CLIMATE CHANGE IMPACT IN AGRICULTURE:

A STUDY OF BAGLUNG MUNICIPALITY -12 BAGLUNG, NEPAL

A Thesis Report

Submitted to

Central Department of Rural Development, Tribhuvan University

In Partial Fulfilment of Requirements for the

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In

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Submitted By

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DECLARATION

I hereby declare that the thesis entitled **"Climate Change Impact in Agriculture: A Study of Baglung Municipality -12 Baglung, Nepal"**, submitted to the Central Department of Rural Development, Tribhuvan University, is entirely my original work prepared under the guidance and supervision of my supervisor Associate Prof. Dr. Suman Kharel. I have made due acknowledgements to all ideas and information borrowed from different sources in the course of preparing this thesis. The results of this thesis have not been presented or submitted anywhere else for the award of any degree or for any other purposes. I assure that no part of the content of this thesis has been published in any form before.

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Sagar Sharma
Date: 2079/7/27
Date: 2022/11/13

RECOMMENDATION LETTER

The thesis entitled **"Climate Change Impact in Agriculture: A Study of Baglung Municipality -12 Baglung, Nepal"** has been prepared and submitted by Mr. Sagar Sharma under my guidance and supervision. I hereby forward this thesis to the evaluation committee for final evaluation and approval.

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Associate Prof. Dr. Suman Kharel

Supervisor

Date: 2079/07/30

Date: 2022/11/16

APPROVAL LETTER

This thesis entitled **"Climate Change Impact in Agriculture: A Study of Baglung Municipality -12 Baglung, Nepal"** submitted by Mr. Sagar Sharma to the Central Department of Rural Development, Faculty of Humanities and Social Sciences, Tribhuvan University, in partial fulfilment of the requirements for the Degree of Master of Arts in Rural Development has been approved by the evaluation committee.

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This study entitled **"Climate Change Impact in Agriculture: A Study of Baglung Municipality -12 Baglung, Nepal"** is submitted to Central Department of Rural Development, TU, Kirtipur for the partial fulfilment of the requirements (RD 588- Thesis) for the degree of Master's in Arts in Rural Development. It is my great pleasure to submit this thesis report under the guidance of Associate Prof. Dr. Suman kharel.

I would also like to acknowledge with much appreciation the crucial role of Associate Professor Bishnu Bahadur Khatri (Head of Department) for approving this thesis title.

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Sagar Sharma
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2022

ABSTRACT

Climate change is great concern of today as it affects not only living being but also effect the whole eco-system of the world. Even in Nepal climate change can affect agricultural production directly or indirectly. The direct impact of climate change is the change in rainfall, drought, change in temperature and change in seasonal cycle, that can reduce agricultural production and the indirect impacts are changes in market price and supply. The study entitled "Climate Change Impact on Agriculture a Study Of Baglung Municipality -12 Baglung, Nepal" thus tried to analyze the impact of climate change in agriculture. Objectives of this study were to analyze the agricultural pattern, to assess the pattern and trend of rainfall and temperature based on meteorological data and to assess the impact of climate change on agriculture.

This study applied both quantitative qualitative research approach and survey method and KII. Required primary data were collected from 170 respondents randomly and secondary data were fetched from Meteorology Depart. In doing so, household survey technique with tools (Cronbach's Alpha value 0.83) has been used. The validity is 0.74 which means no issue of content validity. This study used SPSS version 20 for organizing, summarizing, describing, and generalizing the data.

In this study, it was found that about 54.13% of the total people are depending on agriculture for their livelihood. Climatic parameters (rainfall and temperature) are found to be main factors in the production of agriculture. I studied the trends of rainfall and temperature as well as agriculture production of last 9 years (2012/13-2020/21) in the Baglung district. From this study, trend of rainfall was found to be decreasing and that of temperature was found to be increasing. These climatic factors have both positive and negative impact on the agricultural production depending on the time/ season and type of crops. Similarly, the modern technology applied to the field and seed have positive impact in the production of agriculture. Also, the fertility of soil, provision of irrigation, use of fertilizers, use of insecticides and pesticides etc. are found to be the factors affecting the agricultural production.

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ACRONYMS/ABBRIVIATIONS

CBS	=	Central Bureau of Statistics
CDRD	=	Central Department of Rural Development
CO_2	=	Carbon-dioxide
FARM	=	Future Agricultural Resource Model
FAO	=	Food and Agriculture Organization
GDP	=	Gross Domestic Product
HHS	=	Households
IPCC	=	Inter-Governmental Panel on Climate Change
JTA	=	Junior Technical Assistance
NRB	=	Nepal Rastra Bank
NGO	=	Non-Governmental Organization
NPC	=	National Planning Commission
UNFPA	=	United Nation Population Fund
UN	=	United Nation
VDC	=	Village Development Committee
WFP	=	World Food Program

CHAPTER ONE
INTRODUCTION

1.1: Background of the Study

Global warming and climate change are great concern of today as it affects not only living being but also effect the whole eco-system of the world. So it also affects agriculture sector directly as it is mostly dependent on nature. All the agricultural activities are directly depending upon the agriculture during the cycle. In the large meaning climate change is a global issue resulting by anthropogenic. The impact of climate change are change in precipitation change in temperature and natural hazards such as drought, flood, and landslide. The climate change has affects agriculture and poor livelihood. The climate change has been challenged to developing country like Nepal .

Climate change and its negative impact are topics of current Scientific and Societal concern. Climate change is a global issue resulting from Anthropogenic Activities. Such as the combustion of Fossil Fuel, Deforestation, Urbanization, Population Growth and Sustainable Agriculture with Increase Greenhouse Gases in the Atmosphere and Exponential growth of C02. In addition, the climate is affected by natural forces such as changes in volcanic activity, Solar output, the Earth's Orbit around the Sun, natural seasonal change, change Ocean current and Continental drift (IPCC, 2008).

According to IPCC 2007, global average temperature is expected to rise between 1.4 degree to 5.4 degree Celsius by 2100 (IPCC, 2008) Climate change can affect agricultural production directly or indirectly. The direct impact of climate change is the change in Rainfall, Drought, change in temperature and change in seasonal cycle, that can reduce agricultural production and the indirect impacts are changes in market price and supply (Malla, 2009). The main economic sector of Nepal is agriculture. The climate change is challenging factor for Nepalese economy.

The climate factors are responsible for the reduction of crop yields and production of the crop in Nepal. The small farmers in the Rural Areas of Nepal, whose households depend on agriculture for income are most Vulnerable. Nepal is developing country and it is a country rural areas. More than 80 percent people are still living in rural areas. The economy of Nepal is heavily dependent on agriculture. Which contribute about 39 percent to national GDP and about 75 percent of the economically active population are depended on agricultural sector for their living. Although 70 percent farm families hold less than

one hector of land. In the recent years, the global climate has changed and changes are both due to natural phenomena and human activities. These changes are shown by more frequent and intensity as well as irregular change of disaster such as floods, droughts with in an over years. There changes have largely impact on social, economic and environmental system and shaped prospects for sustainable agriculture and rural development (Pant & Jain, 2012).

Agriculture is sensitive to both short term changes in weather and seasonal, annual an long term variation in climate. Increase on greenhouse gases or greenhouse effects are directly affected on agriculture production. Nepalese agriculture is predominantly. Small scale farming, around half of which is dependent on natural rainfall. 46.5 percent of overall cultivated areas is irrigated while only 69.5 percent of total irrigable area is irrigated. Rainfall and other climate factors are therefore critical tom crops fields (CBS, 2016).

The average temperature in Nepal is rising by 0.5 degrees Celsius per decade however; such minimum changes in air temperature can also lead to rapid melting of glaciers and glacier lake. Nepal's major natural resources and water resources are also at the forefront of climate vulnerability (Sapkota, 2016). Climate change is a global issue. Looking at the global context, the most suffering countries are the least development countries. Although Nepal is contributing 0.025 percent of global emissions of greenhouse gases, Nepal is vulnerable to the negative impact of climate change (Synott, 2012). The climate factors such as rainfall patterns, a rise in temperature, flood and landslides in temperature of a ground surface, that also reduce in groundwater, rivers and lake water (IPCC, 2008). Meanwhile, rivers and monsoon rains are the main source of irrigation facilities in Nepal.

The impact of climate change varies according to geographical location and remoteness. The people living in rural areas are most affected by climate change. The communities living in hills, mountains and river floodplains are more vulnerable to climate change. Moreover, poor communities whose livelihood is totally dependent upon natural resources such as land, water, forest and pasture land are more vulnerable to climate change and possess less capacity to cope up with the disaster caused by climate change (Lohani, 2007). Constantly, women are also vulnerable to climate change. In fact, women are close to nature.

Nepal is identified a highly vulnerable country to the climate change. The agriculture in Nepal is vulnerable for two reasons. First, the existing system of food production is highly climate sensitive because of its low level of capital investment and adoption of modern technological option of livelihoods for a majority of the population depends on agriculture. But will put greater number of people rate risk when agriculture is impacted due to climate variability and uncertainly climate change impacts on agriculture is production are very vague that climate change have decreased productivity. so, it is a complex problem to the world (Karan, 2014).

Climate change impacts live and livelihoods, particular of economically poor and climatically sensitive countries like Nepal. Various studies have shown that the climate change impacts are evident on forest bio-diversity, water resource, agriculture and other sector in Nepal. Therefore different types of climate change impact have been noticed on culture. The poor people of terai region are more vulnerable to climate change as they have less production. Less reserves fewer after native and lower adaptive capacity. In order to identify impacts of climate change on agriculture production system in rural community of Nepal. This study was carried out in Baglung -12 Baglung district.

1.2: Statement of the Problem

Nepal is a mountainous country that cover 147516 km2 total area, with 30284438(country meters.info-2020.08.17) population. Nepal has great geographical and climate diversity. The geographical structure of Nepal resembles a rectangular shape with three main ecological zones, namely, terai, hills and mountains (karki and gurung-2012). The geographical setting of the country ranges varies from 150 meters terai to 8850 meters in the Himalayan (Lohani, 2007).

Nepal emits an insignificant amount of greenhouse gases that causes global warming (Synnot, 2012), however as a result of global warming, the temperature in Nepal is rising by 0.5 degree centigrade decade last 25 year (Lohani, 2007). It is reported that air temperature rises 1 degree Celsius than 1970s and has continuously risen 0.06 degree Celsius per year in Himalayan regions. Glaciers are renewable water resources for fresh water and perennial sources for the several rivers in the country (Lohani -2007).

The raising temperature and emission of carbon dioxide (CO_2) in the same extent is helpful in production of major crops. For example: increase in agriculture production by enhancing photosynthesis process, water use efficiency and soil microbial activities.

Decrease in grain filling due to increase in respiration process, fertilizer use efficiencies, desertification, and increase in soil erosion etc. cause malnutrition in the world. Decrease in quality of food such as reduce in protein and decrease in minerals nutrients content in different crops and vegetables that means in overall agricultural producer, these are the negative effects (Pathak, 2003).

In the recent years, the change of weather patterns in districts has caused the adverse effects on agriculture production resulting in reduction in crop production, crop failure and low productivity (Sapkota et al, 2010). The main reasons for the reduction in crop production are lack of irrigation facility, intense rainfall, long periods of drought, a decrease in soil moisture, loss of soil fertility and wind erosion (Marasini, 2012). Nepali agriculture is highly dependent on climate factors. Drought, heavy rainfall are major evidence of climate change in changing rainfall pattern, pest and disease, hot waves, cold waves, changes in plantation and harvesting period.

This study area 90 percent people depends on agriculture for their livelihood and about 85 percent land covered by agriculture (Ward Profile 2021). But total agricultural production is not fixed. In this study area, some symptoms of climate change have recognized by the farmers for example: shifting of rainfall, catastrophic rainfall, drought, and extinction of water resources like ponds, springs etc. of the study area due to these problems research must be carried out in this area.

Research Questions:

The Researcher aims to find the answer of the following questions

    i.   What is the agriculture pattern in the study area?

  ii.   What is the pattern of rainfall and temperature?

 iii.   What impact has been seen in agriculture due to climate change?

1.3: Objectives of the Study

The general objective of the study is to analyze the impact of climate change in agriculture. The specific objectives of the study are:-

    i.   To analyze the agricultural pattern of the study area.

  ii.   To assess the pattern and trend of rainfall and temperature (climate change) in the study area based on meteorological data.

 iii.   To assess the impact of climate change on agriculture in the study area.

1.4: Significance of the Study

Nepali agriculture sector comprises over 75 percent of employment and contributes 43 percent to the gross domestic production (GDP). Nepal main agriculture center (production region) is Terai. Climate change is serious consequences for agricultural production that direct effects on livelihood of farmers. The climate change has been challenging to fulfill the demand of food for a growing population. In coming decades, the stress on water availability and the shortage of food availability in Nepal is likely to be exacerbated by climate change (Lohani, 2007).

The lack of financial capacity and co-operation between government and other agencies; the action on climate change adaption and mitigation has been a challenge to cope with the climate change. Nepalese people are directly or indirectly related with agriculture because food is he basic needs of human being, so this study is most valuable for everybody of this country.

1.5: Limitation of the Study

This study aims to identify the impact of climate change on agricultural production of Baglung district and this case study from Baglung municipality. Limitation of the study are listed below:-

  a) Limited sample size and sample area the present study might not be generalized.
  b) Considering the limited time and resources, only 100 households are taken for household survey.
  c) This study temperature and rainfall indicate climate variables.

1.6: Organization of the Study

This study is organized with five chapters. The first chapter is concerned with introduction of the study dealing with the statement to the problem, objectives, significance, limitation of the study, and operational definition of climate change. The relevant literatures have been reviewed in second chapter for this study. The third chapter is about research methodology of the proposed study. In the fourth chapter, an introduction to the study area is presented, deal with the social, economic, and demographic characteristics of sample population. Finally, the fifth chapter provide the main findings, summarizing the study as well as conclusion and recommendation. Some

case studies are also illustrated in the appendix for comprehensive information about impact of climate change.

CHAPTER TWO
LITERATURE REVIEW

2.1: Conceptual Review

Climate change and agriculture are interrelated process both of which take place on a global scale climate change affects agriculture in number of way including through change in average temperatures, rainfall and climate extremes:-hot waves, pest and disease climate change is already affecting agriculture with effects unevenly distributed across the world. Climate change will probably increase the risks of food in security for some vulnerable groups such as poor. Production is sensitive to weather and thus directly affected by climate change (WB, 2005).

Climate change is defined as statistical distribution of weather over periods of time that ranges from decades to millions of years. It is also defined long term shift of climatic situation of the earth or a particular place or a region or a whole world. The global temperature has increased since last few decades since 1850, the global temperature has braised from 0.6 degree Celsius to 0.7 degree Celsius approximately (IPCC-2008). Scientists have anticipated that global average temperature increase due to rise in greenhouse gas concentration. The global average temperature in forecasted to rise between1.4 degree Celsius to 5IEW. 4 degree Celsius towards the end of the 21th century (IPCC, 2008).

According to the IPCC, since 1950, records showed that number of cold days and nights have decreased, and extreme hot days and nights have increased (IPCC, 2008). The rise in global temperature leads to increase in heat waves, warm lower atmosphere and deep oceans, fewer frosts, melt glaciers and snow. Climate change was first discovered in the 18th and the 19th century. Half decades later of discovery of the global warming in 1967, computer stimulation calculated that the global temperature might increase by more than 15.55 degree Celsius depending on carbon dioxide level. Then, 20 years later an ice core from Antarctica revealed a link between carbon dioxide and temperature going back more than 100000 years (Singh, 2010).

Global warming on climate encourage to take international action on climate change. That reason first conference on climate change was held in Geneva 1979 (government of UK). This conference identified climate change as an urgent world problem and issued a declaration calling on governments to foresee and prevent potential

manmade changes in climate. Then 1988, UN established IPCC. The IPCC warned that only strong control over air population emission would prevent serious global warming.

2.1.1 Theoretical Review

Anthropogenic Global warming (Joeshph L. Bast, 2010)

According to the first theory of climate change, carbon dioxide (CO_2), methane, and nitrous oxide are the main greenhouse gases that humans are responsible for emitting into the atmosphere. The enhanced greenhouse effect is the process through which this occurs. This hypothesis is known as "anthropogenic global warming," or simply AGW.

The sun's energy travels through space and eventually reaches Earth. Since most of the sunlight entering Earth's atmosphere is transparent, it can reach the planet's surface where part of it is absorbed and some of it is reflected back as heat into the atmosphere. As a result of some gases in the atmosphere, known as "greenhouse gases," absorbing external thermal radiation or internal thermal radiation, the Earth's atmosphere is warmed over its potential temperature.

The planet's orbit and variations in solar radiation are two more external factors that affect Earth's climate, but AGW proponents claim that these "forcings" are insufficient to account for the planet's temperature increase during the previous three decades. Although the forcing brought on by greenhouse gases produced by humans is also quite tiny, the AGW theory contends that positive feedbacks cause the impacts of these gases to grow by a factor of two to four. Even a little temperature increase increases evapo- 7 S even T heories of Climate Change ration, which increases the amount of water vapor in the atmosphere and increases warming.

Theory of Agriculture Transformation

Nobel Prize winner economist (in 1979) T. W. Schultz emphasized that key to agricultural transformation lies in emphasizing technological change in agriculture (Author & Lekhi, 2008). According to the conception of this theory, Schultz doctrine has given focus on following assumptions (Lekhi, 2008).

➤ The problem can be solved through the investments.
➤ The following three factors can transform traditional agriculture system:

- Investment in material capital required for farming and skill development of the farmer.

- All of the modern inputs should be available in sufficient amount and cheap rate.

- Information about agriculture marketing system should be provided regularly.

➢ Schultz does not belittle the importance of industrial sector but he wants the removal of those biases which stand in the way of transfer of resources from rural to urban areas.

➢ He further recommends that manufacturing and other urban sectors should not be subsidized with massive resource transfer of from rural to urban areas.

2.1.2 Climate Change in Nepalese Context

Climate change in Nepal is the major problem for Nepal as it is one of the most vulnerable countries to the effects of climate change. Globally Nepal is ranked fourth, in terms of vulnerability to climate change

Nepal is a country which has complex climate that varies greatly due to its topography. The geographical structure of Nepal resembles a rectangular shape with three main ecological zones, terai, hills, and mountains (Karki and Gurung, 2012). Nepal has lowland regions with warm and humid subtropical climate while high altitude regions are cold and temperature which can reach below zero during winter (Pant 2009).

The extreme climatic condition such as arise in mean annual temperature and an increase in precipitation has adverse impacts on agricultural production in different parts of Nepal. The level of vulnerability depends on socio-economic and environmental factors (Karki and Gurung, 2012). In rainy reason; due to massive rainfall the farmland in covered with huge water which result in force shift of agriculture land to other untouched land area and encroachment of forest land. In addition, the frequent storm would damage crops; and climate change in precipitation would reduce production of land. In the country, 64 percent of agriculture production depend on monsoon rainfall (Lohani, 2007).

The lack of proper irrigation system in the country, the agriculture needs favorable weather condition and monsoon rainfall time and duration makes crop production more vulnerable. The mountain region farmers are more vulnerable to climate change because most of the population relies on agricultural production. Furthermore, the local farmers do not have scientific knowledge of climate and crop yields.

According to the Bhushal (2019)
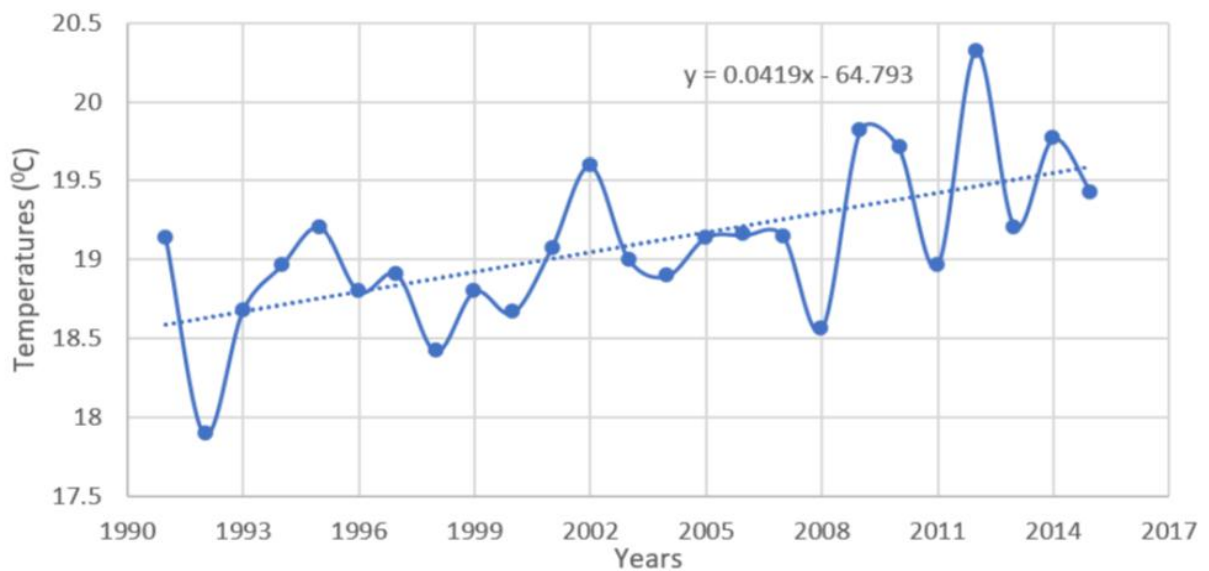
Chart 1: Average annual maximum temperatures in Nepal. (1991-2015).

Chart-1 deals with the average change in maximum temperature of Nepal as a whole. This shows that the average annual maximum temperature is increasing. This means every year; temperature is rising by a certain degree. For instance, the average annual maximum temperature of Nepal in 2012 was 20.3236 which is highest till date whereas the average annual maximum temperature of Nepal in 2015 was reported to be 19.422. The slope of the trend line is positive which means that the average annual maximum temperature is increasing.

Effect of maximum temperature is seen in different crops during their different stages of growth. The temperature required for a crop during a vegetative phase of growth is higher than the requirement during the reproductive phase. Studies have shown that the increasing temperature mainly affects the pollination stage of plant growth. The effect of temperature is enhanced under high vapor pressure deficits because pollen viability (prior to silk reception) is a function of pollen moisture content which is strongly dependent on vapor pressure deficit. Exposure to temperatures above 30°C damaged cell division and amyloplast replication in maize kernels which reduced the size of the grain sink and ultimately yield [14]. In case of response of pollen viability to temperature, the response

of Rice is also found to be similar with that of maize. Similarly, Increase of temperature may cause yield declines between 2.5% and 10% across a number of agronomic species throughout the 21st century [15]. Various evaluations regarding the temperature and crop yields have shown that there is negative response of yield with increasing temperature.

Chart-2 deals with the average annual minimum temperatures of Nepal. The slope of the trend line of the graph is positive which shows that the average annual minimum temperature of Nepal is slightly increasing. However, the average annual minimum temperature of Nepal is decreasing in the recent years. As the data shows, the lowest average annual minimum temperature was 1.772340 C in 1995. And the highest average annual minimum temperature was recorded to be 6.420220 C in 2006. The minimum temperature has decreased to 2.541330 C in 2015 from 4.23140 C in 2014.

The chart shows: $y = 0.0326x - 61.199$
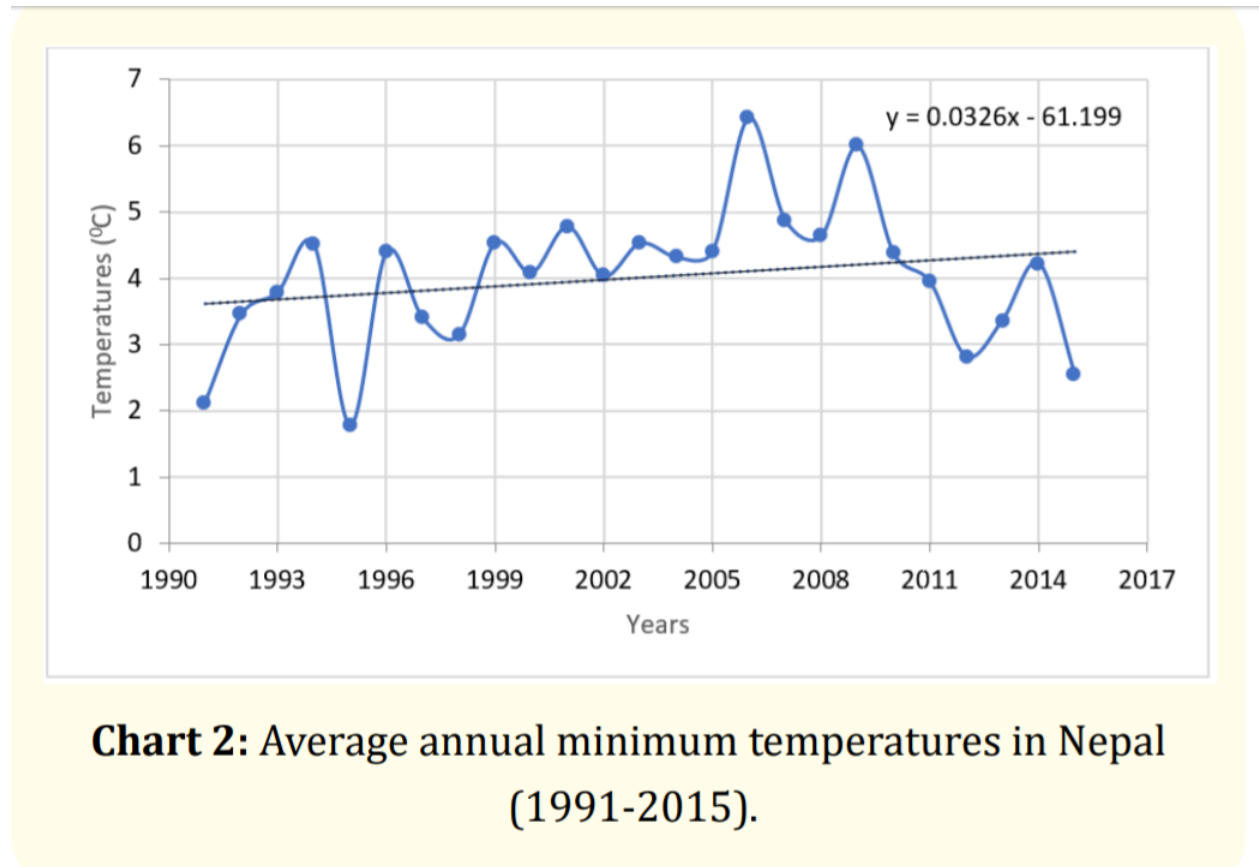
Chart 2: Average annual minimum temperatures in Nepal (1991-2015).

The effect of increasing minimum temperatures can be highly noticed in the temperate crops in Nepal. Temperate crops like Apple, Pear, Peach etc. require chilling temperature to break dormancy in the winter season but due to the increase in average annual minimum temperature, the essentiality of artificial dormancy is seen. Although,

the minimum temperature in an average is increasing slightly, the minimum temperature within years is fluctuating at higher amount. The differences between the average annual minimum temperatures are noticed very high. As seen in the chart, the difference between the average annual minimum temperatures in 3 years (2009-2012) is 3.178910C. The effect of low temperature on plants can be blackening of the tissues and death of the plant due to the freezing of tissues.

2.1.3 Food Security, Climate Change and Livelihood

The FAO (food and agriculture organization) of the United Nations defines food security as "situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (FAO, 2008; Olsson et al., 2014; FES, 2012). The food security has four pillars such as availability, access, utilization and stability. Nepal total production of the country is not sufficient to meet the basic demand of increasing populations. Poverty is one of the major cause of food insecurity. About 31 percent of total population are below the poverty line (FAO, 2010). Hunger, poverty, malnutrition are closely related terms.in another world, low income group have less purchasing capacity of basic food. Nepal imports 1.4-billion-ton food of another country to fulfill the demand of existing population as well as growing population.

The price of imparted food items from other countries is relatively expensive. The price shocks and inflation decrease the purchasing power of poor people or low income group.

2.2 Empirical Review

There are less than expected empirical works on the impact of global warming and climate change on AGDB (agriculture gross domestic production) especially in Nepalese context. Independent and individual research seems beyond that catch as the climate and precipitation time series are unaffordable to ordinary people in Nepal.

Malla (2008) has revealed that with an average of 0.6 degree Celsius a year, a rise in temperature from 1975 to 2006 by 1.8 degree Celsius has been recorded in Nepal. Problem of frequent drought, severe floods landslides and mixed type of effects in agricultural crops have been experienced in the country because of climate change.

Nepal being a small country and occupying a small area in the globe, contribute less to the climate change but is in great threat to the effects caused by the climate change in near future. Nepal is rich in water resources which if polluted, can cause degradation or even eradication of the aquatic plants and animals. Even the terrestrial plants can face different problems. Disorders and diseases due to increasing temperature and increasing UV-RAYS unfolded from the almighty solar radiations. Even, some of the symptoms are being seen throughout the country now a days. People are affected by cancer or various organs of the body (Bhusal, 2019).

A review paper by Karki (2018) expressed the concern in the increasing Carbon dioxide level will ultimately increase the crop yield with absorption of more co2 and increase in photosynthesis. There should be the provision that crop should tolerate increased temperature caused by higher Carbon dioxide concentration. Thus increased crop yield will be promoter for food security condition in Nepalese context, where c4 crops (mage, sugarcane, sorghum, millet etc) are economically significant.

Cline (2007) infers that the agricultural damages tend to be greater toward the equator, and hence concentrated in developing countries. Yields and agricultural production potential would fall about 15 to 30 percent in Africa and Latin America and 30 to 40 percent of India. For a while for the north productivity losses would range between 20 to 30 percent in the southeast, and 25 to 35 percent in the south west plains and Mexico.

NCVST (Nepal vulnerability study team 2009), have projected that the mean annual temperature across Nepal can increase by 0.5 degree to 2.0 degree Celsius by the 2030s which can reach to 1.7 to 4.1 degree Celsius, by 2060s and 3.0 to 6.3degree Celsius by the 2090s. The increase in temperature will be high in winter and pre-monsoon compared to the monsoon and post monsoon due to projected increase in monsoon rainfall and cloudiness increase in temperature is projected to be high in western and central Nepal by about 0.7 degree Celsius than eastern Nepal by 2090s. similarly, hot days in pre-monsoon are to increase by 15-55 percent by 2060s and 26-69 percent by b2090s while in monsoon it is projected increase and decrease with -34 to +22 percent by 2030, -36 to +67 percent by the 2060s and -43 to +80 percent, by the 2090s. Monsoon rainfall is expected to increase in eastern and central Nepal monsoon rainfall than western Nepal. Winter precipitation is expected to decrease by 14 percent also, heavy rainfall is projected to slightly rise in monsoon and post monsoon and slightly decrease in winter and pre-monsoon season.

The change climate pattern largely reduces crop yield globally and in Nepal. Rice and wheat are the two major crops of Nepal and their yield largely depends on the rainfall pattern much of the lifestyle and cultural practices in Nepal revolve around sowing, transplanting, harvesting and consuming rice- however, rice production has been continuously decreasing in past few years.

The vulnerability of the agricultural sector to both climate change and variability is well established in the literature. The general consensus is that changes in temperature and precipitation will result in changes in land and water regimes that will subsequently affect agricultural productivity. Research has also shown that specifically in tropical regions, with many of the poorest countries, impacts on agricultural productivity are expected to be particularly harmful. The vulnerability of these countries is also especially likely to be acute in light of technological, resource, and institutional constraints. Although estimates suggest that global food production is likely to be robust, experts predict tropical regions will see both a reduction in agricultural yields and a rise in poverty levels as livelihood opportunities for many engaged in the agricultural sector become increasingly susceptible to expected climate pressures.

While contemporary policy dialogue has focused on mitigating emissions that induce climate change, there has been relatively limited discussion of policies that can address climate impacts. First, climate variability is already a problem both in developed and developing countries. Second, even moderate climate change provides added impetus to promoting local adaptation options concurrently with the pursuit of global efforts on mitigation strategies. That is, adaptation to climate change and variability (including extreme events) at the national and local levels is regarded as a pragmatic strategy to strengthen capacity to lessen the magnitude of impacts that are already occurring, could increase gradually (or suddenly), and may be irreversible. Consequently, several key themes have emerged from the current literature on adaptations to climate change. First, given the range of current vulnerability and diversity of expected impacts, there is no single recommended formula for adaptation. Second, responsibility for adaptations will be in the hands of private individuals as well as government. Third, the temporal dimension of policy responses is likely to have a significant role in the effectiveness of facilitating adaptation to climate change.

One set of measures will decrease the short-term vulnerabilities of the agricultural sector through adaptations to weather effects. These measures will therefore address concerns with climate variability. However, more often than not policies aimed at

reducing vulnerability to short term climate variation will not reduce vulnerability to long term climate change. Another set of strategies that reduce vulnerability to climate change will thus be necessary. This second set of adaptation measures include options such as improving water management practices, modernization by adopting and utilizing new technologies, and changing crop types and location, including migrating permanently away from the agricultural sector. Finally, a third set of adaptation options need to incorporate economic, institutional, political, and social policy changes that promote sustainable development. The pursuit of such "no-regrets" options through an interdisciplinary approach is fundamental to strengthening local capacity to adapt. In conclusion, it is clear that in the short run, adaptation options in the agricultural sector need to reflect what is currently known about climate conditions. In contrast, in the long term it is necessary for national sectoral policy and assistance provided by international agencies to developing countries to reflect expected changes in the future from climate change.

The focus of policymakers should thus be on formulating and implementing policies that promote better adaptation. In particular, incentives that promote adaptation need to be formulated and incorporated into project designs. It is also clear that policymakers should promote dynamic adaptation, as it is unlikely that there will be one solution for all time. Finally, incentives that promote adaptation policies should be incorporated into poverty reduction and other sustainable development policies that in turn will also enhance the resiliency of the agricultural sector.

Climate change is one of the most defining concerns of today's world and has greatly reshaped or in process of altering earth's ecosystems. Although climate change has been a constant process on earth, but in recent times, approximately last 100 years or so, the pace of this variation has increased manifolds. Due to the anthropogenic activities the average temperature has risen by 0.9 °C since nineteenth century, mainly due to greenhouse gas (GHG) emissions in the atmosphere. As per estimates this rise is expected to be 1.5 °C by 2050 or may be even more, the way deforestation is occurring, GHG emission is increasing and soil, water bodies and air are being polluted. The unprecedented hike in temperature has resulted in increased events of droughts, floods, irregular patterns of precipitation, heat waves and other extreme happenings throughout the globe.

As per the annual report of Weather, Climate and Catastrophe Insight, natural disasters alone have caused economic loses in tune of USD 225 billion across the world in 2018 and since 2016 the losses due to natural calamities have crossed USD 200 billion per year. About 95% of these losses are attributed to weather related incidences, of which cyclones, floods and droughts are the key players and are directly related to climate change. Altogether, the impact of climate change is very comprehensive but its far reaching effects are now clearly visible on agricultural sector, on which relies the food production and economy of the world.

It is also worth noting that world population is expected to reach 9.7 billion by 2050 which would magnify the pressure on agricultural lands to meet the growing food demands already affected by the impact of climate change. As climate change and agriculture have inextricable links, abrupt changes in climatic conditions at such a rapid pace has threatened the food security at global scale. World Food Program (WFP) report of 2018 revealed that increase in crop yield per hectare is significantly slower as compared to rates of rising population. As per Food and Agriculture Organization (FAO) data published in 2016, if the current situation of GHG emissions and climate change continue then by the year 2100 there will be decline in the production of major cereal crops (20–45% in maize yields, 5–50% in wheat and 20–30% in rice). Hence if the trends continue, in very near future crop losses may increase at an unprecedented rate which will substantially contribute to reduced production, spiked food prices, and it will become difficult to cope up with rising needs of growing population (Arora, 2019).

Climate policy today runs two kinds of risk. First, it runs the risk of underestimating the burden of adaptation in dealing with climate change in the future. Secondly, it runs the risk of overemphasizing the environmental and climatic constraints on agricultural production in the present, while ignoring the role of socio-economic factors as significant barriers to agricultural growth. This paper, which is based on a review of the literature, seeks to distinguish the issue of current climate variability and its consequences from the issue of the impact of climate change in the future. It also discusses the uncertainties in predicting the future impact of climate change, uncertainties that constitute a barrier to determining adaptation requirements. At the same time, the paper also attempts to draw lessons relevant to dealing with a future of climate change (Jayaraman and Murari, 2014).

During the past few years two new methods, each based on the analogous region concept, have been developed to account for farmer adaptation in response to global

climatic change. The first, called 'Ricardian' by Mendelsohn, Nordhaus, and Shaw (1994), econometrically estimates the impact of climatic and other variables on the value of farm real estate. Under some conditions, estimates of climate-induced changes in farm real estate capture first-round adaptations by farmers and represent the economic value of climatic change on agriculture.

The second method, promulgated by Darwin et al. (1994) in the Future Agricultural Resources Model (FARM), uses a geographic information system to empirically link climatically derived land classes with other inputs and agricultural outputs in an economic model of the world. FARM provides estimates of economic impacts that fully account for all responses by economic agents under global climate change as well as estimates of Ricardian rents. The primary objective of this analysis is to evaluate how well changes in Ricardian rents measure agricultural or other effects of climatic change after all economic agents around the world have responded. Results indicate that changes in Ricardian rents on agricultural land are poor quantitative, but good qualitative, measures of how global climatic change is likely to affect the welfare of agricultural landowners, if one recognizes that increases in Ricardian rents actually indicate losses in landowner welfare and vice versa. Results also indicate that regional changes in Ricardian rents on all land are good qualitative measures of changes in regional welfare. They are poor quantitative welfare measures because they systematically overestimate both benefits and losses and are on average upwardly biased because inflated benefits are larger than exaggerated losses. Results also indicate that, when based on existing land-use patterns, changes in Ricardian rents on all the world's land are poor quantitative and qualitative measures of changes in world welfare. Despite these shortcomings, changes in Ricardian rents can provide useful information when other measures are not available.

In this analysis, for example, estimated changes in Ricardian rents on all land indicate that climatic change would likely have detrimental effects in Latin America and Africa, beneficial effects in the former Soviet Union, and either detrimental or beneficial impacts in eastern and northern Europe and western and southern Asia. This is consistent with previous studies showing that climatic change would likely have detrimental, beneficial, and mixed effects on economic welfare in, respectively, equatorial, high latitude, and temperate areas (Darwin, 1999).

Research Gap: Although there are many research already had done in others field on impact of climate change but no research had done in Baglung Municipality-12, Baglung in this title. There was no any research done in both quantitative and qualitative research using quantitative and qualitative tools and techniques through questionnaire and KII based variables. So this research is different from other research because of mentioned research methodology, research questionnaire, variables, location and research time.

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Research Design

This was a study of Baglung municipality-12 Baglung district. Since, this study describe about the major impact to climate change on agriculture of study area.

This study has been carried out on descriptive research design.

3.2 Rational For the Selection of the Study Area

Nepal terai region is main agriculture center of the country. Inspite of having that hills is also the destination for different types of crops .This case study from Baglung municipality of Baglung district. Hills is also region for food store such for example Jhapa is tea.

This study area more than 80 percent people have their own land and agriculture is the main occupation of those people. Now climate change is a great consequence for agriculture production directly affected. This is great issue for local farmers are adopting alternative way for livelihood.

This study was selected to find out the actual condition of agricultural production that was affected by environmental change or climate change is study area.

3.3 Nature and Source of Data

The present study was based on primary and secondary data. The secondary information was derived from census report and other related documents. The primary data were collected from the firsthand information gained from the field and secondary data was extracted from department of meteorology. Both Quantitative and qualitative method was utilized in this study. Sample survey of each households has been employed to collect quantitative data whereas qualitative information are acquired from the observation and key information from interviews with selected local people.

3.4 Universe and Sampling

In this study the researchers was applied simple random sampling methods for determining sample population and sample number. The Table mentioned below was made Sample frame and sample number clearer according to Krejcie, R.V. & Morgan, D.W.(1970). According to Ward profile 2078 of Municipality, there are 856 household in

Baglung-12. Among them 300 household are totally involved in Agriculture. These 300 households is taken as sample population in this study, and 170 sample number is chosen by using simple random sampling technique proposed by Best and Khan (2004), which are obtained with a 95% confidence level and a 5% marginal error.

Ecological Regions	Local Levels	Respondent	Sampling Frame	Sample Number
Hill	Baglung municipality ward no. 12,Baglung	Direct Beneficiaries	300	170

(Baglung municipality ward no.12 –ward profile -2078)

$$\text{Sample size (n)} = \frac{\chi^2 * N * (1-P)^2}{ME^2(N-1) + (\chi^2 * P * (1-P))}$$

Where,

n = required sample size

χ^2 = Chi square for the specified confidence level at 1 degree of freedom (Value* 3.841 for 5% confidence level with 1 degree of freedom)

N = Population size

ME = Desired Marginal error (expressed as a proportion)

P = Probability of success (0.5 value for unknown population)

Q= (1-P, i.e. 0.5 value for unknown population)

3.5 Data Collection Techniques and Tools

Household survey, direct observation, key informants' interview, census method are primarily used to collect required information for the study. They are as follows:-

3.5.1 Household Survey

Family study captures data approximately overall economic status of local within the ponder range. Organized survey are used for the family study as a device. This strategy is very important not as it were to urge a common statistic picture, but moreover

to quantitatively support. Data such as population and its composition, proficiency and educational fulfillment, word related structure and slant, landholding ownership, family measure and structure are collected through this instrument. Besides data around put of work, day by day exercises and natural resource are moreover collected. The household survey was done with local farmers in Baglung Municipality-12. The format of household survey questionnaire has been attached in Annex I.

3.5.2 Key Informants Interview

Key informants' interview was also used as a field instrument in this research. It is used to get the information of the past of community and their livelihood strategies. Key informants are those people who know a great deal the community under study. In depth study can be achieved from them about particular community. They provided in-depth information about impact of climate change in agricultural practices and economic activities. Although 4 people were interviewed as a key informant, with ward chairperson, agriculture officer, JTA and old person of ward. The format of KII guideline has been attached in Annex II

3.6 Variables and Operationalization

Dimension of Inquiry	Variables	Methods
Agriculture Pattern	• Season of cultivation • Variety of Production • Time of cultivation • Change in production	• Field Survey Questionnaire
Climate change pattern	• Change in Rainfall • Change in Temperature	• Secondary data from Meteorology Depart
Impact	• Income • Job Diversion • Food scarcity • Natural Disaster	• Field Survey Questionnaire • Secondary data from Meteorology Depart • KII

I. Agriculture Pattern:

On the basis of agriculture pattern the different variable was set like, season of cultivation, variety of production and time of cultivation and change in production by the method field survey questionnaire.

II. Climate Change:

On the dimension of climate change pattern different variables was set change in rainfall and temperature by using the secondary data from the meteorology department.

III. Impact:

On the core dimensions impact of climate change variables of income, job diversion, food scarcity and natural disaster was done by the method of KII.

3.7 Method of Data Analysis and Presentation

The collected data were analyzed and interpreted on the basis of research design. After completing the field survey, collected data during field work were edited and tabulated as per the need of report mirror. Moreover, in order to make the report more precise, maps, figures, and charts and footnotes have been enclosed with this report similarly, chapter-subchapter have been divided

3.8 Reliability ana Validity

To ensure validity and reliability of the research instrument, the researcher ensured that the Questions that are asked are in conformity with the research objectives of the study and a pilot test of the research instrument was conducted and a calculation using SPSS computed for question reliability and validity assessment as follow.

Table 3.2: Reliability and Content validity

		Agricultural practices	**Impact in Agriculture**	
Climate Change	Pearson Correlation		.740[**]	
	Sig. (2-tailed)	.000	.001	
	N	170	170	
Cronbach's Alpha		N		
.830		3		

Source: Field Survey, 2022

CHAPTER FOUR

DATA ANALYSIS AND INTERPRETATION

This chapter deals with the analysis and presentation of data, obtained from primary sources. This chapter includes social structure, caste, ethnicity composition of respondents, food habit, religious, education, economic structure, occupational structure, family size, age and gender composition.

4.1 Description of the Study Area

Baglung is surrounded by Parbat, Myagdi, Rukum, Rolpa, Pyuthan and Gulmi districts. It has four Municipality and six village municipality. Baglung has a moniker of "District of suspension bridges" as there are numerous suspension bridges. It is a hilly district, most of the population settled in the sides of the rivers. Fertile plains situated in the either sides of the rivers are used for farming. Headquarters of Baglung District is Baglung Municipality which is located on a plateau overlooking the holy Kali Gandaki. Like Nepal, Baglung is also diverse in religion, culture, ethnicity, altitude, temperature etc. Hinduism and Buddhism are the major religions. Baglung is rich in herbal medicinal plants. Rice, Corn, Millet, Wheat and Potato are the major crops of Baglung. Small scale mining mostly for Iron and Copper was a major activity in Baglung in the past. However, due to economics of operating small mines most have closed since. Slate mining remains the most widespread form of mining in present times. Slate mined in Baglung is considered excellent for roofing. Baglung Municipality, Hatiya- Galkot and Burtibang are the main trading centers of Baglung. Galkot, Kusma and Burtibang are connected with the district headquarters Baglung Bazaar by roads. Baglung is served by Nepal Electricity Authority and various small local hydropower plants. Recently, telephone has been accessible in almost all villages of Baglung. Baglung is considered to be one of the politically most conscious districts and it plays a significant role in the Nepali politics.

4.2 Socio – Economic Status of Respondents

4.2.1: Age Structure
Table 4.1: Age of Respondents

Age Group (years)	Frequency	Percentage
Below 20	9	5.29
20-30	19	11.17
30-40	35	20.58
40-50	68	40
50-60	28	16.47
Above 60	11	6.47
Total	170	100

Source: field survey, 2022

The members of every age were not economically active and generate income to their family. The young aged girls are involved in education or household activities such as cooking and taking care of their little brothers and sisters. The members above 60 years are also less active in income generation because they have household responsibility rather than earning. Their sons and their family members are considered as earners. The elderly people take care of their small children at home.

The age distribution ratio of the study area which shows the respondents involved in this program. The highest number of respondents is between the ages of 40-50 years which comprises 40 percent. The age below 20 years constituted 5.29 percent of the total respondents. Similarly, the age between 20-30 years constituted 11.17 percent, between 30-40 years constituted 20.58 percent, between 50-60 years constituted 16.47 percent of the total respondents. At last, the age above 60 years constituted 6.47 percent of the total respondents. Thus, from the above table of the age respondents in the field of agriculture, we can say that the age group 40-50 years are mostly responsible and involved for the agriculture production. The age group is also main factor in the agricultural field. Similarly, the age group 30-40 and 50-60 years are also responsible for agricultural production in this research work.

4.2.2 Sex Structure

The male and female population in cooperative were 60% and 40% respectively as described in the figure 3. The distribution of male and female in cooperatives represented significant involvement of women in cooperative activities although it need to improve more in future. Women involvement in cooperative have also represented, their significance in income generating activities and its possible impact in socio-economic development.

figure 1: Sex Structure

- Male
- Female

Female 36%

Male 64%
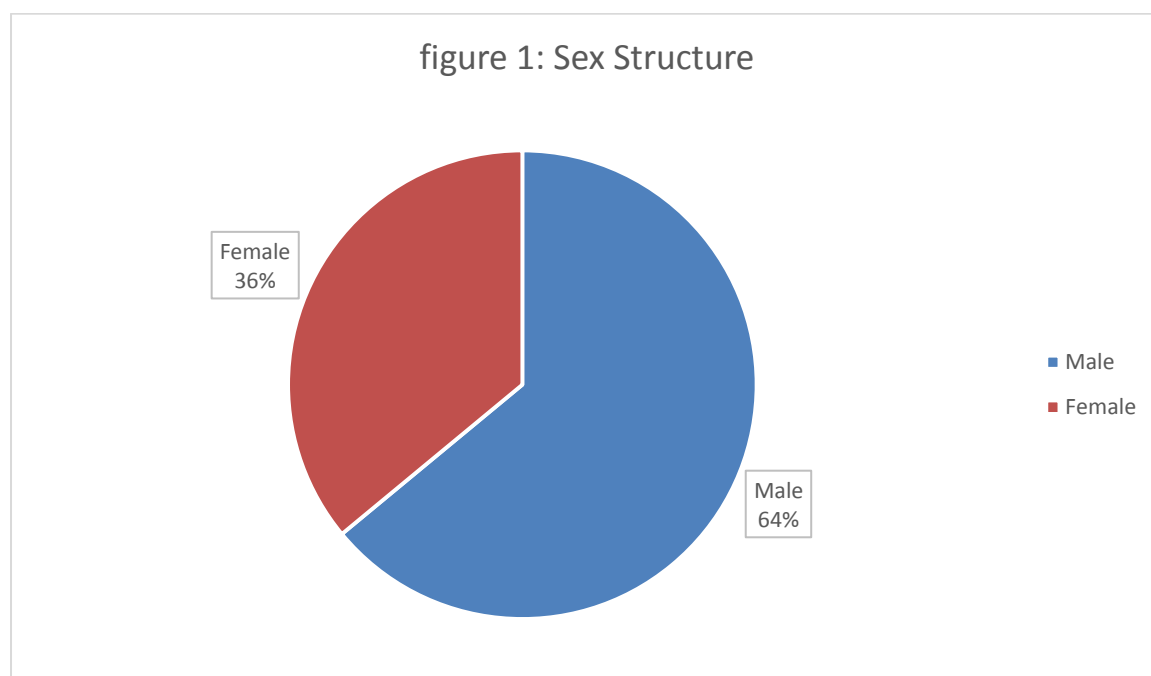
Source: *Field Survey, 2022*

The male and female population in farming were 64% and 36% respectively as described in the figure 3. The distribution of male and female in cooperatives represented significant involvement of women in Farming activities although it need to improve more in future. Women involvement in farming have also represented, their significance in income generating activities and its possible impact in socio-economic development.

4.2.3 Caste and Ethnicity

Nepal has a constitutional monarchy with a multiparty system. There are different cast / ethnic group such as at the time of the 2011 Nepal census, Baglung District had a population of 268,613.Magars are the largest ethnic group with 28.11% of the population. Hill Brahmin are the second largest group with 19.49% of the population. Chhetri are18.62%, Kami 16.04%,5.58% Sarki, Damai 4.71%, Chhantyal 1.5

1%, Thakuri 1.40%   and Newar 1.06%.Of   these,   92.32%   spoke Nepali and 5.45% Magar as their first language. 7.09% of the population spoke Nepali and 0.65% Magar are their second language.

Table 4.2: Distribution of Respondents by Caste/ Ethnicity

Cast / ethnicity	No. of. member	Percent
Brahmin	67	39.41
Chhetri	43	25.29
Kami	35	20.59
Damai	17	10
Thakuri	8	4.71
Total	170	100

Source: Field survey, 2022

The table No. 4.2 show that 39.41% percent of total sample members are Brahmin, followed by Chherti 25.29%, Kami 20.59%, Damai 10% , Thakuri 4.71. The above tables proved that maximum member are Brahmin and minimum member are Thakuri involved in agriculture.

Ethnic distribution of the respondents have represented about the population distribution in this study area along with its distribution in farming practice. It has shown involvement of all ethnic group of people as farmers. From this it can be predicted that people has been working every ethnic group as a farmer in this study area. The Figure 5 stated people Brahmin ethnic group has the highest no followed by Chhetri, Kami, Damai and Thakuri. It has also represented the distribution of ethnic population as per their population in this study area.

4.2.4: Marital Status

Marital status makes differences on members' responsibility and economic as well as agricultural work burden. Implicitly, age group and marital status are found to be affecting factor of the respondents in the case for the involvement in the agricultural field. The marital status of respondents in this research work has been listed below

Table 4.3: Marital Status of Respondents

Marital Status	Number of Respondents	Percentage
Married	134	78.82
Unmarried	27	15.88
Separated	6	3.54
Widow	3	1.76
Total	170	100

Source: Field Survey,2022

The above survey table of marital status of respondents shows that most of the respondents are found married which consists of 78.82 percent. Similarly, 15.88 percent of the total respondents are found unmarried. 3.54 percent and 1.76 percent of the total respondents are separated and widow respectively. This result shows that majority of the members in the sample are married which indicates the married family members are mostly participated in agriculture.

4.2.5: Religion

Different types of religions found in the study area are listed in the following table. Corresponding number of respondents with respective percentages for different religions are shown in the table below.

Table 4.4: Religion of Respondents

Religion	Number of Respondents	Percent
Hindu	149	87.64
Christian	7	4.12
Others	14	8.24

Source: field survey,2022

Above table shows that the most majority of the respondents are Hindu constituting 87.64 percentage of the total respondents. Christian occupied 4.12 percent and other religions occupied 8.24 percent of the total respondents.

4.2.6 Family Size

Most of the respondents are from joint family in which husband and his parents, brothers, wife and their unmarried children live together. They all have expressed burden of responsibility, economy and cultural complexities while living in a joint family. Family size of the selected respondents is presented in the following pie chart.

Figure 2: Family Size
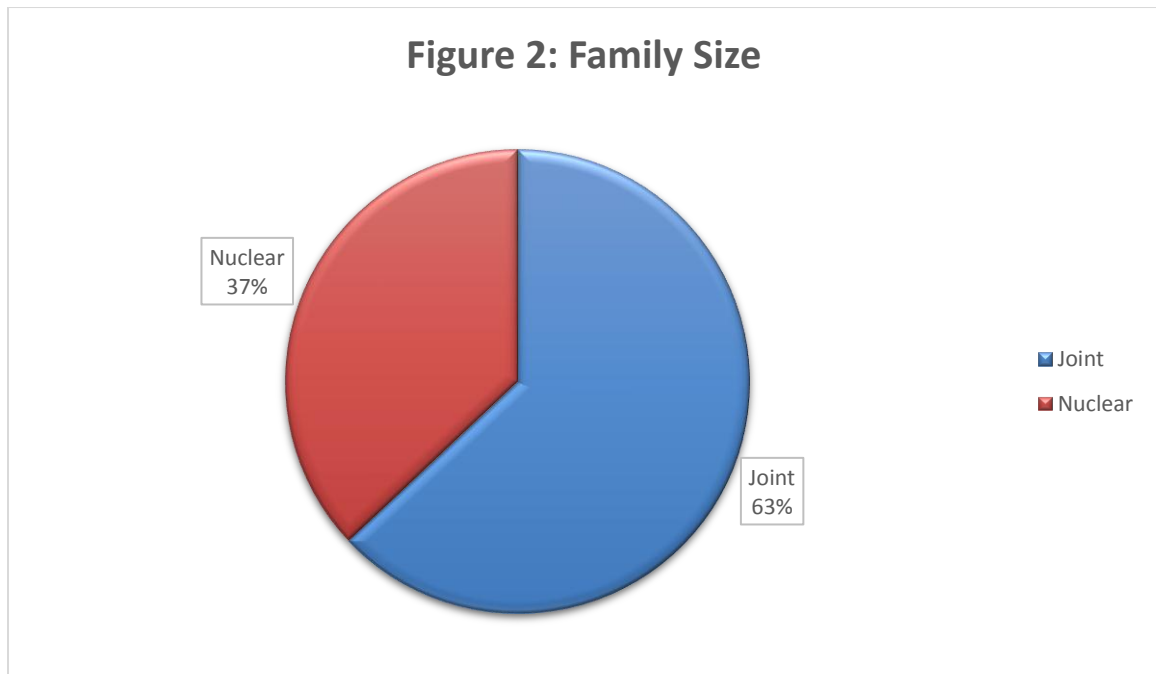
The above chart shows the family types of the resdpondents. The family type also makes differences on decission making and agricultural production. This chart indicates the majority of the respondents are from the joint family with 63% of the total respondents. Only 37 percent of the total respondents are from the nuclear family. This indicates that the family members from the joint family are more responsible in the agricultural production.

4.2.7 Educational Status

Education empowers the human being, as it increases the status of living .Education provides people with the knowledge and skills to contribute and take benefits from development efforts .Education is the key indicator of human development .It has a positive role in the success of life. The main goal of education is to wake up to the bright future. Primary education is a principal mechanism of fulfilling the minimum learning needs of the people needed for effective participation in the economic,social and political activities .

Figure 3: Education of Respondents
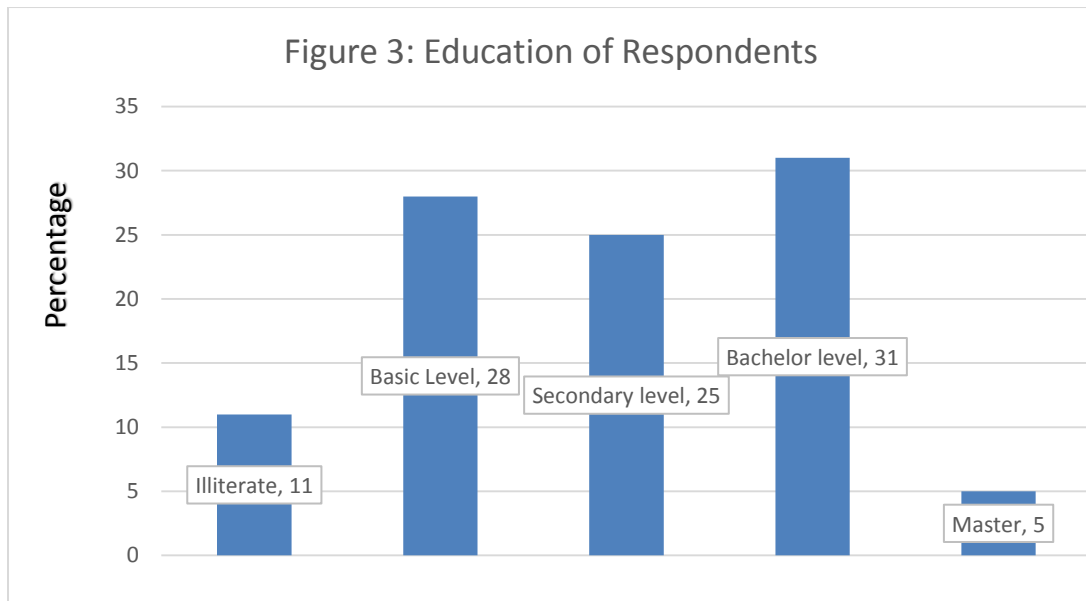
Source: *Field Survey, 2022*

The field research shows that most of the members are educated. About 11 percent of the respondents are illiterate and 89 percent of the respondents are literate. 28 percent of the respondents have the basic level education. Similarly, 25, 31 and 5 percent of the respondents have the secondary, bachelor and master level respectively. This chart also shows that majority of the respondents have the bachelor level education.

4.2.8. Occupation and Economic Status

The occupation and economic status of the respondents in our research field are tabulated as follows. Respondents in this municipality are mostly dependent on agriculture as their main occupation followed by services, business and labor. Out of 170 members 92 have agriculture as their main occupation which indicates about 54.13%. Members involved in service-oriented activities in the municipality as their main occupation are 10.58%. While members doing business and labor as main occupation are 7.64% and 2.35% respectively as in given table below. Remittance (25.29%) is the main part after agriculture for the occupation in the research field

Table 4.5: Occupation and Economic status of Respondents

Occupation	Number	Percentage
Farming	92	54.13%
Service	18	10.58%
Business	13	7.64%
Labor	4	2.35%
Remittance	43	25.29%
Total	170	100%

Source: *Field Survey, 2022*

Above table: 5 shows that 54.13% people engaged in farming which is the highest percentage and 2.35% is the lowest percent people engaged in labor. And 10.58% people engaging in service. And 25.29% people is the second highest depend upon remittance.

4.2.9. Monthly Income

Table 4.6: Monthly income of Respondents

Monthly Income (Rs)	Number	Percent
10,000-20,000	71	41.77
20,000-30,000	47	27.65
30,000-40,000	23	13.53
40,000-50,000	29	17.05
Total	170	100

Source: *Field Survey, 2022*

In concern to the income status of the respondents, the data obtained stated that 41.77% of the members have monthly income ranging from Rs 10,000 to 20,000. Respondents having monthly income Rs 20,000-30,000 are 27.65%, while 13.53% of the members have the lowest monthly income between Rs 30,000 to 40,000 and 17.05 percent have monthly income between Rs. 40,000-50,000.

4.2.10 Monthly expenditure

Table 4.7: Monthly expenditure of Respondents

Monthly Expenditure (Rs)	Number	Percent
10,000-20,000	45	26.47
20,000-30,000	73	42.94
30,000-40,000	30	17.65
40,000-50,000	22	12.94
Total	170	100

Source: Field Survey, 2022

In comparison the monthly expenditure of respondents 20-30 thousand is the highest rank which is 42.94% 73 in the number, and maximum expenditure in the amount is between 40-50 thousand which is 12.94% number is 22. Similarly, least expenditure was done by 45 respondents which is 26.47% amount is between10-20 thousand.

4.2.11 Training taken by Respondents

Figure 4: Trainning of Respondents

[PERCENTAGE]
[PERCENTAGE]
[PERCENTAGE]

Legend: Agriculture related, Animal rearing, No trainning
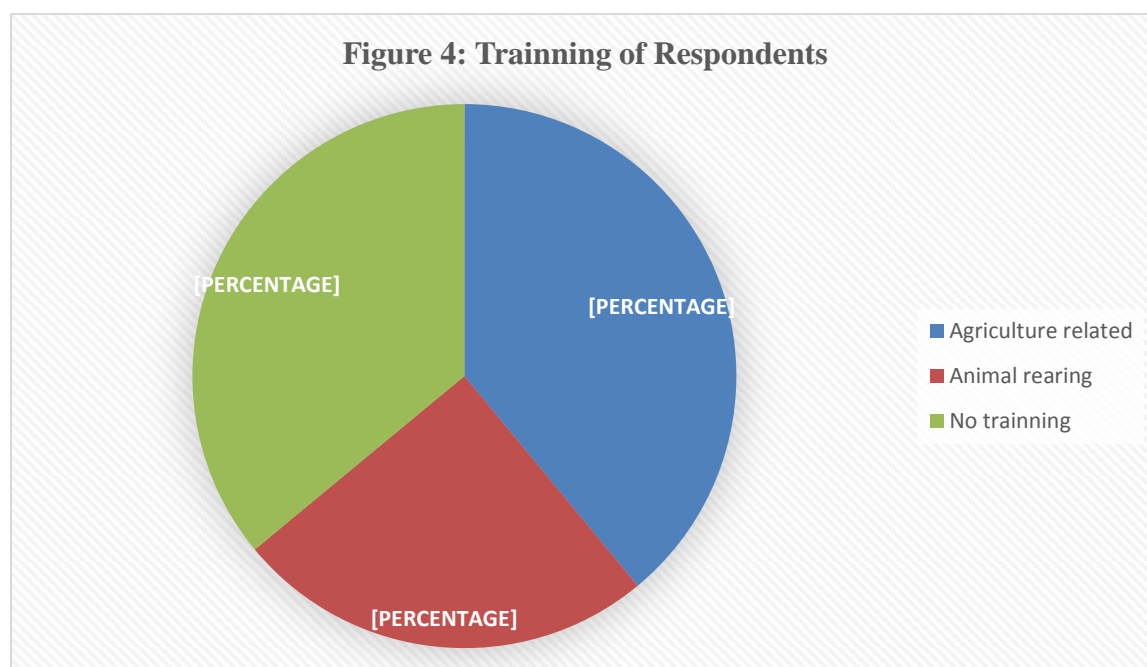
Source: *Field Survey, 2022*

This pie chart shows that 39% of respondents took agriculture related training, 25% took animal rearing training and 36% respondents did not take any training.

4.3 Agriculture Pattern

4.3.1 Agriculture Practice in Study Area

Khet, Bari, pastureland and private forest are the main using land of this area. Most of the respondents have 38.26% bari followed by khet 17.03%, 13.69% Private forest and others about 31.02%. On the lower area of this municipality there is mostly khet. On khet farmers produce paddy, maize, Tomato and millet. In the middle area of this municipality there is bari where farmers produce maize, millet, ginger, potato etc. On the upper area we can see forest and pasture land. Present private land use system of this area is given below.

Table 4.8: Private Land Use System of the Respondents

Type of Land	Area (Ropani)	Percentage
Khet	895	27.22
Bari	1258	38.26
Pasture land	250	7.60
Private Forest	450	13.69
Others	425	12.93
Total	3288	100.00

Source: *Field Survey, 2022*

4.3.2: Main Cultivation of Respondents

Table 4.9: Main cultivation of respondents

Main Cultivation	Frequency	Percentage
Crops	91	53.5
Vegetables	12	7.00
Oil seeds / pulses	13	7.00
Cash crops	20	12
Fruits	1o	6
Animals rearing	23	13.5
Total	170	100

Source: *Field Survey, 2022*

The main cultivations in the study area of Baglung district are crops, vegetables, oil seeds/ pulses, cash crops, fruits and animal rearing. Most of the respondents about 53.52% cultivates crops as in our country. The cultivation of animals rearing, cash crops, fruits, vegetables and pulses is in decreasing percentage as shown in the above table. Only 6% of the total respondents are involved fruits cultivation.

4.3.3: Use of Modern Agro-technology

Table 4.10: Use of Modern Agro-technology

Agro Technology	Frequency	Percentage
Modern	128	75.3
Traditional	42	24.7
Total	170	100

Source: *Field Survey, 2022*

Use of modern technology in the field of agriculture is the main factor which may cause the change in agricultural production. Modern technology makes the system of cultivation more easier in most of the field. So, we take the data of the respondents using the modern and traditional technology in the agricultural production. In the last year, use of modern technology is in increasing order. From the above table of respondents, it is found that about third-fourth of the respondents are using modern technology.

4.3.4: Use of Fertilizer

Table 4.11: Use of fertilizer

Fertilizer	Frequency	Percentage
Green	25	14.7
Chemical	45	26.5
Both	100	58.8
Total	170	100

Source: *Field Survey, 2022*

Use of fertilizers is the main key in the agricultural production. Most of the respondents about 58.8% are using both the fertilizers: green and chemical fertilizers. Nowadays, the use of green fertilizer is decreasing and the use of chemical fertilizer is increasing. Only 14.7% of the total respondents are using only the green fertilizer as shown in the above table.

4.3.5 Use of Pesticides

About 5-6 years ago, chemical fertilizer and pesticides used in this area was in high level and quantity of organic fertilizer was less. Nowadays the quantity of chemical fertilizer and pesticides is decreasing due to aware about the health and using bio fertilizer and pesticides by livestock. Some of commercials farmers are using chemical

fertilizer for increase production. Mainly they are using chemical fertilizer and pesticides on potato, zinger, akabare, maize, mustard and vegetables.

4.3.6: Crop Production Trend

According to ward profile 2066, about 54% private land is suitable for agriculture accept settlement. The production rate of some crops is increasing whereas most of crop's production is going to decrease.

Cereal Crop Production Comparison

Paddy, maize, and millet are the main cereal crops produced by farmers of this ward. Crop production trend of this area is going to decreasing from last ten years. Crop production trend of previous year and this year is given following.

Table 4.12: Cereal Crop Production in the Previous Year and this Year

Crops	Increasing		Decreasing	
	Frequency	percent	Frequency	percent
Paddy	119	70	51	30
Wheat	101	59	69	41
Maize	79	46	91	54
Millet	76	45	94	55
Others	87	51	83	49

Source: *Field Survey, 2022*

From above data we can see the production trend of paddy and wheat is slightly increased but others production rate is decreasing.

Cash Crop Production Comparison

Zinger, Potato, Orange and Akabare clly are the main cash crops produced by farmers of this VDC. Production rate of cash crop form last ten years is decreasing due to many diseases and climate change. Some cash crop is increasing than previous crop trend because some of the respondents are using bio fertilizer and manure Comparison of cash crop production from previous year is given in the following table.

Table 4.13: Cash Crops Production Comparison

Crops	Increasing		Decreasing	
	Frequency	percent	Frequency	Percent
Potato	65	38	105	62
Orange	40	23.5	130	76.5
Ginger	76	45	94	55
Tomato	55	32	115	68
Akabare	67	39	103	33
Others	57	33.5	113	43

Source*: Field Survey, 2022*

Above table-16, shows that there is vast difference in production of cashcrops from previous year to this year. There is vast difference in orange. Most of the plants of orange were decayed due to many disease like; phurse, rate, etc. and unavailability of sufficient water. Tomato and Akabare chiily crop is increasing due to increasing market demend.

4.3.7: Vegetable Production

Cauliflower, Cabbage, carrot, peas, pumpkins, cucumber, Green vegetable etc. are main vegetables produced by the farmers of this area. Nowadays the production of vegetables are also going to decrease due to many diseases, insufficient of irrigation, loss of soil quality.

4.4: Climate Change Pattern

4.4.1: Climate Change Assessment

Table 4.14: Assessment of Climate Change

Feel	Frequency	Percentage
Yes	100	58.8
No	70	41.2
Total	170	100

Source: *Field Survey, 2022*

Climate change is another factor which causes different effects on the different sectors. We can feel the change in climate. From the above table it has been found that

the most of the respondents about 58.8% of the total respondents are feeling change in climate. Also, about 41.2% of the total respondents are not feeling the climate change.

4.4.2: Change Analysis of Secondary Data

The statistical analysis of average temperature, average rainfall and average productivity for last 9 years (using hydrological data from 2012 to 2021) in Baglung district was done using central tendency parameters i.e. (mean and median) and the dispersion of data from mean was done using standard deviation and coefficient of variance as shown in table 4.1.1. We used SPSS for our descriptive analysis from which we obtained the minimum, maximum, and mean values, standard deviation and coefficient of variation for different variables in different districts.

Table 4.15: Descriptive analysis of climatic factors and agricultural production

District		Min.	Max.	Mean	SD	CV(%)
	Temperature (^{0}C)	21.80	23.20	22.45	0.41	1.83
Baglung	Rainfall (mm)	1150.50	1999.00	1708.09	276.63	16.20
	Productivity (Kg/ha)	2100.00	2670.00	2392.22	170.01	7.11

Source: *Meteorology Depart, 2022*

In the last 9 years (2012 to 2021), the maximum temperature in Bgalung was 23.20^0 C and minimum was 21.80^0 C. Similarly, the productivity was maximum (2670 Kg/ha) and minimum (2100 Kg/ha) in Baglung. The fluctuations occurred in temperature, rainfall and productivity in Baglung. The coefficient of variance was maximum in rainfall and minimum in temperature. Hence, fluctuations in rainfall in each year was maximum.

4.4.3: Correlation and Regression Analysis

The correlation obtained for the different variables in this district is shown in table 19 below. From this table we also obtained the significance of our calculations

Table 4.16: Correlation matrix between maize productivity and climatic factors.

District			Pro. (Kg/ha)	Tempr. (^{0}C)	Rain. (mm)
	Pro. (Kg/ha)	Correlation	1	0.179	-0.372
		Sig.(2-tailed)		0.645	0.324
		N	9	9	9
	Tempr. (^{0}C)	Correlation	0.179	1	-0.511
Baglung		Sig.(2-tailed)	0.645		0.159
		N	9	9	9
	Rain. (mm)	Correlation	-0.372	-0.511	1
		Sig.(2-tailed)	0.324	0.159	
		N	9	9	9

Source: *Meteorology Depart, 2022*

This table shows that the correlation between productivity and rainfall in Baglung district is -0.372 which means that rainfall is negatively correlated with the productivity. That is, productivity increases with the decrease in rainfall and vice versa. Similarly, the productivity and temperature are positively correlated with the value o.179 whereas temperature and rainfall are negatively correlated with the value -0.511 (significant at 5% level of significance) which indicates strong correlation. Thus, temperature decreases with the increase in rainfall in Baglung.

Thus, increase in temperature is good for the main crops as the average temperature of this district lies between 19^0C and 26^0C which is within the best temperature for main crops (18-30 ^{0}C). The temperature below and above this rank highly affects the agricultural production. The level of significance is high as there are so many other factors such as use of seed, chemical fertilizers, irrigation etc. which affects in productivity that we did not care in our work. Thus, to increase the production in turn productivity for the food security, other input factors should be applied to decrease the adverse effects of climatic factors. For example, irrigation facilities decrease the drought caused by increase in temperature and decrease in rainfall. Insects and pests increase with the increase in temperature which decrease the productivity that can be reduced by using pesticides and insecticides.

Linear regression analysis was done for the calculation of the constants and coefficients of temperature and rainfall for the future prediction of productivity.

Table 4.17: Regression Analysis

District	Model	Coefficients	SE
	Constant	2936.088	4395.497
Baglung	Temperature (T)	-0.233	0.271
	Rainfall (R)	-6.459	184.380

Source: *Meteorology Department, 2021*

From the regression analysis (above table 20, the equation for the future prediction of productivity in Baglung district can be written as,

For Baglung district,

$$P = 2936.088 – 0.233T - 6.459R$$

This equation is mathematical prediction which is valid only for the certain limits. This means finite values of temperature and rainfall should be there for the production and other factors are considered as constant. For example, equation gives 2936.088 Kg/ha at 0^0C temperature and 0 mm rainfall which is impossible in reality. Crops can not germinate and grow at these conditions. Thus, this equation is only mathematical prediction and physically there are certain.

4.4.4: Trend Analysis

In this study, trend analysis of the climatic factors and productivity of maize in was Baglung done by using linear regression analysis technique.

Trend Analysis of Temperature

The trend analysis of temperature in Baglung was calculated individually which is shown in figure 7 The straight lines represent the observed value of average temperature in different fiscal year for different districts and dashed lines are their trends.

Figure 5: Trend analysis of temperature
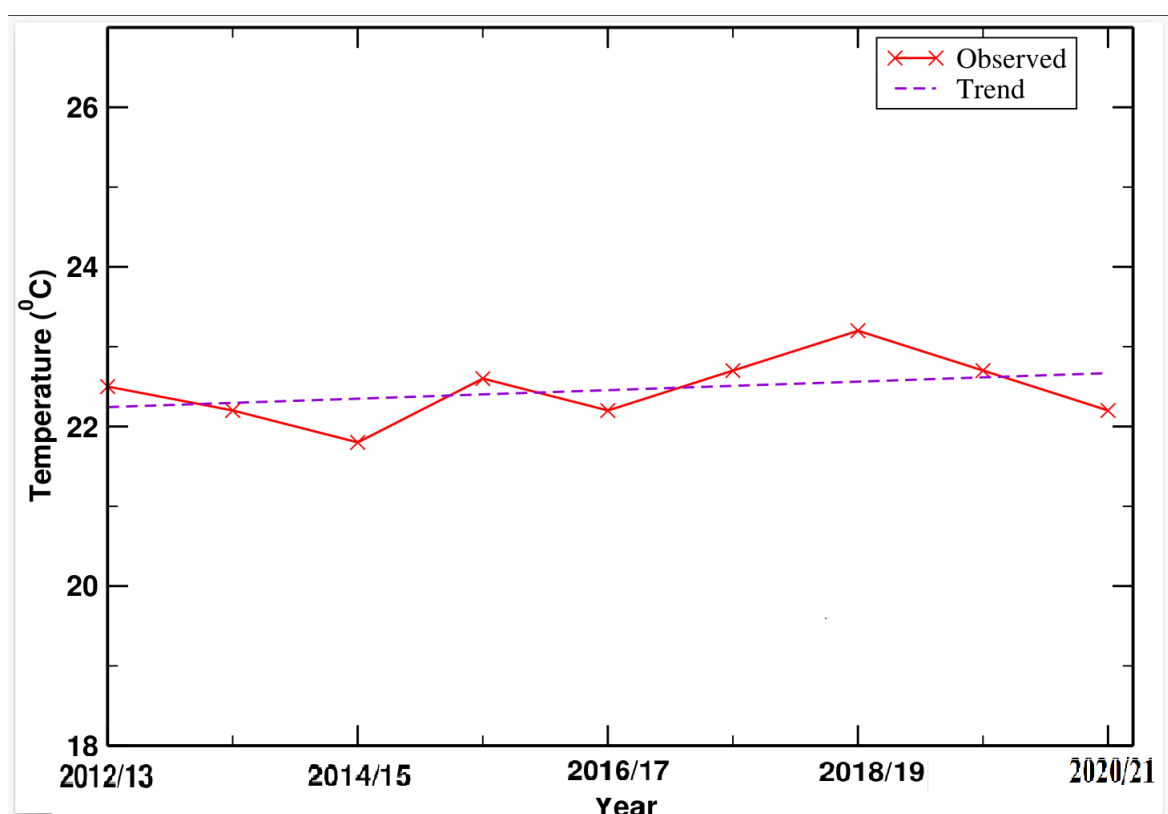
Source: *Meteorology Department, 2022*

The temperature of Baglung district seen highest in fiscal year 2028/18 while lowest was seen in the fiscal year 2014/15 in 9 years period of time from 2012/13 to 2020/21. This indicates that the change in temperature does not follow neither increasing trend nor decreasing trend.

Trend Analysis of Rainfall

The variation of rainfall on yearly basis data is calculated individually for Baglung district by using linear regression. The trend of rainfall in this district in 9 years (2012/13-2020/21) is shown in figure 8. The straight lines represent the observed value of average rainfall in different fiscal year for Baglung districts and dashed lines are the trends of rainfall.

Fig 6: Trend Analysis of Rainfall
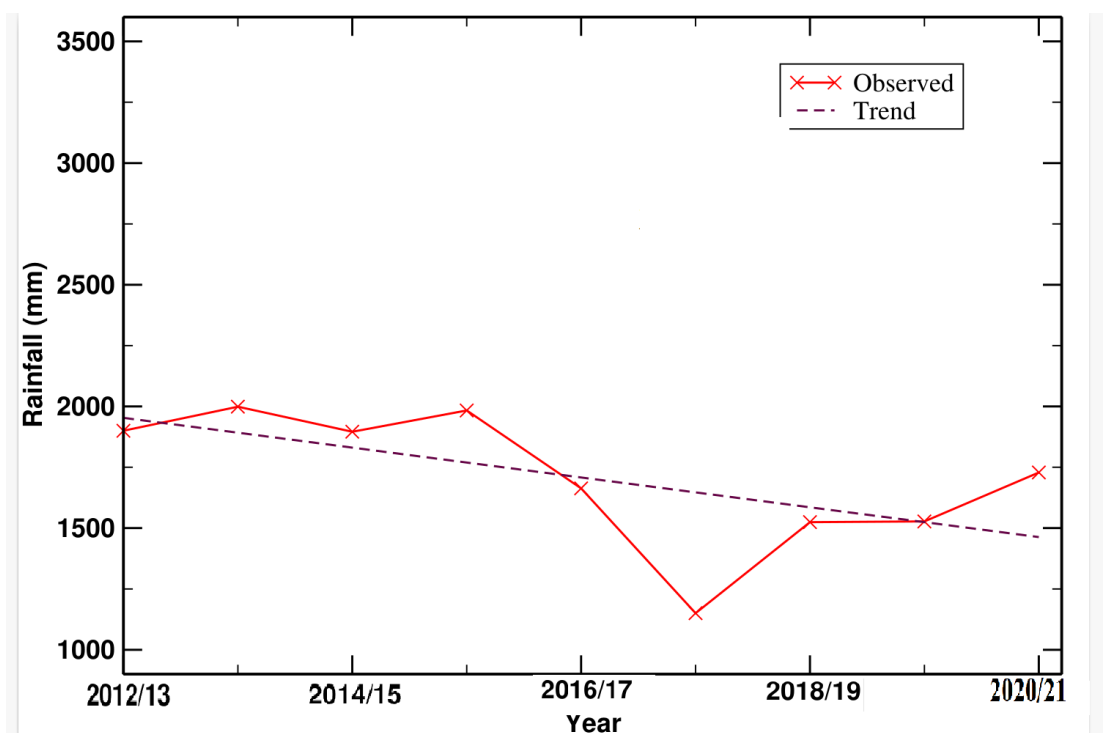
Source: *Meteorology Department, 2022*

There was highly increase in rainfall in 2013/14 in Baglung district. The rainfall was maximum in 2012/13 in Baglung. The rainfall was very less in 2015/16 in Baglung. The rainfall showed the decreasing trend in the Baglung.

4.5: Impact of Climate Change in Agriculture

4.5.1: Climate Change Effects in Agriculture

Table 4.18: Climate Change Effects in Agriculture

Effect of climate change	Frequency	Percentage
Fluctuation in production	90	52.9
Change in cultivation time	30	17.6
Don't know	50	29.5
Total	170	100

Source: *Field Survey, 2022*

With the climate change the agricultural production is changed. Change in climatic factors like temperature, rainfall etc. causes the change in the agricultural production. Most of the respondents about 52.9% feel that fluctuation i production is effect of climate change in agriculture. Similarly, 17.6% respondents feel that change in cultivation time and 29.5% of the total respondents feel no effect in the agriculture and don't know about the effect of climate change in the agricultural production.

4.5.2: Changing Agricultural Practice

Table 4.19: Changing Agriculture Practice

Agriculture practices	Before		After	
	Frequency	Percentage	Frequency	Percentage
Crops farming	90	53	78	46
Cash crops	36	21.2	51	30
Animal raring	44	25.8	41	24
Total	170	100	170	100

Source: *Field Survey, 2022*

Due to the effect of climate change in the agricultural production, farmers are changing their type and way of cultivation. Above table shows that about 7 percent of the respondents are changing the crops farming practice in the study area of Baglung district. Whereas, 8.2 % of the respondents are increased in cash crops farming. Percentage of Respondents are nearly same before and after who were involved in animal rearing district.

4.5.3 Impact Analysis of Productivity of Crops

The trend of the productivity of maize for 9 years (2012/2013-2020/21) was calculated and obtained individually as shown in figure 9. The straight lines represent the observed value of average productivity of crops in different fiscal year for Baglung district and dashed lie are the trend of crops productivity.

Figure 7: Trend Analysis of Productivity
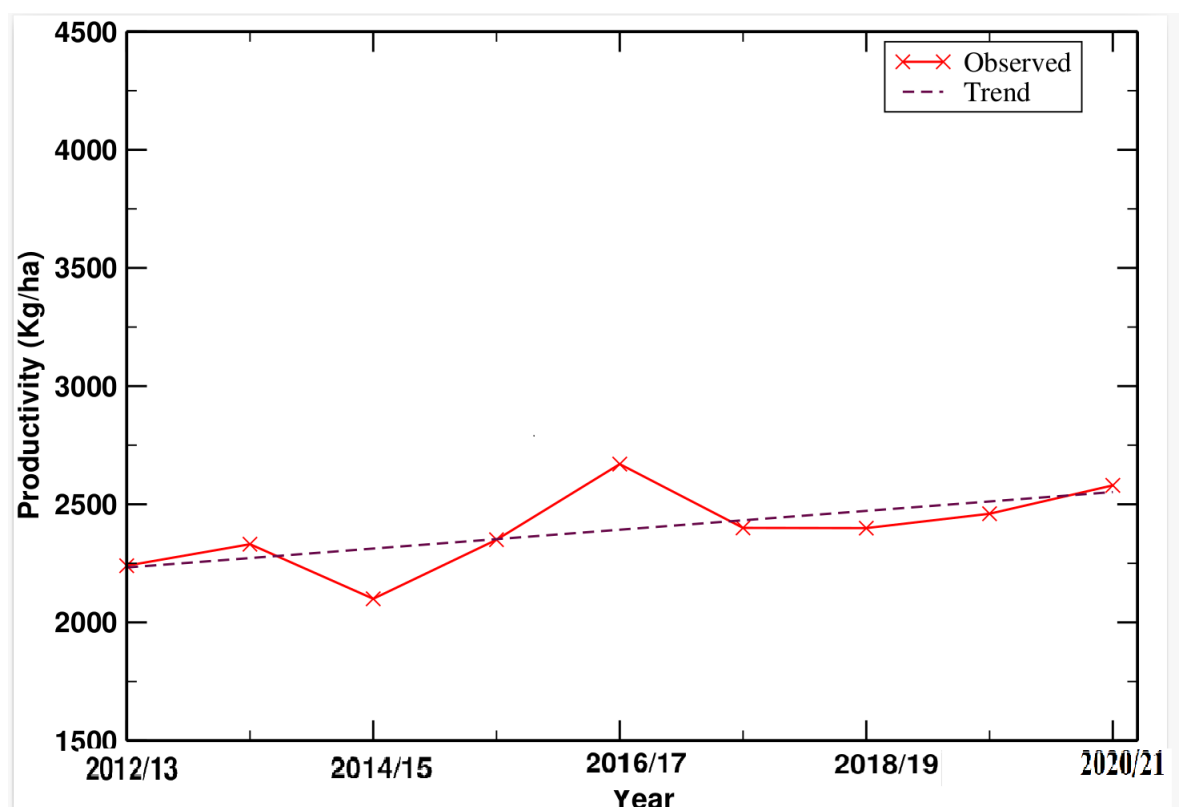
Source: *Meteorology Department, 2022*

The productivity of crops in Baglung district showed the increasing trend. However, fluctuations occurred in individual years. The productivity increased in 2016/17 and decreased in 2014/15 in Baglung district. The productivity of crops gradually increased in last three years (2018/19-2020/21) in Baglung district.

4.6: KII Analysis

KII was done with help of KII checklists (Anex II) with Agriculture officer of Baglung district, ward chairperson, JTA and 3 old farmer of ward no.12. It is found that temperature is slightly increasing. And the pattern of rain fail is irregular. Some of the crops are in increasing most of the crops are decreasing pattern such as maize in increasing but the main crops paddy and millet is more decreasing as comparison to previous different years. The KII respondents said that farmers are decreasing in crops farming while they are attracted to cash crops and horticulture. For the adaptation and mitigation of the climate change they implemented to use modern technology and hybrid seeds crops. It is found that they have suggested to change subsistence farming to commercial farming such like changing paddy to fruits. For the mitigation replacing pesticide by organic manure, afforestation as well.

During KII Local government and technician's respondents are trying to remove disaster of climate change through formulating and implementing adaptation and mitigation methods such as afforestation , motivating to use organic manure and suggesting new varieties of seeds which can adapt with changing environment. The farmers of this study were dilemma what to do to cope with changing environment. They were tried to change different agriculture practices such as cattle farming and cash crops. But their attempt did not gain faith to solve problem of climate change.

Due to climate change the production and employment in the agriculture is decreasing. This ultimately decreasing the income of the farmers. Most of farmer. As most of the farmers have left farming and are attracted to jobs and foreign employment, there is bare land in the village.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATION

5.1: Summary

Nepal is a beautiful, landlocked and agriculture based country. National economy is based on agriculture profession of Nepalese people. More than 60 percent population has been engaging of agriculture for their livelihood and it contributes about 26 percent gross domestic products of Nepal. Geographical distribution of Nepal is varies on three region, ie. Terai, Hills and Mountains. Terai and hills are suitable for crop production due to climate condition. Terai is suitable cereal crop lower hill is suitable for cash crop and vegetable production. Himalaya region is suitable for livestock production and herbal cultivation.

This study presents the effects of climatic variability on the staple crop in Nepal. The adverse effects of climatic factors on the cereal crops is the main issue in the near future in developing countries like Nepal. The temperature and rainfall are the main climatic factors affecting the productivity. Global warming and change in weather affect the productivity. For the food security, production should be increased which is possible only due to increase in productivity as there is certain limit of area to use for agriculture. The cereal crops productivity correlated either positively or negatively with the climatic variability (mainly temperature and rainfall) in the different season. The effects of these factors are different in different region. Seasonal crops are affected differently by these factors. So, to increase the productivity of cereals like rice, maize, etc. the farmers should aware about the climatic conditions, and they should design the plan for cultivating time and other input factors to increase the productivity.

About 54.13% people are depending on agriculture for their livelihood. Agriculture and animal husbandry is their traditional occupation. Agriculture and animal husbandry are interrelated to each other, so they use animal residue for agriculture as a fertilizer and agricultural residue for animal's fodder. Agricultural system of this area is in transitional phase i.e. mixture of traditional and modern farming system. Most of the farmers of this area is practicing only subsistence farming. From 9 years analysis of rainfall there is slightly change in rainfall system

per year. The sum of minimum annual rainfall was recorded 1155 mm in 2017. The sum of maximum annual rainfall was recorded in 2015 about 1999 mm. Mean rainfall of monsoon is also not same there is also difference in rainfall. From data analysis of temperature the warmest year was 2018 about 23.2^{o}c maximum mean temperature was recorded on that year and coldest year was 2014 about 21.8^{o}c minimum annual temperature was recorded on that year. As a whole analysis of above data about 0.3c temperature is increase in every 9 years.

The effects of the climatic factors can be reduced by using and increasing the other input fac-tors. For example, irrigation facilities reduce the effect of drought in the production. There is a gap in the productivity of cereals between Nepal and neighbor developed countries. So, use of modern technologies, use of fertilizer in proper time, insecticides and pesticides, use of modern and hybrid seed etc. should be applied and government should make the policies to aware and encourage the farmers to increase the productivity. Increase in productivity helps to increase food security and economic condition in our country.

The present study is an attempt to analyze the impact of climate change on agricultural system of Baglung-12. From the forgoing discussion, it is clear that the agriculture is the primary occupation of this region. Although business and service (job) is also occupation of some people but agriculture and animal husbandry is major and prominent occupation for their livelihood. Geographical condition, climate, soil type and land use system also helps to agriculture for this area and there is no any infrastructure for alternative source of income.

5.2 Conclusion

From this study it is found that about 54.13% people are depending on agriculture for their livelihood. Agriculture and animal husbandry is their traditional occupation. Agricultural system of this area is in transitional phase i.e. mixture of traditional and modern farming system. Most of the farmers of this area is practicing only subsistence farming. From 9 years analysis of rainfall there is slightly change in rainfall system per year. The sum of minimum annual rainfall was recorded 1155 mm in 2017. The sum of maximum annual rainfall was recorded in 2015 about 1999 mm. Mean rainfall of monsoon is also not same there is also difference in rainfall. From data analysis of temperature the warmest year was 2018 about 23.2^{o}c maximum mean

temperature was recorded on that year and coldest year was 2014 about $21.8^{o}c$ minimum annual temperature was recorded on that year. As a whole analysis of above data about 0.3c temperature is increase in every 9 years.

Climatic parameters (rainfall and temperature), quality of soil, using pattern of fertilizer and pesticides, quality of seeds also affecting the agricultural (farming) system of study area. Production of some cereal crops is decreasing due to soil quality, use of chemical fertilizer and pesticides, many disease problems and quality of seeds. Production of cash crops is also decreasing due to many climatic problems, quality of soil, and air borne disease.

5.3 Recommendations

In the near future, we wish to research more about the cereal's productivity, climatic and other factors affecting the productivity in different districts with the collaboration with some national and international supporting organizations. We will conduct the awareness program to increase the productivity and hence production of agricultural products. Also, the data analysis may be useful for the agricultural and environmental organizations to study the possibilities of agriculture in different districts in Nepal for the economic improvement and food security in the near future. Moreover, this type of study could be helpful in making plan in agriculture with the study of climatic factors affecting agriculture.

In this study, the following recommendations have been made on the basis of findings. These recommendations may be useful for the future researcher, local farmer and policy makers on the local level and national level.

- Most of the people in this area are engaged in agriculture and most of them know about climate change. There is a necessity to make them additional aware about climate change.

- The traditional pattern of agricultural system in this area should be modernized by using modern tools, technology and highly productive crops and healthy seeds.

- Local people in this area should conserve the natural resources, sources of water because availability of natural resources also helps to agricultural system of any region.

- Government of Nepal and related agencies must be promoted to the local farmers for alternative source of income and new farming system for this area.

- Crops plant of this area is decayed due to many diseases like: phurse, dhurse etc. So the district agriculture office should help to provide new seed and should give subsidy for crops plantation.

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Annex-I

Questionnaire for HHs Survey

Questionnaire

Name of the respondent: Code no:

    date:

Group A: Demographic and socio-economic information

1. Adress: District …………………. Municipality……………….. Ward No:.......................

2. Age:..........................

3. Sex: male ☐   female ☐   other ☐

4. Marital Status: single ☐   married ☐   Divorce ☐   W☐ed   ☐
        separated

5. Religion: Hindu ☐   Buddha ☐   Christian ☐   Muslim ☐

6. Caste: Brahmin ☐   Kshetri ☐   Janajati ☐   Dalit ☐

7. Family System: Joint family ☐   Nuclear Fam ☐

8. Education: …………………………………….☐   ☐

9. Training: a. Capacity development training b. skill development training c. no training ☐

10. Family Occupation: Agriculture ☐   govt. job   business ☐   private ☐
    job   Remittance ☐   other ☐

11. Monthly family income:

51

12. Monthly expenditure:

Group B: Agro Development Practices

13. Can you please give me information about your land?

Kind of land	Area (Ropani)
Khet	
Bari	
Pasture land	
Forest	

14. What are your main cultivation?

a. crops   b. vegetable   c. oilseeds/pulses   d. cash crops   e.

fruits   f. animal rearing

15. Do you use modern agro-technology?

a. yes   b. no

16. What sorts of manure are you using?

a. green manure   b. chemical manure   c. both

17. Crop Production Comparison between past year and this year.

Kind of Crops	increasing	Decreasing
Paddy		
Wheat		
Maize		
Millet		
Others		

18. Do you know any climatic changes in the following cases from last ten years?

Parameters	Increasing	Decreasing	Same	Do not Know
Temperature				
Rainfall				
Humidity				

19. Do you think these parameters have impact in your agricultural production?

    a. Yes   b. No   c. Don't know

20. Do you change your agricultural practice due to change of climate pattern?

    a. Yes   b. No

Thank You!

Annex-II

Key Informant Interview (KII) guidelines

KII Respondents Table

Post and Status of Respondents	Number	Name of Respondents
Agriculture Officer	1	Basanta Paudel
Ward Chairperson	1	Kopilamani Chapagai
JTA	1	Badri Sharma
Old Farmer	3	Laxmi Datta Padhya Prem Bahadur BK Phadindra Chhetri

Part One: Introduction

Namaste,

This study is concerned with Empact of Climate Change in Baglung Municipality- 12, Baglung.

Here is the list of subjects that the interview is concerned.

1. Please be aware that all responses will be kept anonymous and used solely for academic purposes. Every respondent's viewpoint is appreciated equally.

2. You have the option of answering or not answering the questions during the interview procedure.

3. The response will only be used for academic purposes.

4. If you don't want to answer a question, let me know so I can move on to the next.

5. Please let me know if you do not want to continue the interview so I may halt it.

6. You play a crucial role in this study since the information you provide will be used to determine its outcome.

7. The study is meant to be useful in identifying problems, obstacles, and recommendations for Empact of Climate Change.

8. We kindly ask you to join in this study by taking the interview.

Part Two: Individual Details

1. Name: ....

2. Designation: ....

3. Name of the Organization: ....

Part Three: Questions Related to Research

1. How do you feel about the increasing or decreasing temperature as comparison to previous to this year?

2. What about the pattern of rain fail weather increasing or decreasing?

3. What may be the cause of changing in crops?

4. What will be the adaptation and mitigation for this condition with your suitable views and ideas?

Annex-III

Sample size determination

TABLE 1
Table for Determining Sample Size from a Given Population

N	S	N	S	N	S
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	1000000	384

Note.—*N* is population size.
S is sample size.

Source: Krejcie & Morgan, (1970)

Data from meteorology Department

Table 1: Average Temperature (in c)

Fiscal year	Baglung
2012/13	22.5
2013/14	22.2
2014/15	21.8
2015/16	22.6
2016/17	22.2
2017/18	22.7
2018/19	23.2
2019/20	22.7
2020/21	22.2

Table 2: Average Rainfall (in mm)

Fiscal year	Baglung
2012/13	1900
2013/14	1999
2014/15	1896
2015/16	1983.4
2016/17	1663.3
2017/18	1150.5
2018/19	1524.6
2019/20	1527.4
2020/21	1728.6

Table 3: Average Productivity (in kg/ha)

Fincal year	Baglung
2012/13	2240
2013/14	2331
2014/15	2100
2015/16	2350
2016/17	2670
2017/18	2400
2018/19	2399
2019/20	2460
2020/21	2580