

# Impact of Climate Change on Agriculture, Gender and Adaptation Practices

## A Case Study of Mustang

Agriculture is an essential source of employment and food security in Nepal. But policy has yet to catch up in realizing the sector's importance. Only 35 per cent of cultivated land in the country is irrigated, thus, pushing farmers to rely on rains. Consequently, farming is highly sensitive to climate change. This is further exacerbated by ill-preparedness regarding this growing problem, especially among poor farmers. The use of traditional technology, poor access to external resources and inputs and mixed farming and livestock production system are all different eggs crammed in the same basket of vulnerability. To put it more simply, these environmentally marginalized farmers are prone to problems related to soil degradation and increasingly limited water resources. Any change in precipitation patterns is likely to lead to uncertainty in cropping patterns. Additionally, increasing incidences of droughts, floods, vector-borne diseases in livestock, lead to worsening conditions for marginal farmers. These effects are further exacerbated by a lack of access to mitigation measures and safety nets.

The effects of climate change have already been felt leading to a decline in production, loss of crops (Paudel et al. 2008), loss in acreage and a decline in the livestock population (Regmi et al. 2009). While the negative effects of climate change are expected to be more pronounced as time goes by, studies bizarrely suggest that crop productivity is expected to rise with climate change, especially as a result of rising temperatures. Yields of rice, wheat and maize are expected to rise significantly with the rise in temperatures (Gautam 2008). Similarly, in high-altitude regions, drier winters and a fall in snowfall is likely to lead to a shift in forest lines and change in cropping patterns. This leads to possibilities of cultivation of new crops even while threatening the existing ones (Manandhar et al. 2013). Similarly, a rise in river discharges can lead to increased access to water resources in certain areas as well (Manandhar et al. 2011b). Indeed, cultivation patterns can change due to climate change effects.

Keeping these opposing factors in mind, it is hard to determine the overall impact of climate change on agriculture in Nepal. However, it can be implied that the effects of climate change are likely to be unequal among crops, regions and sections of farmers. Certainly, the poor and marginal farmers are likely to be more exposed to the negative effects, women even more. It is now well understood that climate change affects women disproportionately, compared to men, as they are closer to nature, compared to men. Tasks like food gathering and production; collection of water, firewood and fodder; and collection of medicinal plants for maintenance of health are activities associated with women. These activities require direct interaction with the natural environment and therefore, lead to a higher exposure to changes therein (Dankelman and Jansen 2010).

Besides the household chores, women are also responsible for agriculture and livestock related activities. At present, women constitute 51 per cent of the global agriculture labour force (FAO n.d.). They are also documented as working more than men in the fields, although their working hours are frequently underreported. Additionally, activities related to animal husbandry including grazing of cattle, bringing water and fodder to cattle, milking and cleaning animal sheds are tasks normally designated to women. Therefore, changes in agriculture patterns are likely to affect women more, compared to men. However, in spite of the disproportionate responsibility, decisionmaking is not in their hands. In a rural setting, rights over land, water sources and other natural resources are controlled either by their spouse or other men in the community. Control over income from agricultural activities is largely exercised by men. Therefore, despite the importance of natural resources in their lives, women are often dependent on men in their family and their community for access to and use of resources, both natural as well as financial. Therefore, it is crucial to identify and study the sources and extent of vulnerability to climate change effects among women.

SAWTEE has conducted a study to examine the effects of climate change on agriculture and the impact of the subsequent adaptation practices on women. The rise of temperature in the Hindu Kush - Himalayan region has been more pronounced in the higher altitudes compared to the adjacent hills and plains. Therefore, the effects of climate change are expected to be more pronounced in the Himalayan Region of Nepal.

This study was a district based case study of Mustang aiming to examine the effects of climate change in two

particular VDCs, Marpha and Kunjo. This part of Nepal is on lies on the Tibetan Plateau. Various other studies have already suggested that climate change in the Tibetan Plateau has been extremely pronounced leading to rising degradation of rangeland, changes in climatic patterns and fluctuations in precipitation (Zhong et al. 2003; Gao et al. 2005). Therefore, the study team had expected the effects of climate change to be more pronounced in Mustang.

Secondary information was used to identify the areas of study and to conduct a literature review. The study was qualitative in nature and primary data collection involved a household survey (with questionnaires), key informant interviews and focus group discussions. Six villages in the two VDCs were surveyed. Village chieftains (mukhiya), important farmers and local leaders, members of local farming and cooperative groups and agriculture related government officials of the area were involved in focus group discussions and key informant interviews. Similarly, secondary data was collected from relevant institutions in the study area as well as desk research.

### Climate change perception in the district

There was unanimous agreement, among all respondents surveyed, that climate had changed and that temperature had risen in recent years. While findings on changes in winter temperatures were not significant, respondents invariably agreed that temperatures as well as length of the summer season had increased. Other changes in the climate were also reported—the pattern of rainfall, for instance, was a major reported change. Though responses regarding total rainfall were inconclusive (in Marpha), it was agreed that the intensity of rainfall had definitely increased. A massive landslide was observed in Marpha Village in 2015 which filled the streets of the entire village with mud and debris. The effects were equally significant, although more subtle, in Kunjo. A majority of the respondents there reported a fall in total rainfall but a rise in the intensity of rainfall. Monsoon in Kunjo, which was previously characterized by incessant low intensity rainfalls that lasted for days, had now given way to sporadic but high intensity rains which rarely last for more than a day.

Changes were reported in snowfall patterns too. In Kunjo, a sharp reduction in the amount of snowfall has been noticed recently, but this has been complimented by a rise in rainfall during the snowfall period. In Marpha, meanwhile, participants noted a sharp rise

in snowfall in recent years (last year's snowfall was especially very high). Respondents from both the VDCs agreed that the timing of the snowfall had started to vary recently. The snowfall which was normally observed during the months of Paush-Magh was now observed as early as Kartik- Mangsir and as late as Chaitra-Baisakh. Changes were also reported in the case of hailstones, with Marpha

reporting higher incidences of hailstones and farmers in Kunjo reporting a significant drop. Hailstones have bad implications for the farmers of Marpha. They tear leaves in the apple orchards, damage fruit skin and lead to fungal infection on damaged tissues. These can result in overall injury to the apple trees. Consequently, apples affected by hailstones fetch lower prices due to poor appearance of the fruits.

A change in the wind pattern (especially rising incidences of Northern winds) in Marpha and a rise in extreme wind in Kunjo; a rise in mist/fog frequencies and a fall in frost instances were other climatic changes reported in Mustang.

### Impact of Climate Change on Agriculture in Marpha

The effects of climate change on agriculture in Marpha were primarily noticed on two fronts: a rise in pests and diseases in the crops, and a fall in quality and productivity of the plants. Among these, the rise in pests and diseases has perhaps been the most visible and important manifestation of climate change. Warmer temperatures, especially during the spring season, enhance the development of these pests by abbreviating the egg- and larval periods (Hann et al. 2008). The emergence of new pests also implies absence of natural predators, which further permits faster proliferation.

All crops (including apples) have been plagued by pests and diseases in recent years. Apples, have seen a rise in diseases, like scab, rot and powdery mildew, and pests like zygaena moth and red spider moth. Farmers also reported pests and diseases in staple food crops like naked barley and buckwheat, no to mention cash crops such as vegetables, potatoes, maize and beans. While the Temperate Horticulture Development Centre reports incidences of various diseases and pests in all such crops, most farmers appear to be overwhelmed by army worm (fauzikira) and white grub (khumrekira) as their the major pests. They say that potatoes and apples are the most vulnerable crops.

Rising temperature has a pronounced effect on the productivity of crops, especially apples. Apples in Marpha are high chilling varieties that require at least 1600 hours of chilling between 00 and 70 Celsius for the purpose of flower initiation and fruit colouration.

Chilling requirements, if not completely met, result in irregular and temporally spread out flowering, causing discolouration and inconsistent fruit growth. Experts opine that the rise in winter temperatures has led to increasingly shorter chilling periods in Mustang. This has led to a loss in quality of apples in areas like Lete and Kobang. The increasing number of hailstorms too have affected apple quality, no to mention injuring and bruising apple trees. Such apples fetch lower prices in the market.

To counter these effects, farmers have made some necessary changes in their farming practices, but such changes remain insubstantial. They have increased the use of pesticides to counter the pests in Marpha. Since there are a wide variety of pests, Marpha farmers now think it is essential for them to use pesticides for their control. At the moment, pesticides are provided by the government at subsidized rates via cooperatives or individually.

The role of cooperatives and farmers' associations has been very important in this regard. These organizations have been involved in raising awareness about the facilities provided by the government as well as the importance of the use of pesticides. The most active of such organizations was seen in Marpha VDC, where the local cooperative is forcing the villagers to use pesticides to prevent contamination from "untreated" plants. These organizations are also actively providing the members with the necessary pesticides themselves. These organizations, along with Temperate Horticulture Development Centre, have also been providing training on maintenance of apple trees, including activities like cutting, pruning, fertilizing etc. However, awareness on the proper use of pesticides and participation in the organizations were not found to be uniform across villages. In Syang and Chhairo, knowledge of a proper mechanism to administer the pesticides was not as high as in Marpha. However, improvement in the irrigation systems was reported in these two villages.

A few farmers also reported shifting the plantation time of potatoes and naked barley to a bit earlier, because of the earlier onset of summers.

## Kunjo

The most important change in Kunjo is the loss of apple cultivation. While reasons behind the disappearance of apple orchards are varied, a rise in scab disease incidence, due to the temperature rise is definitely one of those important factors. Warmer temperatures in the winter as well as increased

precipitation during spring leads to the proliferation of scabs. Apple groves have now been replaced by maize, potatoes and other crops. Warmer temperatures have further led to an increased potential for cultivation of crops which were not feasible in the village earlier. Crops like tomatoes, chillies and cucumbers (along with turmeric and ginger which were earlier not possible even in a greenhouse) are now being cultivated in Kunjo. Productivity of these crops, especially chillies, has improved remarkably.

Similarly, lack of rains during monsoon has made life easier for farmers. Weeding has now become easier owing to their low growth (especially in the maize and potato fields which are to be harvested during the months of Bhadra and Ashwin). Also, farmers do not have to work in muddy fields soaked in rain. They now enjoy a pleasant weather and sunshine during the summer and monsoon in Kunjo.

As in Marpha, a rapid proliferation of pests has emerged as an important challenge in Kunjo as well. Incidences of pests are most pronounced in potatoes where the White Grub (Khumrekira) leads to frequent loss of crops. Because there is no permanent motorable access to Kunjo, farmers there have to do the harvesting during the month of Bhadra although potatoes are ready to be harvested during the month of Shrawan. The rains and the rise in river discharge block the road

during monsoon. This period between Shrawan and Bhadra is when white grub infestation occurs. The lack of road access and climate change have both contributed to a loss in potato harvests in Kunjo.

In maize, army worm (fauzikira) has emerged as a major threat, damaging the leaves as well as cob, leading to poor crop quality. Additionally, a rise in incidences of high intensity winds has also led to damage of the maize crops. These winds have damaged greenhouses, trees in the forests and roofs of houses. Similarly, a greater frequency of fogs and mists was perceived to have harmed buckwheat harvests in the village.

These effects have left a major impact on Kunjo residents. First, apple cultivation has been lost. This is a significant loss. Apples sell at approximately twice the price that potatoes sell (the next most valuable produce). Therefore, farmers have foregone a considerable income potential from loss of apples. Secondly, there has been a considerable rise in the use of pesticides and fertilizers in the VDCs. Thirdly, the movement away from apples to maize and potatoes has brought about important changes in the work related responsibilities among the farming families in Mustang, especially in terms of the greater workload that such changes have brought on women. The movement away from traditional food crops like uwa and barley has further affected these responsibilities (discussed shortly).

## Gender relations in Mustang

Household structures in Mustang are found to be matriarchal. Although women's representation in the community level political structure was found to be poor, women were functionally found to be the household heads. They are accountable for holding the household money, designating areas of expenditure as well as savings. It is women who allocate resources and responsibilities to various members of the family in Mustang. Even in the case of remittances, although men were the primary recipients, it was women who were in charge of spending the money.

Women in Mustang also worked considerably more hours working for men. Although the current study did not involve time use analyses, earlier studies have consistently reported that women in Mustang work more than men. While women are equally involved in economic activities, they are far more involved in domestic chores and other activities like water and fuel collection and food processing. In fact, even in areas traditionally identified as "male oriented", like



Shaleen Khanal

agriculture, women in Mustang are more involved in those activities than men. While activities like ploughing, tilling, and digging are expected to be done by men, both women and men are involved in plantation of crops. All remaining agricultural activities were considered the domain of women, although assistance from men was expected. These included activities like weeding, watering, harvesting and fertilizing the soil. So, while the nature of men's tasks was more labour intensive it required working for a week or so during planting seasons. The nature of women's tasks, meanwhile, required them to work throughout the year. Plantation and harvesting seasons were indeed the busiest times for women. During these seasons, besides working in the field, they were also expected to conduct all kitchen related activities as well.

Migration of men has further burdened the women of Mustang. Migration is a male prerogative in Mustang and the resultant absence of this crucial human resource means that women tend to lose important helping hands in various family chores as well as field work. In the field, families tend to hire external labour at certain prevailing rates, but the family chores are entirely left for the women to execute. On the other hand, families that can afford to leave their fields fallow and have indeed done so (in the absence of men and scarcity of labour).

Women of such households have found their workload to have decreased. Therefore, for women in richer families, migration has reduced their workload and made their days much easier.

Changing gender roles have also helped improve the position of women in the community. Women are increasingly in charge of agricultural activities, not only in selecting the crops to be cultivated, but also in terms of organizing and managing the labour force in the farm. They have also started forming women's cooperatives that exclusively support women in the villages. Women themselves are administrators of these groups, and their leadership skills are further enhanced by this experience. While women are traditionally considered the head of the households; cooperatives have given women the opportunity to display their leadership skills in a social context.

### Changing agricultural practices and Gender

Because changes in cultivation practices was not observed in Marpha, lessons drawn in this section have been taken primarily from the Kunjo case where loss

in horticulture (apple) has been replaced by cultivation of other cash crops including maize and potatoes. Besides the loss in potential income, this shift has had a pronounced impact on gender roles. First, apple farming in Mustang is widely considered to be a male task. Activities concerning apples like tilling and maintaining land, cutting and pruning apple trees and application of pesticides and fertilizers are all conducted by men. Meanwhile, for much of the crops that have replaced apples, like vegetables for instance, the rearing and harvesting has to be done by women. Therefore, the shift away from apples has meant that, women's workload has definitely increased. On the other hand, the absence of adaptation patterns in Marpha has been complemented by additional work for men, work related to maintenance of apple orchards in terms of weeding, scientific cutting and pruning and periodic use of insecticides. In Marpha, therefore, albeit to a small extent, the increase in the number of hours required for horticulture implies that the workload for men has increased.

In recent years, changes in cultivation patterns in both VDCs have been towards vegetable farming. Most of the respondents mentioned that vegetable farming is entirely the domain of women.

The study found that all vegetable farming activities are done by women, except plantation when both men and women are involved. Vegetables coupled with food crops require multiple plantations and harvesting every year. Crops like beans, tomatoes, carrots and zucchinis are planted during spring and items like cauliflower and cabbages are planted during autumn. Between the period of plantation and harvest, these crops regularly require irrigation, weeding, tilling as well as fertilizing, all of which are done by women.

Government assistance, although well intentioned, has further incentivized this process of feminization. The government provides seeds and inputs for cultivation of vegetables to farmers in the villages. And, it has traditionally been understood that vegetables are more labour intensive than food crops (Joshi et al. 2003; Subramaniam et al. 2000; Bhattacharyya 2008). A movement away from traditional crops, therefore, implies an increase in the workload, which, in this case, primarily falls on women. For instance, the District Agriculture Development Office provides a one time sum of NRS 40,000 to farmers for cultivation of carrots. Carrots, however are extremely labour intensive. Based on claims by officials who cite locals, carrot farming on a ropani of land requires the labour of at least 90-

95 people. Men refraining from tasks like weeding, therefore, means that this entire burden of additional work is likely to be carried by women. The same holds true for greenhouses as well, where most of the tasks were found to be done by women.

## Conclusion

The findings of the study indicate that the local people of Mustang have perceived that there has been a noticeable change in the district's climate—the temperatures getting warmer and precipitation patterns changing. These also happen to be the most visible indicators of climate change. These effects have manifested in changing cropping patterns in the district, not to mention crop quality and productivity. A rise in pest and disease attacks, falling apple quality and changes in cropping feasibilities (including a rise in production and productivity of some vegetables) can be attributed to effects of climate change. In the event of these climatic changes, adaptation practices by farmers have taken forms of changing cropping patterns (including rise in vegetable farming), and maintenance of crops (in form of increased use of pesticides and increase in weeding, pruning and such activities). Since vegetable farming is largely a women oriented job, this has meant that effects of adaptation practices in Mustang have been skewed in favour of men with women have to work more than men. Any local agriculture and climate change related policies therefore, should not only consider the vulnerability of farmers in this process but also the impact of such policies on women.

## References

- Bhattacharya, R. 2008. Crop Diversification: A Search for an Alternative Income of the farmers in the State of West Bengal in India. In: Proceedings of the International Conference on Applied Economics (ICoAE), Kastoria, Greece, 15-17 May, pp 83-97.
- Dankelman, I., & Jansen, W. "Gender, Environment and Climate Change: Understanding the Linkages." In Gender and Climate Change: An Introduction, edited by Irene Dankelman, 21-54. Wiltshire: Earthscan, 2010.
- Food and Agriculture Organization (FAO). N.d. FAO and the Eight Millennium Development Goals. Accessed at: <http://www.fao.org/3/a-az951e.pdf>.
- Gao, R., Lu, Z., Li, Q., Guan, Y., Zhang, J., He, R., & Huang, L. 2005. Geophysical survey and geodynamic study of crust and upper mantle in Qinghai-Tibet plateau. *Episodes*, 28. 263-273.
- Gautam, A.K. 2008. Climate Change Impact on Nepalese Agriculture and Strategies for Adaptation. Paper Presented in NAPA Workshop Organized by LI-BIRD and Biodiversity International. 23 December 2009 (Mimeo, LI-BIRD).
- Hann, P., Grünbacher, E., Trska, C., & Kromp, B. 2008. Effects of Climate Change on the Dispersion of White Grub Damages in the Austrian Grassland. 8th European Summer Academy on Organic Farming, Czech Republic. September 3-5, 2008.
- Joshi, P.K., Gulati, A., BIRTHAL, P.S., & Tewari, L. 2003. Agricultural Diversification in South Asia: Patterns, determinants and policy implications. MITD Discussion Paper No. 57. International Food Policy Research Institute. Washington DC.
- Paudel, D., Sthapit, B.R., & Shrestha, P. 2008. Stability of Social Seed Networks and Nodal Farmers in Rice Seed Flow System: Does it matter for On-farm Conservation? *Agriculture and Human Values* (submitted).
- Manandhar, S., Pandey, V.P., & Kazama, F. 2011b. Application of Water Poverty Index (WPI) in Nepalese Context: A Case Study of Kali Gandaki River Basin (KGRB). *Water Resource Management* 26: 89-107.
- Manandhar, S., Pandey, V.P., & Kazama, F. 2013. Assessing suitability of apple cultivation under climate change in mountainous region of western Nepal. *Regional Environmental Change* 2013.
- Subramaniam, S.R., Varadarajan, S., & Asokan, M. 2000. India. In: *Dynamics of Vegetable Production and Consumption in Asia*, Ed: Mubarak Ali. Asian Vegetable Research and Development Centre. Taiwan.
- Zhong, C., He, X.R., Li, H.X. 2003. Application of Remote Sensing Technology to Grassland Degradation Assessment in Naqu, Tibetan Plateau. *Remote Sensing Technology and Application* 18(2): 99-102.



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