

Impact of Climate Change on Communities in Phobji and Gangtey valley in Bhutan⁺

*Tshering Yangden**

Abstract

While Bhutan is a carbon-negative country, it still is under constant threats of climate change as it compasses global warming. The most significant impact is the melting of glaciers which has led to the loss of livelihoods including human lives. As Bhutan is a country with dramatic variations of elevation with hot and humid weather in the south to cooler regions in the north, different regions are subjected to different impacts of climate change. Using a qualitative method of research, this study examines the impact of climate change in Phobji and Gangtey Valley under Wangdue Phodrang district in Bhutan, a popular tourist and conservation spot. Previous studies in the same place have concentrated on the impact of climate change on conservation efforts and no studies have been found on the impact of climate change on other forms. This study found that climate change impacted crop cultivation, livestock, gender, and food security. Besides the negative impacts, positive impacts such as the introduction of a new variety of vegetables in greenhouses due to the rise in temperature that leads to improvement of food security have been observed.

Keywords: climate change, livelihood, gender, food security

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* Senior Researcher, Tarayana Centre for Research and Development, Tarayana Foundation. Email: ashisoenadema@gmail.com
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Introduction

Climate change is a global issue. The shifting patterns of weather, rising sea level, and increasing temperature has led to threats to food security, catastrophic flooding, and human-wildlife conflicts. According to the United Nation's fifth assessment report of 2014, from 1880 to 2012, global temperature increased by 0.85 Celsius, oceans have warmed, snow and ice have diminished and sea level rose by 19 cm from 1901 to 2010 (United Nations, 2023). The effect of climate can directly harm living beings, destroy habitats, and impact livelihoods and communities (WWF, 2022).

In spite of being a champion of environment conservation and one of the pillars of the Gross National Happiness (GNH) development concept, Bhutan is not an exception, and the impact of climate change is felt across the country. According to Meenawat and Sovacol (2010), Bhutan faces five climate change vulnerabilities: landslides and flooding, deteriorating agricultural production, impoverished forests, worsening health security, and impaired hydroelectricity generation. Flooding has been triggered by the melting of glacial ice. For instance, glacier melts increased the depth of the *Lugge Tso* in Bhutan in 1994. This outburst caused severe damage to paddy fields, houses, pastures, and forest plantations, 21 loss of human lives, and thousands of fish (Watanabe and Rothacher, 1996). Another outburst of *Lemthang Tsho* (lake) in 2015 led to erosion, widening of the lake's outlet, displacement of big boulders and washed away bridges, horse trails, and activated landslides (ICIMOD¹, 2015). Bhutan has been witnessing unprecedented massive landslides that removed entire stretches of roads at several locations and have threatened human settlements and livelihoods occupying most of the headlines in the media during the monsoon seasons.

Climate change has impacted the natural habitats of wild animals and resulted in increased human-wildlife conflict. Royal Bengal Tigers of the hot plains of Bengal have been

¹ International Centre for Integrated Mountain Development

spotted in Bhutan at an altitude of 11,733 feet (Kuensel, 2017). Black-necked cranes usually sighted in altitudes of 3000 meters and above were found in Zhemgang and Sarpang districts which are hot tropical regions (Kuensel, 2021). Even the Yak herders who are normally cut off from the fast-developing urban areas and spend most of their lives as nomads in the high mountains have begun to notice changes in climate patterns. A sampling study of one hundred elderly yak herders in northern Bhutan to understand their awareness of ecosystem indicated that the herders have experienced warmer weather leading to longer vegetation growing periods, increased rainfalls, droughts, drying up of water sources, and declines in forage areas (Wangchuk & Wangdi, 2018).

The impact on agriculture has already begun to affect the livelihoods of the Bhutanese on which more than half the population depends. Human-wildlife conflict has increased in communities. For instance, tiger attacks have dwindled livestock in Trongsa (The Bhutanese, 2015) and there have been suspicions of attacks on humans. Crop damages and livestock attacks by wild animals have caused major financial losses to farmers. A study conducted on 274 households in Bhutan in 2000 reported a loss of 2.3% of their livestock to wild predators and all sampled households lost crops to wild animals with the wild pig being the most common culprit at 97% (Wang et. al., 2006).

Phobji Valley, the site for this research has experienced varying degrees of rainfall and temperatures. According to meteorological data from NCHM (National Center for Hydrology and Meteorology²) of Bhutan, the average rainfall in Phobjikha in 1996 was 4 mm³ and 0.7 mm in 2023 with a drastic difference of 36.2 mm in 2015 and 36.9 mm in 2017 indicating the erratic pattern of rainfall. There is no significant difference in the maximum temperature from 1996 to 2023, however, the minimum temperature in 1996 was 3.7 Celsius and 9.4 Celsius

² This data is obtained through email from NCHM and hence not included in the reference list.

³ Millimeter.

in 2023 which is a significant increase allowing the growth of new vegetables as explained in the positive impact section below.

Phobji Valley located at 3000 meters and above sea level, in particular, has been the subject of several case studies for climate change and environment conservation by virtue of the place being a highly successful conservation area for the endangered black-necked cranes and its popularity as a tourist destination⁴. However, other impact studies such as livelihoods, livestock, agriculture, and local economy hardly exist. In view of this, this study aims to examine other forms of impacts climate change has on the two communities in Phobji and Gangtey.

Literature

One major impact of climate change is seen in the reduction of rice production in Punakha Valley over the last 20 years. This was triggered by a decrease in water availability due to climate change which led to shifts in crops that need less water (Kusters & Wangdi, 2013). The impact of climate change on the reduction of crop production prompted a study on five key crops⁵ to identify areas of intervention in case their production became unsuitable due to changing patterns of climate (Parker et al., 2017). Six districts were selected in the study including Wangdue Phodrang which showed that both climatic and non-climatic factors influenced the decisions of farmers on continuity of crop production. The impact of climate change on crop production was found to be the erratic supply of irrigation water, crop damage both from drought and wild animals, diseases, and pests (Ngawang et al., 2020). Bhutanese people living in the upper basin of the Brahmaputra River also

⁴ Phobji and Gangtey are used interchangeably because of the fact that the valley comprises of two gewogs administered under local leaders. The valley has approximately 811 households as of December 2023 (as reported by gewog administrative offices) scattered in 49 settlements and some of the major livelihood activities are potato cultivation, timer, fuelwood and non-timber forest products.

⁵ Crops identified were rice, maize, potato, chili and tomato.

experienced a loss in agricultural products due to the continuous depletion of ecosystems (Johnson and Hutton, 2014).

Resource-dependent communities were also assessed for their adaptive capacities to climate change in Nikachu watershed in Trongsa where it was revealed that people's adaptability varied within communities and locations (Choden et al., 2020). A similar assessment was conducted in Trongsa and Bumthang⁶ on farmers with smaller landholdings. With the significant difference in altitude of the two areas, the impact of climate change on these two districts was also different. While Bumthang was vulnerable in terms of health and natural disasters, Trongsa was more vulnerable in terms of livelihood strategies and water (Rinzin et al., 2020).

Past studies related to Phobjikha Valley focused on the impacts of climate change on the ecosystem, conservation, marshland, and migratory habits of Black-necked cranes. In 2014, ICIMOD and RSPN conducted a joint study on the assessment of natural and human disturbances on the wetland ecosystem which also included a brief assessment of livelihoods in Phobjikha. The study recommended diversification of livelihood options by breaking the monoculture of potato cultivation and linking communities to the tourism supply chain of food and craft products in order to reduce poverty. A report compiled by the Royal Society for Protection of Nature (RSPN) in the same year also on the impact of climate change on the wetland ecosystem in Phobjikha. Another study by Chaudhary et al. (2017) on the impact of land cover change on the ecosystem found that the decrease in land cover as a result of conservation efforts has implications for the livelihoods and biodiversity of Phobji Valley. The authors suggest guidance from leaders to use integrated and holistic approaches to both conservation and community development activities for long-term sustainability and to reduce pressure on forests and marshes.

⁶ Bumthang (2,600-4,500 m), Trongsa (2,108 m)

Perhaps, the closest study of the types of impact of climate change is the study conducted in Khotokha Valley. Khotokha also in Wangdue district has a similar altitude and landscape to that of Phobjikha Valley. Similar to Phobjikha, around 90% of the communities depend on potato production and livestock. The study indicated that climate change has reduced precipitation, increased rainfall affecting yield, increased pests and new invasive weed species have colonized pastureland preventing the regeneration of fodder (Suberi et al., 2018).

Methods

Three approaches of qualitative methods have been used for this study: textual analysis, focal group discussions, and key informant interviews. Because of the popularity of Phobji and Gangtey Valley as conservation sites, the areas were selected as most of the studies conducted were on the impact of climate change on the ecosystem, and studies on other forms of impacts have hardly been explored. Separate sets of semi-structured questionnaires were prepared for both FGD and key informants.

Textual analysis: Existing literature, reports, media contents, and other related documents were analyzed to extract an understanding of climate change impacts in Bhutan. In particular, the literature review concentrated on studies in Phobjikha Valley in order to examine gaps left by previous studies.

Focal group discussions: Six focus group discussions were held between October 2021 and March 2022 to gain an in-depth understanding of the impacts experienced by the communities in the valley. Three communities of Kumbu village under Gangtey gewog and Zizi and Drangha villages under Phobji gewog were selected based on information from local leaders and their in-depth knowledge about the places. Two focal group discussions were held in each site comprising of a group of men and another group of women. This was done to capture the gendered impacts of climate change and enable, observe, and interpret experiences from different approaches.

Relying on a single gender does not provide a true picture of experiences as climate change affected men and women in different ways. This is because of the power dynamics between men and women in gender roles, decision-making, and social relationships that provide a framework for the existence of social order in the communities besides biological sex (United Nations, 2019). Each focal group discussion had a minimum of ten participants with the highest number at twenty-five within the age range of 10 to 60.

Key informants: A total of five in-depth key informant interviews were conducted between October 2021 and March 2022. Two local leaders of Gangtey and Phobji Gewogs, one conservation expert, one GLOF specialist, and one organic farming expert were interviewed based on their first-hand knowledge and direct dealings with climate change issues. The two local leaders were elected members who grew up in the communities and were aware of government policies on climate change whereas the specialists have years of working experience in relation to climate change and related fields.

Ethical clearance: Any study that involves sensitive topics especially subjects that concern health issues requires ethical clearance from the ethics committee in Bhutan. However, general topics that do not impact human beings personally can be studied without ethics clearance but are subject to consent from interview participants. As such, a brief background on the purpose of the research along with a consent form was prepared to inform participants of their rights to withdraw at any time, confidentiality, and anonymity in the process of participation in research. Consents were obtained from all participants and where possible were captured in the audio recordings.

Findings

Impact on crops

The impact of climate change has been disruptive at all stages of local food production until consumption. The focal group

discussions with the communities showed that the rising temperature has disrupted the normal growth stages of potatoes which is the main cash crop of the valley. The ripening season of potatoes has become erratic and people cannot plan the actual time of harvest. This has also led to confusion in sowing and harvesting time. Without proper planning, any mistake in the calculation of sowing and harvesting periods also leads to crop damage such as the appearance of new invasive weeds, reduction in yields, and diseased and stunted size of crops with odd shapes. This has indirectly affected livestock fodder. Turnip, mustard plant, and buckwheat which are used as cattle fodder are rotated throughout the year with potato as the main cash crop. The yield of crops other than potatoes has also decreased. The sizes of turnips which were once enough to feed the cattle of one household have reduced and the yield of buckwheat and mustard plants has decreased by almost a fourth of normal production. The communities pointed out that the once fleshy turnips have now started becoming hard, diseased, and half edible which the cattle reject after a few bites. The yield of potatoes itself has halved over the course of the past few years. Production of crops was further impacted by the shortage of chemical fertilizers in the past two years because of COVID-19 restrictions. There has also been a shift in cover of snowfall which has been decreasing annually leading to a reduction in cold periods.

The impact of climate change on agriculture is not new. Chhogyel and Kumar's study in 2018 showed that between 80-90% of crops in high altitudes were lost to blast disease and windstorms destroyed maize crops belonging to hundreds of households as a result of climate change. The communities in Gangtey and Phobji Valley are also dependent on rainfed springs susceptible to climate change. However, a study by CNR (College of Natural Resources) in 2022 found that the level of awareness among the communities about the impact of climate change on water sources and its protection strategies was minimal (Wangmo et al., 2022).

Impact on livelihood

The people in the Phobji /Gangtey communities mostly depend on the domestic sale and export of potatoes for their income. Their earnings from the sale of potatoes are supplemented by engaging in daily wage work at construction sites which pay them approximately 300⁷ to 400 Ngultrum per day. When there is a dearth of wage work within the valley, men move out to other districts in search of work. People living on the Gangtey side of the valley traditionally migrated with their cattle to the lower region in winter where they owned rice fields and moved to Gangtey in summer to grow potatoes. However, in recent times people have stopped the winter migration as potato export has become more lucrative and the paddy fields in the lower regions have been left fallow. The shortage of rice is easily replaced by the excess cash they get from selling potatoes. People living higher up in Kumbu Valley occasionally moved to the highlands to collect cordyceps for additional income which also has declined either due to overharvest or climate change of which the people are not clear. In addition, there are a significant number of houses licensed to operate homestays for both international and domestic visitors which provides a good source of income. However, this source of income is unreliable as seen with the recent COVID pandemic and communities must fall back on farming and livestock for their livelihood.

The communities belonging to the Phobji valley do not have the migratory tradition, unlike the people on Gangtey side of the valley. They depend solely on potatoes and livestock for their income. In addition to the damages to potatoes from heavy rain, many of the households have small landholdings which are fragmented further when inheritances are passed on to children and some were landless and lived on leased land. The farmers in Zizi village used to supplement their income by going to urban places and beg for rice or money which have been now banned by the village leaders. Therefore, any negative impact from climate change affected their source of income from crops. The decrease in income also affected the

⁷ Approximately Nu. 80 per 1 US\$

environment as people had to depend on forest for roofing which must be replaced yearly amidst strict government restrictions. People with smaller landholdings in Phobji community do not have enough money to buy CGI (corrugated iron sheets) for roofing purposes.

The communities further relied on the use of chemical fertilizers to increase the yield of potatoes. When crops are damaged due to erratic rainfall, frost, and snow, the drop in yield decreases their income and the farmers are unable to pay back the loan they take to buy fertilizers. The alternative way is to switch to organic farming by increasing the number of livestock to produce manure. However, traditional fertilizers did not increase the yield as much as chemical fertilizers, and people were willing to go organic only if there was an increase in yield or if organic products fetched premium prices to compensate for the extra labor they must invest. Increasing the number of livestock for fertilizer also becomes labor intensive mostly for women and people have less time to search for and participate in alternative sources of income.

Interestingly, a woman who had been organic farming for the past 28 years has stated that the soil has remained soft and easy to farm year after year. She experimented with chemical fertilizer in a separate land and after one year, the soil became hard to plough even with power tiller. When a large quantity of cow manure was spread, even the weeds were reduced and there was not much difference in labor consumption when compared with labor requirement in chemical fertilizer. While not much difference was noted in actual labor use between organic and chemical fertilizer farming, the biggest difference was the time consumption in the preparation of cattle manure. Chemical fertilizers can just be bought from markets and spread easily while a huge number of cattle is required to produce manure for organic farming. The time spent caring for the animals becomes a full-time responsibility and a household must dedicate a person to the job, again mostly women. While this section discusses climate change's impact on crops, the

debate on the intensity of use of labor between organic and non-organic farming is an interest of further research.

Impact on food security

Climate change has initiated a vicious circle of food production and has created multifold impacts. While production is affected by the deterioration of soil quality, the food supply has become unstable, and the quality of food consumed deteriorates as lower-income people cannot buy nutritious food thereby even affecting mortality. Except for some vegetables, all other necessities must be bought from shops including rice, cooking oil, salt to detergents. The loss of yield and productive soil on a yearly basis becomes the biggest threat to food security.

Another indirect impact on food security is the increase in waste and the difficulty in its management. The communities talked about how the valley would rarely see waste from manufactured products and all they could see were bones from dead animals and dead wood logs. With many factory foods available in shops, people can now see plastic wrappers, pet bottles, and other products that are not biodegradable. There was no organized waste collection and some of the plastics were consumed by the cattle grazing in the valley and many livestock have been lost because of it. The people reported that when autopsies were performed on the dead animals, large quantities of plastics were found in the stomach. The loss of livestock also impacted food security as local dairy production declined.

Impact on gender equality

The negative impacts of climate change are known to increase gender inequality reducing women's ability to be independent (Eastin, 2018). The equal access to opportunities granted by the Constitution provides a ground for equal development among different genders. However, in practice, traditions and social norms still are the overriding factor for the division of work among men and women. Thus, depending on the roles, the impact of climate change is different for men and women. Similarly, the same factor is applicable in Phobji and Gangtey

valleys where tradition plays a major role in work division among men and women.

It is mostly men who go out to work and women engage in potato farming and household work. While the general opinion was that men and women did equal work, on questioning further, it was found that women did housework, cattle herding and feeding, looking after children, and cooking, whereas men got more leisure time to play sports. Decision making depended on who the head of the house is. Mostly women headed households but it was felt that women did not have the capability of men as heads of households. Daughters usually inherited land and as such, women's mobility to seek better opportunities elsewhere is restricted. It also begs the question of which part of the land is inherited by women: rural or urban. One response from a participant was that urban lands which have much higher market values are inherited by all siblings whereas rural land which is much lower in value is inherited by women. It may be argued that if both sons and daughters inherit equally in urban places, women have additional inheritance in the villages. However, it must not be forgotten that the very fact women are tied to their rural inheritance restricts their mobility beyond their own communities and therefore have very less opportunities to reside in urban places. In addition, any impact of climate change on the community is borne by women as they are the ones left behind in times of calamities.

Many women are also not able to attend meetings at the local government where they can voice their needs to the leaders. Because of their role in taking care of the household and children, it is mostly the men who attend important meetings. Women would instruct their men to pass on their needs to the leaders but whether the men follow the instructions or not remains unclear. The non-communication of women's needs to leaders affects climate change adaptation strategies for them.

While the above argument is that women face the impact of climate change more than men, this can be a subject of debate

in some cases. From the interviews conducted in Phobji and Gangtey Valley it was evident that most of the decisions in the households are made by the matriarch of the family. The woman of the house is responsible for the division of work among family members. Thus, if men went out of communities to look for work to bring in additional income and leave women behind for household chores, it was at the direction of the matriarch. This creates an artificial feminization of work in agriculture because men come back to work in the fields during the time of plantation and harvest and other important work activities. The absence of men most of the time in the communities seems to be deliberate decisions made by women heads of households and does not seem to be an issue where men and tradition can solely be held accountable for the inequality in work division.

Another assumption that the drying up of water sources due to climate change impacts women more than men can also be questioned in present times as women no longer have to travel far to fetch water. With development, water connections are brought to the doorsteps, and in fact, if the pipes are damaged, it is usually the men who go out for repair jobs.

Impact on livestock

Contrary to the impacts of climate change faced in other parts of the world such as drought, diseases, and environmental changes leading to fewer livestock products (Singh, 2022) the valleys in Gangtey and Phobjikha are facing different types of impacts on their livestock. Due to the increase in temperature, wild wolves that were previously found in lower lands have migrated to the valleys threatening the very existence of cattle. The valley has also become an attraction for predators as unproductive old-aged cattle are brought to the valley to graze on the limited grassland. In the process, both stray and owned cattle become equal prey to wild dogs, leopards, and even stray dogs. Households reported having lost cattle to these predators on a weekly basis. Some households have lost between 10 and 20 cattle in a year thereby affecting livestock products and ultimately leading to food insecurity.

Positive impacts

The rise in temperature and increased intensity of rainfall had a positive effect on household chores such as water and firewood collection. The decrease in the amount of snowfall and frost has made it easier for the locals to step out of their homes and perform essential household chores. The introduction of electricity in the valley and the community's dependence on natural resources for cooking and heating has also been greatly eased. Some positive impacts felt are because of warmth, new crops vegetables could be grown in greenhouses. This has made the communities become self-sufficient in vegetables which otherwise they would have to purchase from warmer places that need long-distance travel. Greenhouses are the only places where none of the farmers use chemical fertilizers and produce healthy organic vegetables. The only complaints the communities have voiced against vegetable cultivation in greenhouses were the lack of facilities for winter storage for excess produce and the lack of knowledge for value addition.

Conclusion

Even though Bhutan is the only carbon-negative country in the world, Bhutan is not spared from the impact of climate change as seen in the melting of glaciers and lake outbursts leading to the destruction of the livelihoods of the people. The communities in Phobjikha and Gangtey also face their own share of climate change impacts such as the appearance of new invasive weeds, new crop diseases, loss of livestock, and threatening food security. Not every impact is negative. One of the positive impacts that the valleys experienced was the introduction of new crops in greenhouses which otherwise the communities would have to buy from lower warmer regions. The COVID pandemic also helped the communities realize that depending on import for fertilizers is not sustainable in the long run when similar incidences occur.

Recommendations

Predators: While the human-wildlife conflict is between humans and wild boars, leopards, and wild dogs, the biggest threat is wild dogs preying on grazing cattle even within the human settlement areas. Communities hardly reported the loss of cattle to predators as they felt that the government hardly took notice of their complaints and did not receive any compensation. Thus, there must be a strategy to reduce the declining number of livestock that affects food security.

Encouraging women to voice their opinion: Women cannot attend most of the meetings because of their nurturing and caring role in the households. It is the men who attend most local government meetings, and the voices of the women are not communicated to the local leaders. There must be awareness programs on the importance of women's participation in important community meetings.

Research in the weather pattern: Due to the increase in temperature, some farmers have been confused about the potato sowing season which affects the yield. Therefore, research needs to be conducted about the gradual increase in temperature over a number of years so that farmers can predict their crop cultivation time.

Exploring livelihood beyond farming and tourism: Because of the lack of alternative work besides tourism and farming, many of the men venture out of the valley in search of work thereby leaving women and children behind to combat any impact of climate change. Introducing new forms of work activities such as the value addition process of excess crops or other skills could retain men within the households and support the family.

Awareness of burning plastic waste: The easiest form of waste management for the communities in Gangtey and Phobji valleys was burning waste. The farmers are unaware that burning waste induces climate change. Therefore, occasional

awareness programs about proper waste management should be introduced in the communities.

Limitations

The study is limited to Phobji and Gangtey Valley in Wangdue district and is not representative of the whole country.

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