Effect of Climate Change on Vegetable Seed Production in Some Selected Pockets of Nepal

Mohan B. Thapa[1] and S. Dhungel[2]

ABSTRACT

This study was conducted in seven vegetable seed production pocket districts representing high hills, mid hills and terai region of Nepal. This study was based on the primary information collected using semi-structured questionnaires, focus group discussions and key informants survey. Meteorological data of last 10 years from different metrological stations on or nearby the production pockets were collected and analyzed. The pattern of rainfall shows a slightly increasing trend in the mountainous areas receiving higher amount of annual precipitation. Amount of total precipitation in mid hills was found decreasing continuously with a slight increase in the year 2007. The pre-monsoon and winter rainfall was also in decreasing trend in terai whereas, rainfall pattern shows increasing trend in high hills which shows terai areas more vulnerable due to erratic rainfall pattern whereas high hills might benefit from the increasing rainfall pattern to some extent. A slightly increasing trend was noted in average annual temperature within the study area in a decade. The increasing trend of temperature was found higher in high hills and mid hills as compared to Terai. Furthermore, warming in the winter was higher as compared to other seasons. Eighty-six percent of respondents in high hills, 72% in mid hills, 78% in terai responded that they felt increase in temperature as compared to previous years. Similarly, the increase in winter temperature was felt more than that of summer experiencing warmer witers than previous years. The high hills received higher amount of precipitation in the recent years in terms of intensity and duration of monsoon. Almost all vegetable seed producers in high hill felt increased precipitation whereas trend of rainfall was in decreasing pattern in mid hills and Terai as experienced by 81% and 60% of the respondents respectively. Twenty percent in Mustang, 12% in mid-hills and 4% in Sarlahi reported that they felt some positive impacts due to climate changes. Forty-one percent of the respondents in Mustang expressed their view that cultivation of brinjal, chilly and cucurbits has been done successfully in Mustang these days. The flowering and ripening of broad leaf mustard, cabbage and carrot has sifted 10-15 days before. Most negative effects were felt in Sarlahi as responded by 89% of the farmers followed by mid hills (78%) and Mustang (40%). Sixty-six percent of the respondents in Mustang, 72% in mid-hills and 86% in Sarlahi felt that the planting time has pre-pond by about 15-20 days. The shift was found greater in Mustang (25 days) and lower in Sarlahi (13 days). However, planting time in case of rainy season crop had shifted some days after (22% in mid-hills and 8% in Sarlahi) generally due to delayed monsoon.

Key Words: climate change, adaptation, mitigation, resilience, coping strategies, vegetable seed production

INTRODUCTION

Climate change has been one of the emerging global challenges in the recent years. Accordingly, the United Nations General Assembly adopted a resolution to develop an international legal instrument to address this global problem. In accordance with this, the Inter-governmental Negotiation Committee met several times and the United Nations Framework Convention on Climate Change (UNFCCC) was adopted in May 1992. This Convention was opened for signature at the UN Conference on Environment and Development in Rio de Janeiro, Brazil in June 1992. Nepal signed this Convention on 12 June 1992 and ratified it on 2nd May 1994, making it effective three months later on 31st July 1994. Nepal has experienced

[1] Senior Horticulturist (Retd. DDG, DoA, Hariharbhavan, Lalitpur.); mbthapa2009@gmail.com
[2] Agriculture Extension Officer, Monitoring & Evaluation Section, DoA

an average maximum annual temperature increase of 0.06degree Celsius. Despite having only 0.4 percent of the total global population and being responsible for only 0.025 percent of total GHG emissions in the world, Nepal will be affected disproportionately, especially from increasing atmospheric temperature. Changes in the annual rainfall pattern, intense rainfall and longer droughts have been observed. Similarly, both days and nights are presently warmer. The number of days with 100 mm of heavy rainfall is increasing. The timing and duration of rainfall is changing. The adverse impacts of climate change have been noticed in agriculture and food security, water resources, forests and biodiversity, health, tourism and infrastructures.

The agro-climatic diversity of Nepal also favors different kinds of vegetable seeds hence have both the comparative and competitive advantage for the local markets as well exports to International markets. Over the past decade, Nepal's vegetable seed industry has grown considerably with respect to the number of farm families engaged in vegetable seed production and the quantity of seed produced and marketed within and outside country with support of various governmental and non-governmental organizations. They have targeted small, poor and disadvantaged farmers and have been able to demonstrate that vegetable seed production can be a viable option.

METHODOLOGY

The first hand data were collected by conducting face to face interview with the vegetable seed producing farmers of seven potential vegetable seed production districts of the country i.e. Dhankuta, Sarlahi, Dadeldhura, Ramechhap, Rukum, Surkhet and Mustang covering five development regions ranging from high hilly region to Terai. Similarly, Focus Group Discussion and Key Informant Survey were also conducted for the collection and triangulation of the data. Meteorological data of the study districts for the period of last 10 years (2001-2010 A.D) were collected from Department of Hydrology and Meteorology and analyzed by using different data analysis software as SPSS & MS Excel sheet.

RESULT AND DISCUSSION

Annual rainfall trend

The annual precipitation in the study area within a decade showed an erratic pattern of rainfall with an alternate increasing and decreasing pattern. In Terai areas maximum rainfall occurred in the year 2004 and 2007 and minimum in the year 2009. The pattern of rainfall shows a slightly increasing trend in the mountainous areas receiving higher amount of annual precipitation. Amount of total precipitation in mid hills was found decreasing continuously with a slight increase in the year 2007 only. Interestingly, the year 2004 received highest rainfall in Terai whereas just opposite to that the mountainous areas received the lowest precipitation in that year. This erratic pattern of rainfall with an alternate increasing and decreasing pattern within the country thus creating rain deficit in some areas moderate rainfall in other and alternate changing pattern of rainfall creating floods, landslides in one year and severe drought in other as well. The pre monsoon and winter rainfall was also in decreasing trend in terai whereas rainfall pattern shows increasing trend in case of high hills which shows terai areas more vulnerable due to erratic rainfall pattern whereas high hills might benefit from the increasing rainfall pattern to some extent.

Change in temperature

Figure 2 shows a slightly increasing trend in average annual temperature within the study area within a decade. Nepal's temperature has increased by 1.8 degree Celsius during last 32 years. In Nepal average temperature increase was recorded as 0.06 degree Celsius per year and that

in Terai and Himalayas was 0.04 degree Celsius and 0.08 degree Celsius /year respectively (Shrestha et al., 1999). The increasing trend of temperature was found higher in high hills and mid hills as compared to Terai. Furthermore, warming in the winter was higher as compared to other seasons.

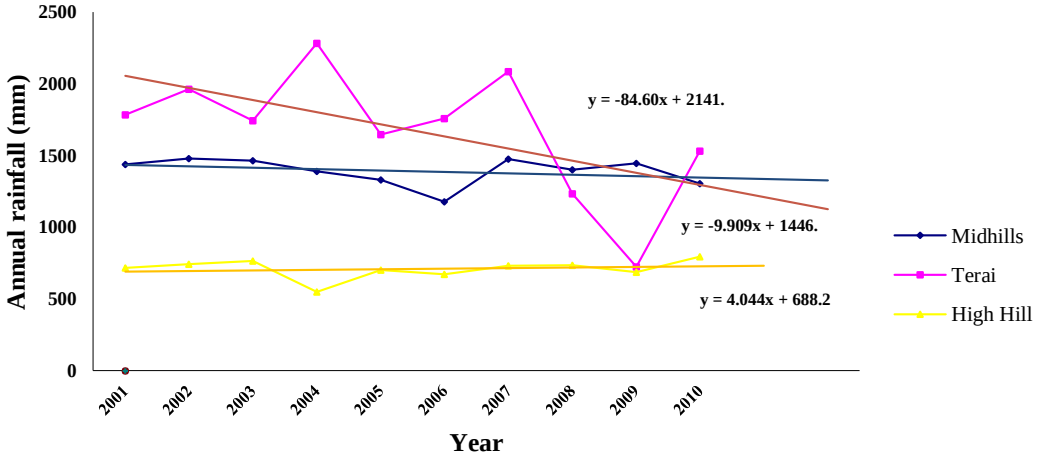

Figure 1: Trend of annual precipitation in the study area (2001-2010)

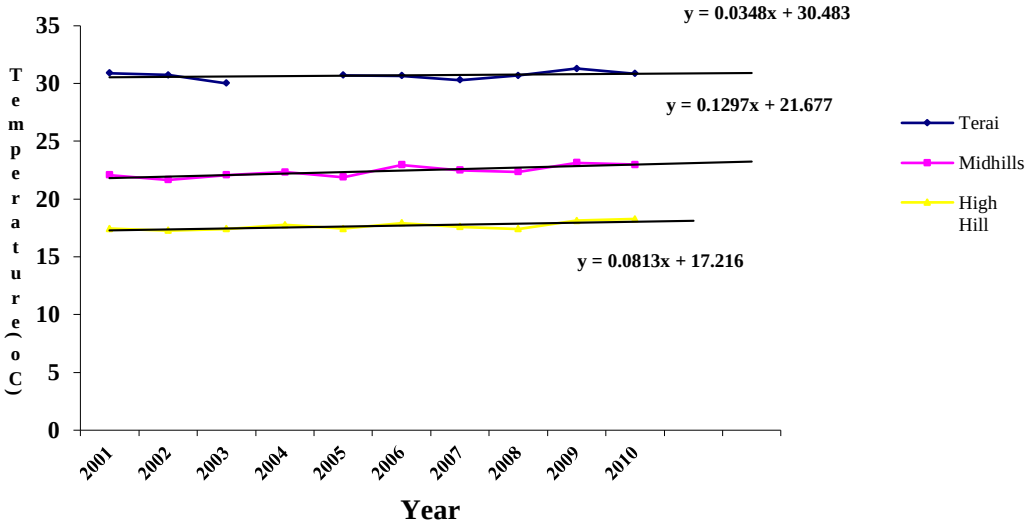

Figure 2: Trend of change in temperature over a decade (2001-2010)

Farmer perception on climate change within a decade

Most of the respondents in the study areas perceived the change in temperature (29.5%) and change in rainfall pattern (24.6%) as the most prominent and important indicators of climate change. Change in temperature and rainfall pattern is the most prominent indicators of climate change as perceived by farmers. Almost all the respondents (86% in high hills, 72% in mid hills and 78% in terai) responded that they felt increase in temperature as compared to previous years. None of the respondents reported the decrease in temperature concluding that days are getting hotter and felt more in high hills. Similarly, the increase in winter temperature was felt more than that of summer experiencing warmer winters than previous years. The high hills received higher amount of precipitation in the recent years in terms of intensity and duration of monsoon. Almost all vegetable seed producers in high hill felt increased precipitation

whereas trend of rainfall was in decreasing pattern in mid hills and Terai as experienced by 81% and 60% of the respondents respectively. Also, 34%, 94% and 60% of respondents in high hills, mid hills and terai felt the initiation of monsoon has delayed thus enforcing delayed plantation of major crops. Similarly, the decrease in snowfall is especially felt in the high hilly areas. During FGD, farmers reported that snowfall used to occur 8-9 times up to 4-5 feet few years before but had decreased to 4-5 times up to 4-5 inches only these years. Similarly, thunderstorms were felt sometimes which was unusual previously. Early flowering of forest plants i.e. Rhododendron and temperate fruits i.e. apple, pear, peach, plums etc were felt in mid and high hilly areas. Similarly the drying of natural water resources, more effort needed to take water from the wells due to decreasing water level, drying of ponds/lakes were felt in Terai regions. The increasing disease pest infestation was however felt by most of the respondents of the study area.

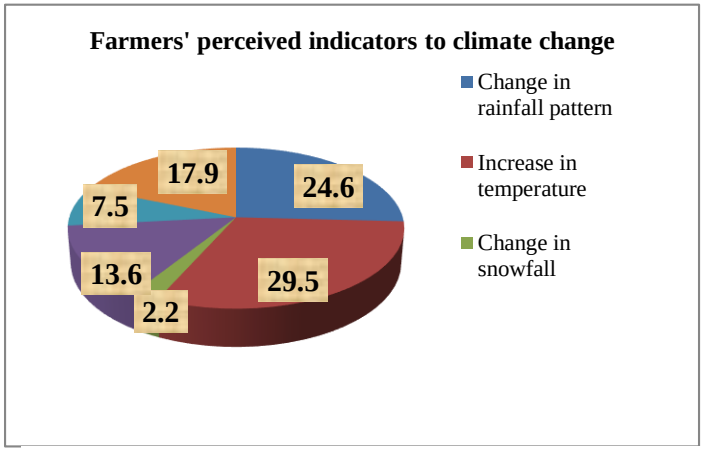

Figure 3: Farmers' Perceived Indicators to Climate Change in the Study Area (2012)

Effects of climate change in vegetable seed production

There was mixed response of the farmers when they were asked about the effect of climatic change on the vegetable seed production. Very few farmers (20% in Mustang, 12% in Mid Hills, 4% in Sarlahi) reported that they felt some positive impacts due to climate changes. Farmers of Mustang were able to grow cauliflower, cabbage, chili, tomato and cucumber, which used to require greenhouses in order to survive. Similarly some farmers of Dadeldhura reported that the shift in planting time of Lady's Finger from June to August has prevented seed damage due to excessive rain. 41% of the respondents in Mustang expressed their view that cultivation of Brinjal, Chilly and cucurbits has been done successfully in Mustang these days due to favorable environment created due to changed climatic condition. The flowering and ripening of Broad leaf mustard, Cabbage, Carrot has sifted 10-15 days before. However higher proportion of respondent were in the view that they experienced negative impact of changed climate. Most negative effects were felt in Sarlahi as responded by 89% of the farmers followed by mid hills (78%) and Mustang (40%) was found.

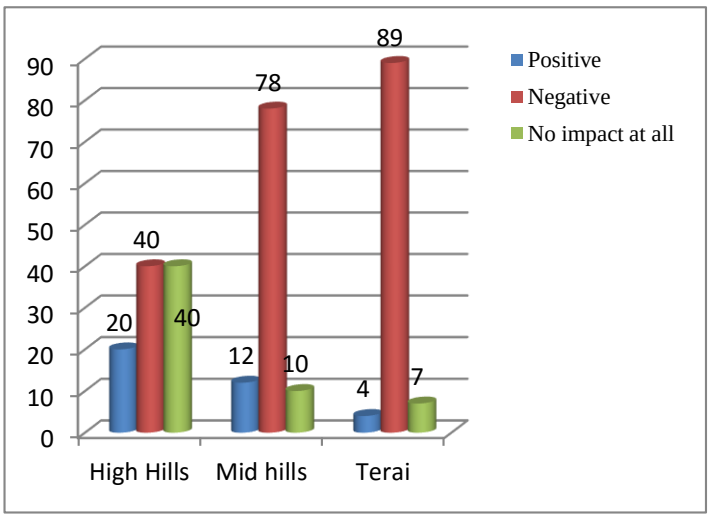

Figure 4: Farmer's Perceived Effect of Climate Change in Vegetable Seed Production (2012)

Comparatively less and untimely rainfall had affected the sowing and harvesting time especially in rain fed areas. Increased temperature especially in Terai had affected the flowering, seed setting and ripening of specially the cucurbits and tomato. Hybrid seeds are more sensitive to humidity and temperature, therefore, their germination and development is directly affected by such weather conditions. Dry spell directly affects the quality of vegetable

seed produced. There is higher pest incidence due to drought conditions. The increasing disease pest infestation, as indicated by 63% of respondents in Mustang, 21% in mid hills and 32% in Sarlahi was the major negative impact. Decreased in quantity and quality of seeds produced (22%) was another negative impact felt.

Shift in planting time

The impact of climate change as perceived by the vegetable seed producing farmers was the shift in planting time. Most of the respondents (66% in Mustang, 72% in mid hills and 86% in Sarlahi) felt that the planting time has pre-pond by about 15-20 days. The shift was found greater in Mustang (25 days) and lower in case of Sarlahi (13 days). However, planting time in case of rainy season crop had shifted some days after (22% in mid-hills and 8% in Sarlahi) generally due to delayed monsoon.

Change in flowering and ripening time.

Change in climate as perceived by the farmers of the study area had direct affect on flowering and ripening of vegetable crops. Majority of the respondents in mid-hills (80%) felt early flowering of vegetable crops especially the Cole crops and radish. Similarly, flowering in Tomato, brinjal was felt earlier in Terai region. Flowering of Broad leaf mustard, cabbage, Chilly and carrot have shifted some 15-20 days earlier in Mustang. Change in ripening time was found in line with that of flowering time of vegetable crops.

Eighty nine percent of farmers in mid hills, 73% in Mustang and 67% in Sarlahi experienced crops reaching early maturity. Farmers had their opinion that the increase in temperature lead to forced maturity of the seeds. During cold waves in Terai the ripening time of vegetable seeds were found delayed.

Both the early and late ripening had adverse affect in seed quality. Problem in seed shape, size and luster were experienced due to early maturity. Kumar et.al, 2009 in one of the study found rapid rise of temperature at the time of the pollination lead to pollen abortion in cabbage hence no viable seed was produced. Though no cases of complete failure to seed set in any of the vegetable seed produced in the study area, the increased temperature decreased setting of seeds especially in beans in mid hills (71%) and Tomato and cabbage in Sarlahi (54%). The production per unit area of seeds was found decreasing as responded by 74.1% of the respondents.

Effect on quality of seed

Much of the variation in seed quality among seed lots is the direct or indirect result of variation in weather before or at harvest, hot dry periods generally providing good quality seed (Austin, 1972). Majority of the respondents (94% in mid hills, 93% in Sarlahi and 66% in Mustang) felt decreased seed size as compared to previous year. Similarly, the shape of the seed was also found changed. The wrinkled seeds were found by 71% and 59% of the respondents in mid hills and Sarlahi respectively. The proportion was relatively less (7%) in case of Mustang. Farmers also found decrease in luster of the seed they produced. Almost 80% of the farmers accepted that seeds were dull looking and less attractive than previous. Sher Bahadur Roka of Surkhet worried that the quality of seed has decreased so rapidly that farmers/buyers might not accept for seed purpose. Some farmers in Ramechhap reported late harvesting and drying of bean seeds due to continuous rainfall at the harvesting season thus degrading the seed quality. Siddique and Goodwin, 1980 found reduced seed quality in bean (Phaseolus vulgaris L.) due to high temperatures after anthesis.

Intensity of disease pest

Results indicate that climate change could alter stages and rates of development of the pathogen, modify host resistance, and result in changes in the physiology of host-pathogen interactions. The most likely consequences are shifts in the geographical distribution of host and pathogen and altered crop losses, caused in part by changes in the efficacy of control strategies. Incidence of pest and diseases was found more severe in Terai. The incidence and damage caused range from medium in some crops to devastating loss in other. Ninety three percent of respondents in Sarlahi felt excessive incidence of disease in some major vegetables as beans, cucurbits, tomato and potato.

The increased infestation of aphids, fruit fly and borer had directly affected the production and increased cost of production whereas the yellow mosaic virus in lady's finger and mosaic virus in tomato has decreased the quality of the produced seed. Cabbage butterfly and Diamond black moth infestation in cabbage, cauliflower and radish, neck rot in Tukinasi variety of radish was felt increased in Mustang. Gradual shift of pest and disease of Sarlahi have felt in hills and mountains. The infestation of aphids and powdery mildew were found increased in Mustang. Some pathogens of important crops from Terai zones has adapted in hills and mid-hills (e.g. rust and foliar blight) that adversely affects the quantity and quality of vegetable seeds. However during group discussion in Dadeldhura some positive impact of changed climate in disease pest infestation were also discussed. The decreased infestation of beetle in beans due to late plantation (Third week of August) in comparison to the early plantation in July was felt. This was due to the completion of the life cycle of the insect before planting time. Radish when planted in third week of August showed less or no infestation of aphids compared to late plantation in September.

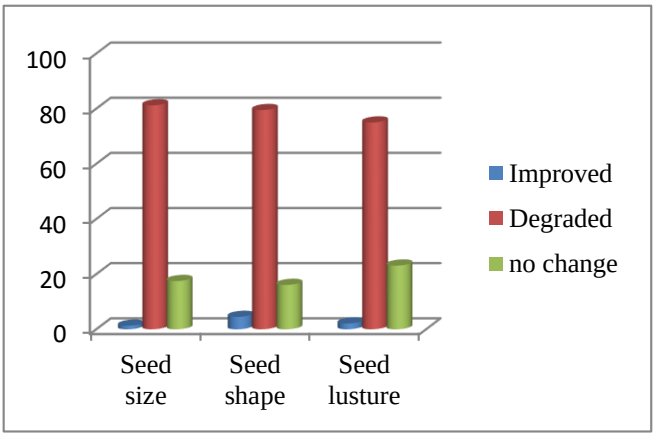

Figure 5. Effect of changed climate on quality of vegetable seed as perceived by

SUMMARY AND CONCLUSION

Climate change is evident in the study areas. Communities are already experiencing unusual changes in temperature and rainfall patterns, which were supported by a number of indicators such as decreased rainfall over the last few years, increased rainfall intensity within short duration, increasing temperature, invasion of weeds and species, and outbreak of pests and diseases. These outcomes were linked to increased risks and hazards, increased magnitude of impacts and their severity and vulnerability posed by such factors in vegetable seed production and hence to the livelihoods of farmers residing in all the three ecological zones.

Current and future scenarios of climate change indicate that many of the study areas will face risks that include higher aridity, more variable water supply, melting of glaciers, erratic rainfall, and periods of water scarcity and drought. Drought may cause outbreak of pests and diseases. The shift in planting, flowering and ripening time of vegetable seeds, decrease in quantity and quality of seed produced, poor germination of seed, poor pod and seed setting along with the change in crop canopy were also experienced by the farmers of the study area. Impacts were observed contributing to loss of species and local landraces, declining productivity and yield, outbreak of diseases and pests.

ACKNOWLEDGEMENT

This study has been performed as a project of VSPIII/CEAPRED under financial support from CEAPRED/SDC.

LITERATURES CITED

ABPSD/MOAC, 2011. Statistical Information on Nepalese Agriculture-2010/2011. Agri-Business Promotion and Statistical Division, MOAC, Kathmandu, Nepal.

Agriculture and Environment, 2008. Global warming and its relationship with agriculture. The Journal of Agriculture and Environment Vol:.9, Jun.2008 Review Paper

APP, 1995, Agriculture Perspective Plan, Agricultural Project Service Center, Kathmandu, Nepal.

Bajracharya, et al., 2007. Impact of climate on Himalayan glaciers and glacial lakes. ICIMOD/ UNEP, pp7-19.

Bhandari, B. 2009. Summer Rainfall variability and the use of rice (Oryza sativa L.) varietals diversity for adaptation: Farmers Perceptions and responses in Nepal. M.Sc. Thesis. Swedish Biodiversity Center. Uppsala. Sweden.

Dahal, N. 2006. Implications of Climate Change in Nepal: Some Observations and Opportunities. Paper Presented at 23rd Warden Seminar, November 2006 held in Pokhara, Nepal. www.mtnforum.org/rs/ol/counter_docdown.cfm?fID=626.pdf Retrived April 23rd 2012.

Imtiaj H.1990. Review of Nepal's Seed Sector. FAO/DANIDA Regional Trust Fund Project.

Initial National Communication, 2004. Initial National Communication to the Conference of the Parties to the United Nation Framework of Convention on Climate Change. Ministry of Population and Environment and United Nation Development Program.

IPCC, 1992, Climate Change: The Supplementary Report for the IPCC Scientific Assessment, WMO/UNEP, New York.

Kumar P.R, Shiv K. Yadav, S.R. Sharma, S.K. Lal and D.N. Jha; 2009. Impact of Climate Change on Seed Production of Cabbage in North Western Himalayas. World Journal of Agricultural Sciences 5 (1): 18-26, 2009.

Malla, G., 2003. Impact of climate change on water and soil health, Agriculture and Environment. MOAC, p63-71.

Regmi, H. R., 2007. Effect of unusual weather on cereal crops production and household food security. The Journal of Agriculture and Environment, pp20-29

Shrestha, M.L., 1997. Proceedings of the Workshop on Climate Change in Nepal. Organized by Department of Hydrology and Meteorology, Babar Mahal, Kathmandu, Nepal Sponsored by US Country Study Program.

Supply Situation of Vegetable Seeds in Nepal: An Analysis from Policy Perspective

Krishna P.Timsina[1], Ganesh P.Shivakoti[2] and Kent J. Bradford[3]

ABSTRACT

[1] Senior Scientist (Agriculture Economics), Nepal Agricultural Research Council krishnatimsina@yahoo.com)

[2] Professor, School of Environment, Resources and Development, Asian Institute of Technology (AIT), Thailand

[3] Professor, Seed Biotechnology Center, Department of Plant Sciences, University of California, Davis, USA