, and wheat is going to slightly increase in recent years in comparison to the previous year. The local people were not satisfied with the production of local varieties in different sectors of production so they were changing verities of cereal crops, most of the farmers used improved seeds, chemical fertilizer, and pesticides because of this reason, production is increased. Higher air temperature in the ripening period causes the crop to ripen faster, as a result of the carbohydrate in the plant steam and leaves cannot translocate properly, thus grain size

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becomes smaller and the yield becomes less. So crops require optimum air temperature. Crops can't tolerate high air, soil and water temperature. And high temperature produces several problems in agriculture such as shortening the time of reaping of crops, shortening the time of germination of the seed, increase the number of pests and disease and others. There is a problem in the production of the cereals crop that is also not fixed. There are many problems in agricultural plants, sometimes rain deficit, sometimes heavy rain, flood, frost, and longtime drought. So we can say climatic parameters are also affecting the crops of this area.

3.10. Change Adaptation

The farmers have been adopting a variety of options and technologies adapt to the impacts of climate change in agriculture. These measures include changing crop varieties, the use of improved seeds of cereal crops, changing cropping patterns, practicing intercropping systems, terracing sloping lands to halt landslide and erosion, use of chemical fertilizers and pesticides. Imported improved varieties through have high production potential but are less resistant to climatic stresses such as windstorm, hail, and rain. Farmers of this Municipality prefer the improved seed varieties of rice, maize, and wheat for high productivity. The improved seed should be high production in the comparison of the local seeds.

4. Conclusion

This study attempt to analyze the production in the agriculture system of Banepa Municipality from the foregoing discussion it is clear that agriculture is the major and prominent source for livelihood. Although agriculture is the main source of income, it is not sufficient to feed their family because of the less agricultural land and production. Poor economic condition and low human development in terms of education, occupation, and other physical infrastructure is the social feature of the municipality. The impact of climate change is gradually becoming a matter of great concern for every country including Nepal. This impact is affecting the poor and vulnerable in Nepal, most of whom are farmers working on their farms for survival.

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Farmers suggest that rainfall is untimely and the temperature has increased. Due to this change farmers have experienced new diseases and weeds in crops farming. The new diseases and weeds could be the effects of climate change. The use of inorganic fertilizers like DAP, Urea, and Potash have also increased many folds while organic manure has gone down nutrient loss from soil and land degradation. All these help reduce crop production. At the same time, people are changing their traditional occupation. They search new alternatives such as business and employment outside Nepal which are less risky than agriculture to diversify their livelihood.

Farmers have the pursuit of different strategies to reduce the vulnerabilities of climate-related disasters. These strategies include intercropping, crop rotation, migration, and diversification of income. In general climate change should be considered in long term planning horizon to maximum adaptive capacity.

The study has found from the study area 91.66%, 94.11%, 76.47%, 88.46%, 87.50%, 91.43%, 89.66%, 86.21% and 90.91% rise in rainfall increase the productivity of rice. It was found a standard deviation of 3.02. Similarly the production of maize in rainfall replied 83.33%, 88.24%, 82.35%, 80.77%, 87.50%, 74.29%, 82.76%, 72.41% and 81.82% rise in rainfall increase the productivity of maize. It was found a standard deviation of 2.84. Furthermore, the study found83.33%, 82.35%, 70.59%, 76.92%, 91.67%, 80%, 72.41%, 62.70% and 72.73% respectively rise in rainfall increase the productivity of wheat. It was found a standard deviation of 2.60 from the respondents of ward number 1, 3, 4, 5, 7, 8, 9, 10, and 11 respectively.

This research was confined within the Banepa Municipality ward Nos. 1, 3, 4, 5, 7, 8, 9, 10, and 11 and has generalized for the municipality as well as the whole district. The research was focused on the social aspects of agriculture production with limited to the questionnaire, in-depth interviews, and observation. All the results are dependent on the respondents' responses.

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There are certain outcomes of this research. The major outcomes under the objectives are listed below:

- Many of the farmers think there is an impact on climate change in agriculture.
- There is a negative impact of change in every climatic parameter in agriculture production. Change in some of the climatic parameters has led to an increase in the production of some crops like rice, maize, and wheat.
- Most of the farmers in the study area do not have comprehensive knowledge of climate change adaptation techniques in agriculture.
- There is an increase in the production of major crops like rice, maize, and wheat. However, the increase in production reported being the use of improved seeds, a large dose of chemical fertilizer, intensive use of pesticides, and insecticides in the field crops.
- The majority of farmers know the different climatic pattern and they feel that many of the climatic parameters like temperature, rainfall, cloud, relative humidity, hailstone, and fog have an impact on agriculture production in the study areas.

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