Comparative Study of Three Indigenous Communities about Indigenous Traditional Knowledge in Agricultural Practices to Combat Climate Change Effects

(Study based on three ecological regions in Nepal)

Sagarika Bhatta

Kathmandu, Nepal

Abstract: This paper deals with the role of Indigenous Traditional Knowledge in an agricultural system of locally evolved practices that are used by the Indigenous communities in three climatic zones in Western region of Nepal. The intent of the paper is to highlight the importance of Indigenous Traditional Knowledge in agriculture and its role in adaptation to Climate Change. All primary and secondary data were collected and verified. Data and information were collected using PRA tools application in field. Dunnai, Bhallacha and Shivapur of Dolpa, Rukum and Bardia district respectively were selected as the survey site because these represent (i) different agricultural activities, (ii) the demographic and social settings are very different iii) presence of indigenous community and iv) ranked as vulnerable to Climate Change(NAPA 2010). During interaction with people, government authorities and stakeholders who compared their traditional agricultural practices with modern farming while most of the farmers agreed Indigenous Traditional Knowledge is the best way to adopt. It is farmer oriented and evolved by the farmers. Modern technologies are developed by researchers and often not suited to the local environment. Aiming to promote through mainstreaming media, few articles were published, promoted through social media and documentary was made out of the basic concept from three regions. The training programs for extension workers, regional research, awareness among the farmers on the role of Indigenous Traditional Knowledge in agricultural for adaptation is very necessary in the context of Nepal.Key words: Climate Change, Indigenous Traditional Knowledge

I.INTRODOCTION

The impacts of Climate Change are more pronounced in agricultural systems. Erratic climatic pattern, rainfall, unprecedented fluctuations in annual temperature and pest outbreaks affects agricultural productivity. Stopping the cause of Climate Change in beyond the scope of farmers they nevertheless can adapt to farming practices to an extent that minimizes the potential productivity losses in Nepal. Climate Change impacts have affected the livelihood of rural farmers. To some extent rural farmers have leveraged their indigenous knowledge to adapt to the changes. Indigenous Traditional Knowledge is the acquired knowledge of indigenous peoples through time and space. The two types of Indigenous Tradition Knowledge, namely Indigenous Traditional Knowledge as technology and indigenous traditional knowledge as cognitive facilitator of development (Varte, 2012).

Indigenous practices though have contributed to limit the impact of changing climate, lack of proper documentation and promotion of these practices hinders in evaluating their effectiveness and transferring the knowledge.

OBJECTIVES OF THE STUDY

- To explore, understand and identify the effects of Climate Change and Indigenous Traditional Knowledge used in agricultural practices to combat Climate Change effects in the three climatic zones of Nepal.
- To document identified issues, knowledge, skills and ways to sustain ITK within the community.
- To promote Indigenous Traditional Knowledge as solution to Climate Change on agricultural practices through mainstreaming media

II. METHODS OF DATA COLLECTION

Qualitative research methods focus on discovering and understanding the experiences, perspectives, and thoughts of participants—that is, qualitative research explores meaning, purpose, or reality (Denzin & Lincoln, 2005). For primary qualitative data collection PRA tools was used during the research period.

Sampling frame: The households containing Indigenous communities in the wards of VDC's were the sampling sites.

Inclusion criteria: The households out of total within the wards of VDC's which contained indigenous people who are involved in agriculture were included.

Sampling method: A simple random sampling of the total household was done to select the households to be surveyed because the population was homogenous.

Sample size: The sample size was taken from 15% (20 households in Dunnai), 26 % (20 household in Bhallacha and 11% (20 household in Shivapur) of the total number of households. Here, n= 20 households and the Total household, N= 130 (wards of Dunnai), 75(wards of Bhallacha), 182 (wards Shivapur). Following equation was applied to obtain an estimated sample size.

p = 1- N-1 / N× N-2 / N-1.....N-n/N- (n-1)

p = 1- N-n/N

P = n/N

PRIMARY DATA COLLECTION

Primary data and information was collected through field visit, questionnaire survey and key informants interview (KII), Focal Group Discussions (FGDs).

- **Mapping and modeling**- The first step in the research was mapping and modeling. It was used to obtain spatial information of the area. Information gathered helped to verify the information on the sketch map. A transect through an area with local informants helped to learn different condition, problems of the area, environment, agriculture, social and economic condition, changes in environment.

- **Questionnaire Survey**

  Based on the no of households in the VDC's, sample size was determined. In order to generate reliable and valid data and minimize errors, a probability technique was applied to determine the sample size.

- **Semi Structured interview-** The individual interview-representative information about the Climate Change and Indigenous Traditional Knowledge from individual informants including people from CBO"s NGO's and VDC's was collected from all three places.

- **The key informant interview**- specialized information from one or group of persons about the Climate Change and ITK. The interviews were carried out with government authorities for depth knowledge about the place and practices.

- **Focus Group Discussion** -It was useful for obtaining general information about the past and present situation, the different in climatic condition and method used for adapting it during FGD's.

- **Seasonal calendar**- A seasonal calendar helped present large quantities of diverse information in a common time frame. These yearly cycles are important in determining the change in the situation, impact due to Climate Change and their adaptation techniques. Information collected during the drawing of the seasonal calendar is very rich, not only in terms of what is put down by the community, but also in what comes out from the discussions during the process.

SECONDARY DATA

Secondary data was collected from the relevant journals, magazine articles, books, web site, thesis reports, and official records.

III. RESULTS

COMPARATIVE STUDY

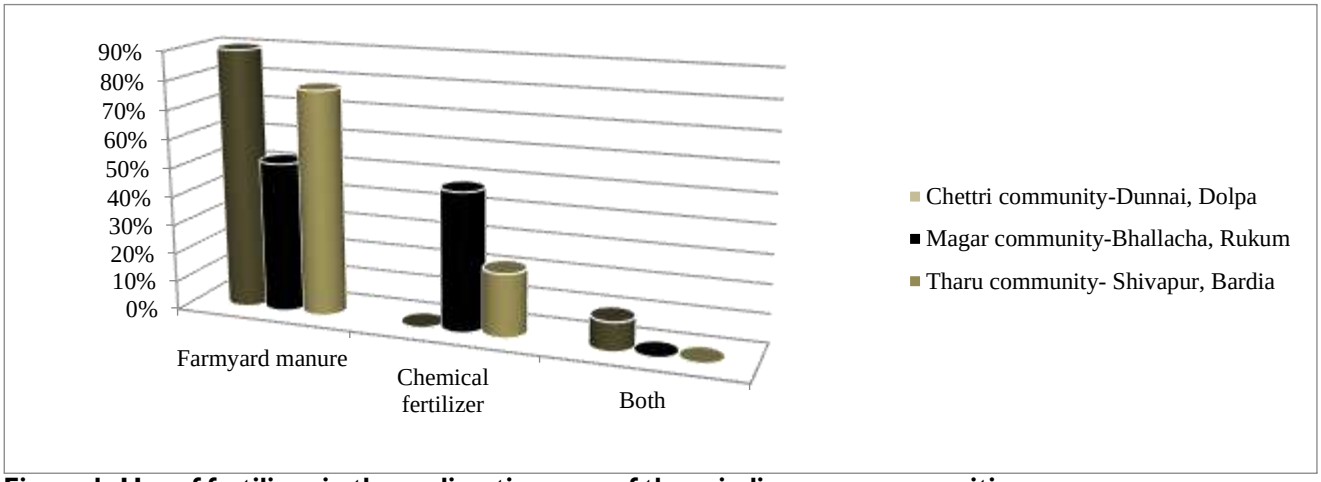


Figure 1: Use of fertilizer in three climatic zones of three indigenous communities

According to figure 1, in all three places people are still using farmyard manure. Chemical fertilizer has been introduced and people are experimenting it. While experimenting in Dunnai people have now either stopped using chemical fertilizer or started using both according to situation and crops, realizing that it gives less production after few years. In Bhallacha, some people have started using chemical fertilizer and have observed higher production but most of them still prefer farmyard manure. In Shivapur, they have already observed how chemical fertilizer destroyed their soil quality along with giving less

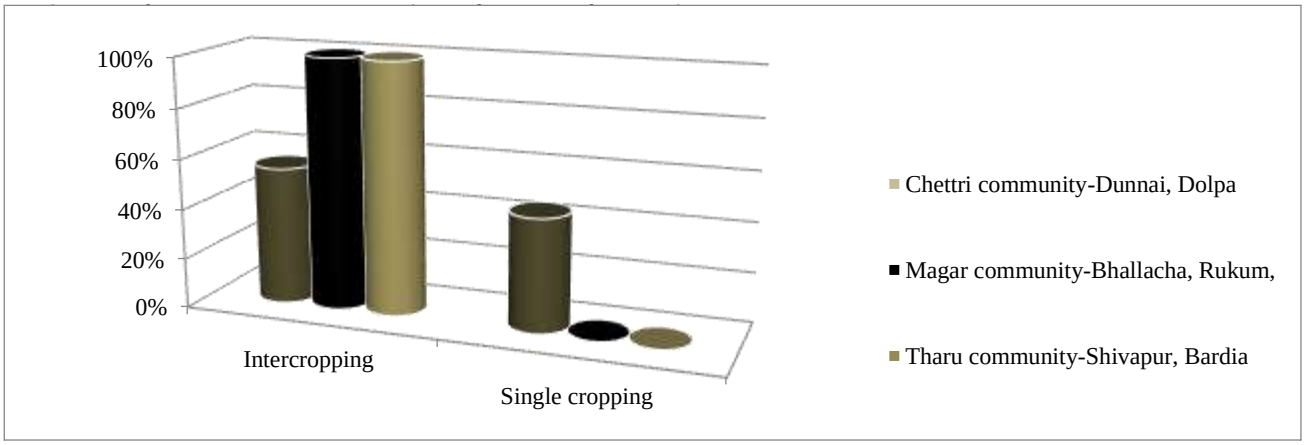


Figure 2: Agriculture practice in three climatic zones of three indigenous communities

According to above figure 2, in all three places people are practicing intercropping. In some of the higher altitude of Dunnai some people practice single cropping.

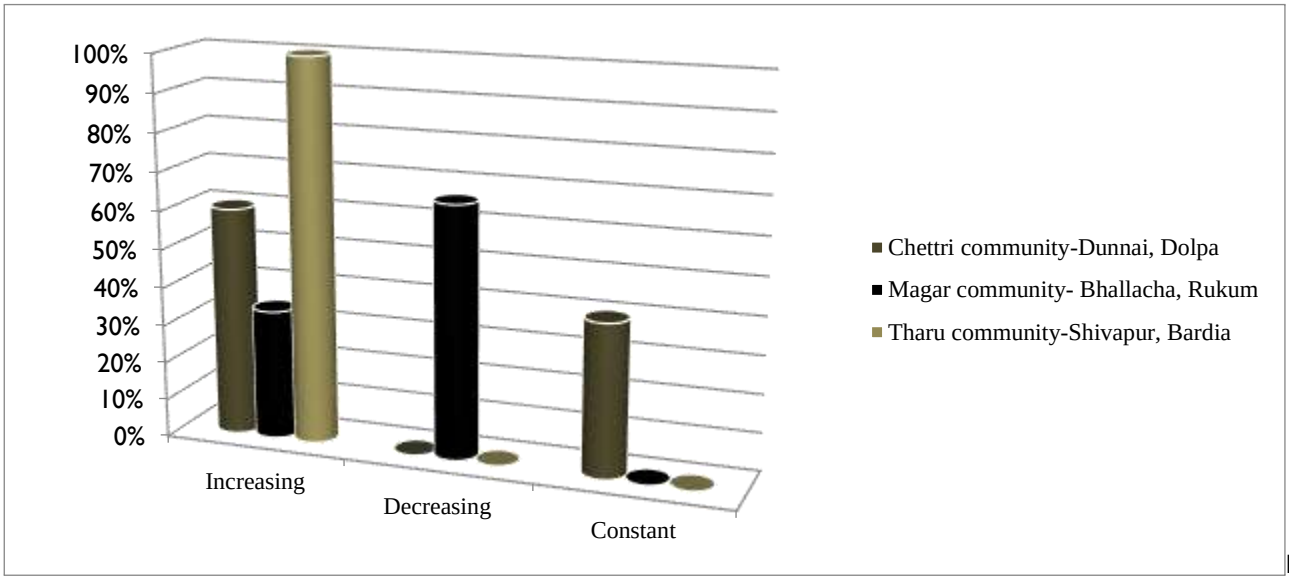


Figure 3: Pest attack in crops in three climatic zones of three indigenous communities

According to above figure 3**,** in Dunnai and Shivapur, pest attack in crops is increasing as result of rise in temperature, less and irregular rainfall but in Bhalllacha this change has resulted in decreasing pest attack in crops.

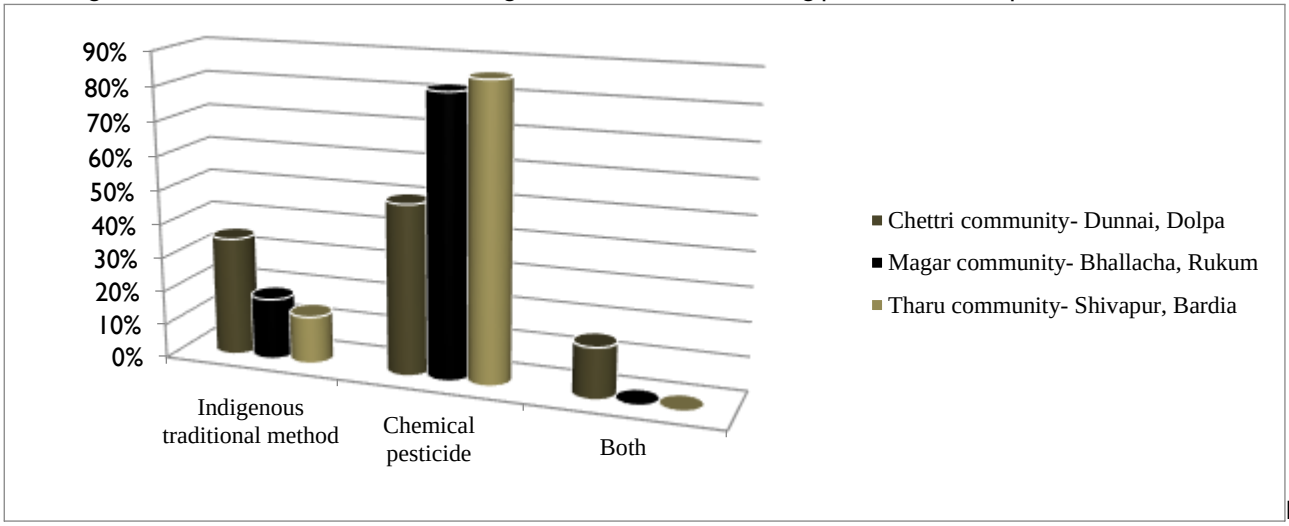


Figure 4 : Use of pesticide in crops in three climatic zones of three indigenous communities

According to above figure 4, in all three places people are using chemical pesticide knowing the fact that homemade pesticide is good. They are using it because homemade pesticide is not possible to manufacture for large scale agriculture.

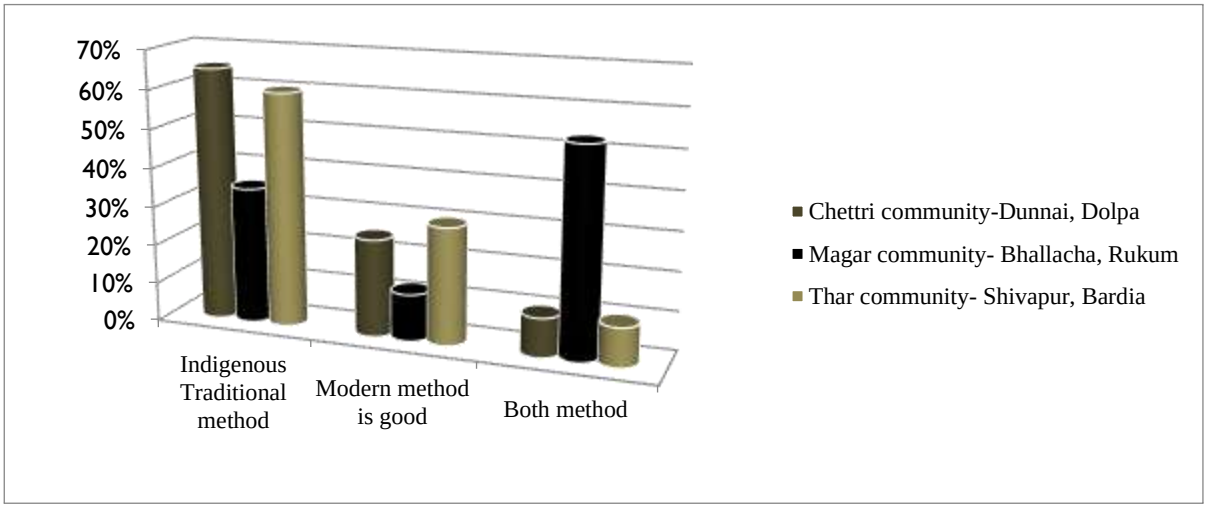


Figure 5: Indigenous Traditional Knowledge and its adaptation to Climate Change in three climatic zones of three indigenous communities

According to figure 5, in all three places people agree on fact that indigenous method in agriculture practices are more sustainable, cost-effective, environment friendly and adaptive to changing climate.

Precipitation and temperature data

Test interpretation

H_0: There is no trend in the series

H_a: There is trend in the series

The data was taken from DHM (Department of Hydrology and Meteorology) of nearest place to survey site. Analysis of precipitation data was carried out by using Mann Kendal Test, the value of p-value (Two-tailed) is calculated using exact method. As the computed p-value is lower than the significance level alpha=0.95, one should reject the null hypothesis H_o, and accept the alternative hypothesis H_a. The risk to reject null hypothesis H_o while it is true is lower than 64.24%. According to the test, there is trend in the series of rainfall data of Rukum from 1984 to 2012. The trend of Average precipitation is decreasing by 0.443mm Sen's Slope every year, which is a sign of climate variability.

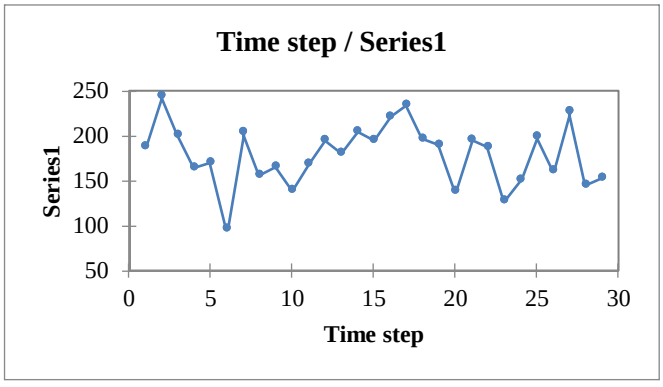


Figure 6: Rainfall data of Musikot, Rukum

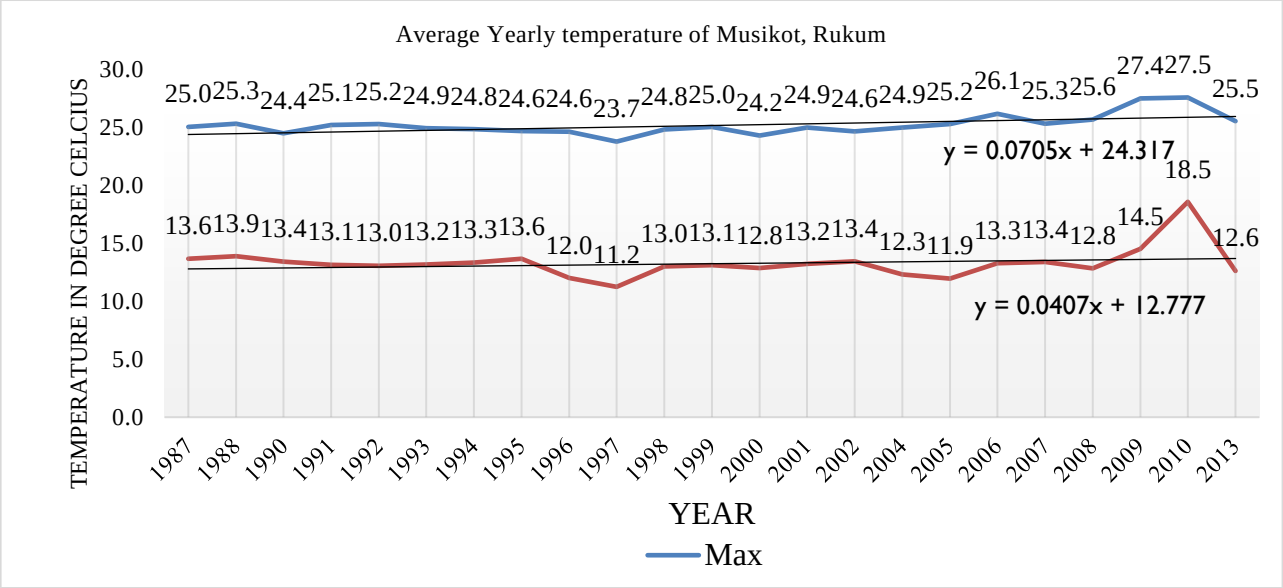
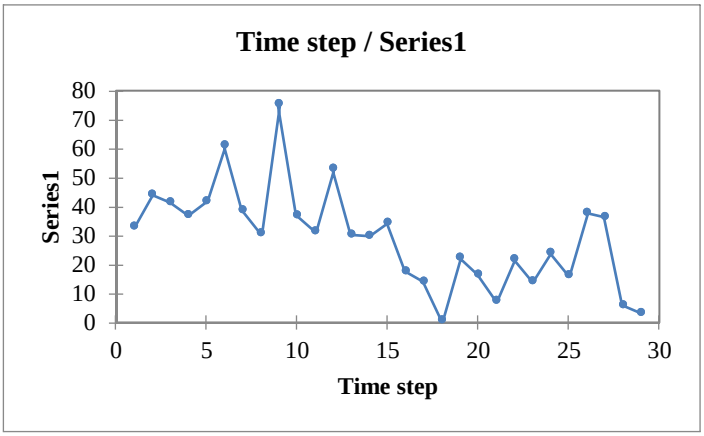


Figure 7: Average max and min temperature of Musikot, Rukum

Test interpretation

H_0: There is no trend in the series



H_a: There is trend in the series

The data was taken from DHM of survey site. Analysis of precipitation data was carried out by using Mann Kendal Test, the value of p-value (Two-tailed) is calculated using exact method As the computed p-value is lower than the significance level alpha=0.95, one should reject the null hypothesis H_o, and accept the alternative hypothesis H_a. The risk to reject null hypothesis H_o while it is true is lower than 0.01%. According to the test, there is trend in the series of rainfall data of Dunnai from 1984 to 2012. The trend of precipitation is decreasing by 1.254mm Sen's Slope every year, which is sign of climate variability.

Figure 8: Rainfall data of Dunnai, Dolpa

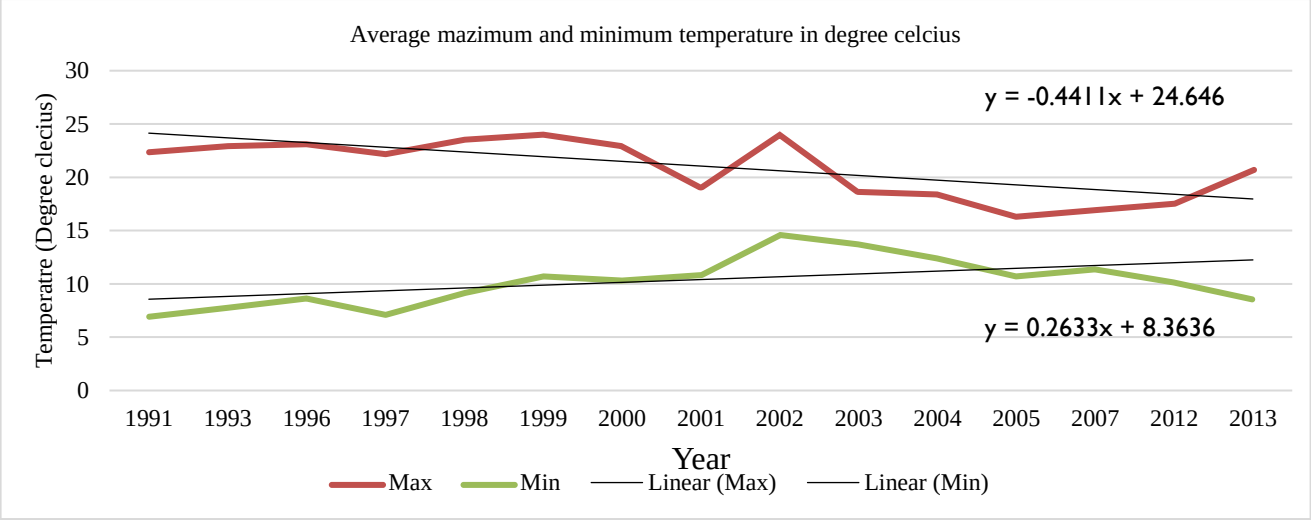
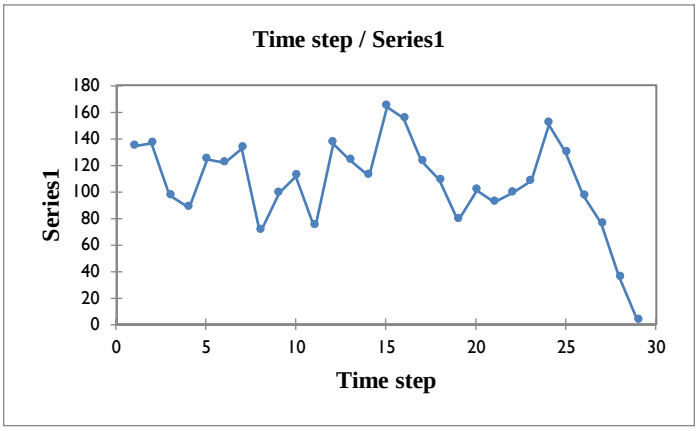


Figure 10: Average max and min temperature of Dunnai

Test interpretation

H_0: There is no trend in the series

H_a: There is trend in the series



The data was taken from DHM of nearest place to survey site. Analysis of precipitation data was carried out by using Mann Kendal Test, the value of p-value (Two-tailed) is calculated using exact method. As the computed p-value is lower than the significance level alpha=0.95, one should reject the null hypothesis H_o, and accept the alternative hypothesis H_a. The risk to reject null hypothesis H_o while it is true is lower than 7.49%. According to the test, there is trend in the series of rainfall data of Bardiya from 1984 to 2012. The trend of precipitation is decreasing by 1.417mm Sen's Slope every year, which is sign of climate variability.

Figure 10: Rainfall data of Gulariya

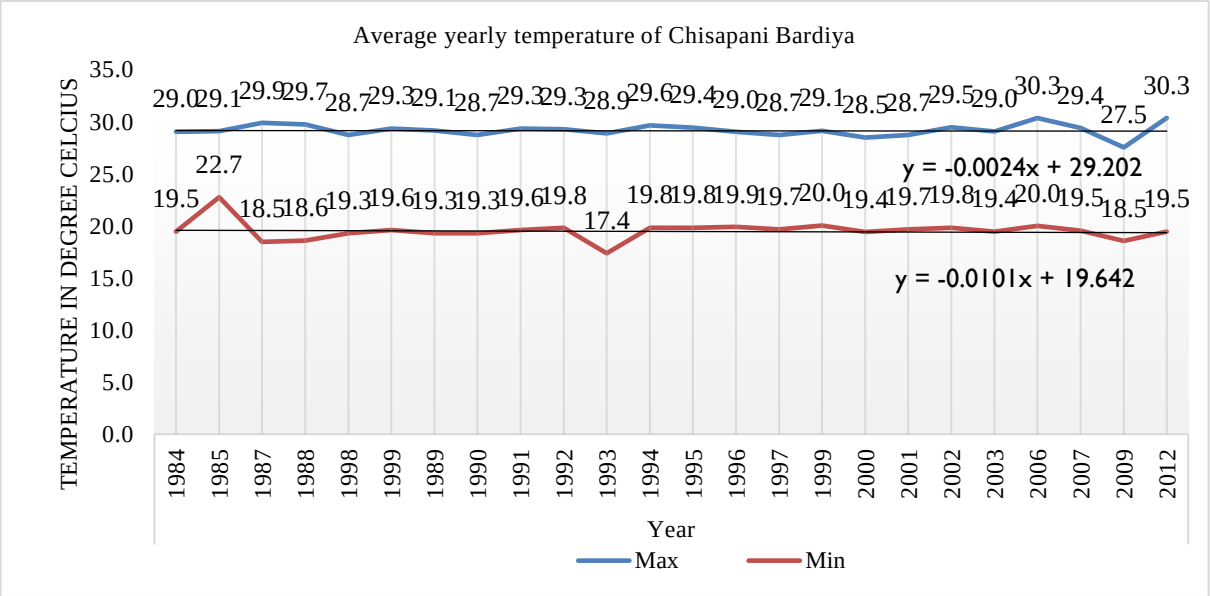


Figure 11: Average yearly data of max and min temperature of glulariya

IV. DISCUSSION

INDIGENOUS TRADITIONAL KNOWLEDGE AND ITS ADAPTATION TO CLIMATE CHANGE

According to people in three places Indigenous Traditional Knowledge in intercropping of *Glycine max*(soya beans), *Solanum tuberosum* (potato) with *Zea mays*(maize) and *Pisum sativum* (pea) with *Avena sativa* (oats) are practiced because the beans are well grown while cultivating in-between the maize, support (local name: ***Thakra***) is also not required and attracts parasitic wasps that control corn earworm and at the same time serves as weed cover. Scientifically, intercropping crops with legumes may be an important food security strategy in the context of Climate Change (IDRC, 1996). According to Scheidegger(2008), intercropping has a higher biological efficiency than sole cropping because of better buffering against climate extremes, more efficient use of resources(light, nutrients and water), less problems with pest and diseases.

In Dunnai, Soyabean are grown at the ditch of land with paddy and *Cannabis sativa* (local name: ***Bhango***) plant is planted at the edge of agricultural land so that they can produce oil from it though it has scientific benefit, it lays a branch primary root that reaches a depth of 2 to 2.5m and a branch of secondary nodes that grows between 60to 80cm below ground. It is versatile crop that will grow and adapt to any soil and climatic condition with the minimum requirement of abundant irrigation or moisture (Adnan M. Esmail, 2010).

In Bhallcha and shivapur, they practice mulching in ginger to control weeds. They use ***Ausuro*** and ***Khirro*** for mulching purpose as these works as a pest control which is an Indigenous Traditional method. According to Scheidegger (2008), mulching helps for better water balance, sustained soil fertility, higher soil organic matter content, it can offset reduced rainfall, buffer erratic rainfall distribution, reduce soil temperature and store more carbon.

Most of the people in village in three places use the farmyard manure in Indigenous Traditional way. Farmyard manure helps to cope with this changing situation because it demands less water. It increases organic matter in soil which in cropping system will be critical to retain water, increase yields and reduce risk in rain fed agriculture while sequestering carbon, it helps to repair ecosystem and increases the resilience of both people and landscapes to Climate Change. Reduces agriculture's greenhouse gas emissions and increases carbon sequestration, it strengthens food security and delivers environmental benefit (Climate Smart Agriculture, The World Bank).

Homemade pesticides like liquid obtained from boiling of cow bone, cattle urine, ash application, dipping *Urtica plaviflora* (***Sisno***) in water for 12 hours; mixing *Juniperus indica* (***Dhupi***) in cow urine etc. is used to control pests in crops. According to Khanal(2010), organic agriculture provides better result in many aspects of environmental issues compared to conventional agriculture. So, Indigenous Traditional method might be the best way to control pest without any side effects on environment, soil and plant production itself.

V. CONCLUSION

In initial days of our research, we were under belief that Indigenous Traditional farming practices and its related properties would have been totally lost. The research work was frequently attacked by people favoring modern technologies and Chemicalization of agriculture. For some time, during meetings with Government authorities in Rukum, some of the times we felt we were treated to be anti-development and advocates of old traditional methods. When we went into discussion with staff of agriculture development agencies about validity of indigenous methods of subsistence that were still under use of majority of farmers, the initial response was less towards indigenous practices in Rukum and Bardia but authorities of Dolpa were more agreed on fact Indigenous Traditional Knowledge and its effectiveness and said integrating best of Indigenous Traditional Knowledge and modern technologies would give good result to combat Climate Change. While visiting all three places, interacting with people and according to analysis of DHM data, changes in precipitation and temperature within last thirty years was found which is affecting agricultural system.

Indigenous Traditional Knowledge is passed on and modified from generation to generation and from farmer to farmer, whereas modern technologies are communicated from researchers via extension personnel and/or farmers. Different Indigenous Traditional Knowledge practiced by these three indigenous communities which helps in combating Climate Change are: intercropping, crop Rotation, crop shifting, mulching, use of farmyard manure, homemade pesticides, use of local tools in field, irrigation, storage of local seeds and grains, landraces which are more resistant to changing environment and other traditional way of agriculture practice.

Some of the problem that has made people shifts towards modern practices:

> Lack of understanding of traditional agriculture which further leads to a communication gap between promoters and practioners giving rise to myths such as local seed gives less production, it takes long time for preparation of Farmyard manure. 2. The accomplishments of farmers by using their own ITK often are not recognized, because they are not recorded in writing or made known; and 3. Poor involvement of farmers and their organizations in integrating, consolidating, and disseminating what is already known.

The motives were to highlight, document and promote Indigenous Traditional methods under use by farmers which are in verge of lost. Promotion of the Indigenous Traditional Knowledge documented was done through social media, articles and documentary (.https://www.youtube.com/watch?v=KMEKNshBqcs). Here, documentation and screening of Indigenous Traditional Knowledge is necessary before the valuable information is lost forever. It may be an alternative, a substitute or a complement to modern technology; it may generate ideas for future research.

VII. REFRENCES

Adnan M. Esmail, (2010). Cannabis Sativa: *An Optimization Study for ROI*. MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Agbola, T. &. (2007). *Climate Change and food crop production in Ibadan Nigerian.African crop science conference* (Vol. 8).

Bajracharya, R., Sitaula, B., Sharma, S., & Jeng, A. (n.d.). *Soil quality in the Nepalese context-An analytical review* (Vol. 33(2)). International Journal of Ecology and Environmental Sciences.

Bank, T. W. (2010). *Development and Climate Change: Overview.* World Development Report

Denzin, N. &. (n.d.). *Introduction: The discipline and practice of qualitative research* (2nd ed.). (T. s. research, Ed.) Thousand Oaks, CA Sage.

Khanal, R. (2009). *Climate change and organic agriculture. Journal of Agriculture and Environment*

Malla, G. (2008). Climate Change and its Impact on Nepalese agriculture. *The Journal of Agriculture and Environment*, 9: 62-71.

MoE. (2010). *Climate change vulnerability mapping for Nepal, NAPA.* Kathmandu, Nepal:Ministry of Environment

Scheidegger, U. (2008). The role of biodiversity in times of climate change, with reference to intercropped potatoes. *Abstracts from Ph.D., thesis of the University of Applied Sciences*.

Varte, I. z. (2012). Role of Indigenous Traditional Knowledge in sustainable resourcemanagement. *Two days seminar on Environmental Issue in North east India.* Manipur:Evangelical Assembly Church & Indira National Tribal University, RegionalCampus.