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Climate Change Adaptation and Sustainable Livelihood: Perception from the Indigenous Sherpa Community from the Mountains of Nepal

Anuska Joshi* and Riyanti Djalante

Institute for the Advanced Study of Sustainability, United Nations University - Jingu-mae, Shibuya-ku, Tokyo, Japan

Abstract

The vulnerability of Nepal to climate change and its low human index makes adaptation very crucial to combat the impacts of climate change, while ensuring sustainable livelihood. One such highly vulnerable community in the Himalayan region of Nepal is the Sherpa communities who have long been the face of mountaineering, and have established their livelihood around the harsh topography of the mountain. As the climate model projections point towards already changing and potential future impacts in the region, it is a question of concern as to how the community perceive these changes and the threat and what kind of adaptation measures they have taken up as a response to these changes. Location specific studies in the area are very less, albeit the transboundary studies in higher elevation. This study aims to find how the community perceives the changes and potential threats of changing climate and if they have been adopting any adaptation measures. The study also aimed to research if they connect these adaptation measures as a way of sustaining their livelihood. This research shows that despite being regarded as a highly vulnerable area, the indigenous Sherpa people are highly unaware about the ongoing climate crisis, and also do not perceive it as a serious future threat. However, they have been adopting autonomous adaptations in response to the harsh climate.

Keywords: Climate change; Impacts; Adaptation; Sustainable livelihood; Nepal; Indigenous community

Introduction

The IPCC (Intergovernmental Panel on Climate Change) Fifth Assessment Report (AR5) highlights anthropogenic climate change having widespread impacts on both the natural and human systems, with each decade being successively warmer since the 1850s (Pachauri & Meyer) increasing at approximately 0.2°C per decade (Allen). The report also projects the continuing rise of temperature throughout the 21st century, implying the persistence and increase of climate related disasters and extreme events (Pachauri & Meyer) [1]. As such, the climate related hazards are expected to create new risks as well as exacerbate the already existing one, with such risks being unequally divided and having greater impact to vulnerable communities and places (Pachauri & Meyer). There has been various documented impacts of climate change in the indigenous community of the Himalayas where glacial melts is affecting millions dependent on the seasonal flow of water, (United Nations Department of Economic and Social Affairs, 2019) [2].

In the case of Nepal, specifically the groups residing immediately downstream from glaciers being the most vulnerable due to risks of outburst floods as well as reduced reliability of local water sources (Shretha). The various studies done on the Hindu Kush Region pointed out to the possible implications of climate change in the way of life of the people, and also other cross cutting issues faced by the people there, including gender vulnerability and migration associated with income generating activities [3]. As the way of life of people correlates with their use of their natural surroundings, impacts in the natural system evidently brings impacts to the livelihood of the people. Especially in the case of many of these pastoralist communities, the way of the system has been existing stably for centuries, only to be disrupted heavily within a short duration time. The impacts are further made worse due to poverty, inaccessibility as well as social marginality (Merrey, Hussain, Tamang, Thapa, & Prakash) [4].

The mountain terrain are steep and harsh and the indigenous peoples have survived in this harsh and often unpredictable mountain environment for millennia (Aldendelfer & Zhang); with the

environment shaping tradition and unique lifestyle of the indigenous people and the people shaping the Himalayan landscape (Konchar) [5]. Most of the impacts observed in the rough mountain terrains are linked to supply service, like water and resource access, societal and cultural service, like agriculture and tourism, and habitat service, like the upward migration of species (Mukerjee, Sinisalo, Nusser, Garrard, & Eriksson) [6]. The impact of changing climate also embeds deep into belief system, for instance, the Sherpa community believe that the melting of ice and snow is like an apocalypse that will occur if they are inattentive to their Buddha Dharma (Practicing of Buddhism) (Allison) [7].

Like with other Hindu Kush Himalayan regions of the world, the indigenous people in the far flung places of Nepal are placed into so called “lower class” social hierarchy, giving them even lesser access to power and resources, making them even more vulnerable (Goodrich, Udas, & Larrington-Spencer) [8].

This research deals with identifying adaptation strategies and perception of one particular indigenous community, the Sherpa Community in Lukla of Nepal. Such location and perception aid in contributing local scenario on the global climate change model and also planning adequate and effective adaptation measures (Lamsal, Kumar, & Atreya) [9]. Not all vulnerability are consistent, and the vulnerability is depending on the contextual situation, and thereby lack of grass root studies in specific areas could have an over generalization of the situation in a larger area. However, the use of indigenous

*Corresponding author: Joshi A, Institute for the Advanced Study of Sustainability, United Nations University - Jingu-mae, Shibuya-ku, Tokyo, Japan; E-mail: anuskawrites@gmail.com

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communities' response to the changing climate, and the integration of their knowledge in climate change has not been well documented in the case of Nepal (Magar), (Ministry of Science, Technology and Environment, Government of Nepal) [10]. In the case of Himalayas, oftentimes specific knowledge about the wellbeing of rural areas are not readily available while the impacts of climate change on the natural resource and livelihood of people have been predicted (Sharma, et al.). Mountain ecosystem are some of the most fragile ecosystem on earth while also being a key source of water, energy, mineral, forest and being important in development as well as ecological sustainability (Machi, Gurung, & Hoermann). But due to their remoteness and fragility, the communities often have a very limited livelihood options and are further exposed to climate variability and changes along with economic pressures and increasing pressure on land and resources (Pandey, Jha, Alatalo, Archie, & Gupta) [11]. These pressures can lead to further ecological imbalance and is projected to threaten the relationship between human and environment in the long run (C & Yohe), which means that unsustainable use and overexploitation could put more pressure on future generations compared to the already marginalized mountain populations (Pandey, Jha, Alatalo, Archie, & Gupta) [12].

The specific research question for the study is as follows:

“What kind of adaptation strategies are the indigenous Sherpa community of Lukla taking in response to the changing climate and in what ways does it help them in sustaining their livelihood?”

Methodology

As this study was highly based on the perception of the indigenous Sherpa people living in Lukla, the framework applied was the social constructivism approach with interpretive framework, whereby research participants were asked semi-open as well as open-ended questions. The analysis was done based on their description and perception, which were dependent on their view of their environment and community and the changes taking place [13].

The necessary ethical approval was acquired. A consent form was created to make people aware of the aim and objective of the research the premises under which the data obtained will be used.

Data collection

For this research, primary as well as secondary data were collected for the study. Necessary climatic and social data were obtained from reports and articles during literature review process [14].

Household interview as well as focused group interview survey was done in the study area to get information about climate change trend and adaptation strategies of community people to the impacts of climate change. Convenience sampling along with snowball sampling was done, as the guide from the indigenous group determined the route to be taken and people to interact [15]. Also, respondents went on increasing with the recommendation of the locals. This was necessary due to constraint regarding language barrier. The sample size was decided to be 25 households for around 50 household in the study area [16]. While there is no definitive ideal sample size for qualitative research, the sample size was decided upon attainment of saturation (Glaser & Strauss), as well as barriers regarding time, resources as well as language. Focused group discussion was done with local stakeholders with the target groups being elderly communities, farmer groups, women group, local politicians, government representatives as well as representatives from any locally placed NGOs or INGOs [17]. Key informants' interview with semi structured interview was advantageous in directing the conversation as well as getting locally

relevant information. The key informants were representatives from community, local organizations as well as local and national planning community [18]. Field observation was crucial in the study to observe firsthand the existing condition of the place, the population dynamic as well as socio-economic condition. Important observations was mapped and recorded to parallel with the responses from the community people [19].

Data analysis

For this research, the qualitative analysis was done based on the preliminary stages of the research which included selection of research paradigm, participants, semi-structures questionnaires, transcription and literature review (Akinyode & Khan) [20]. First the data was logged, notes and anecdotes were collected, the data was coded and thematic areas were identified (Akinyode & Khan). The social data was categorized, coded and database was maintained in MS Excel. Content analysis was done by categorizing and tabulating the data [21]. Coding was done manually to represent theme or idea. These themes were identified based on repetition of information and from the respondents, and also based on the graphs derived from Excel. Due to the small number of sample size, this was done manually without the use of any software [22].

Description of Study Site in Nepal: Lukla, Everest Region

Nepal is a small country with an area of about 800 kilometers along the Himalayan axis by 150 to 200 kilometers across with an area of 147,181 square kilometers. It is a landlocked country bordered by India on three side and China's Tibet Autonomous Region to the North. Home to some of the highest peaks in the world, the entire territory of Nepal is considered in the Hindu Kush Himalayan Region (Wester P. , Mishra, Mukherji, & Shrestha) [23].

Lukla is a small town in the Khumbu Pasanglhamu rural municipality of Everest region of Nepal (Figure 1). It is situated at 2,860 meters elevation and is regarded as the entry point of visitors heading to the Mount Everest. Lukla is a small airstrip with many lodges and shops, and Chaurikharka lies about half an hour walk downhill from Lukla [24]. For the Sherpa people living in Lukla, the major transportation system connecting the place to the capital is still airways (Figure 2). The Lukla Airport, or the Tenzing Hillary Airport, is the only air strip in the area, and is even regarded as the third most dangerous airport, in regard to its topography [25].

The municipality's hydrology is heavily dependent on and influenced by the Indian monsoon and also the temporal redistribution effects due to glacier and snow melt (Thapa & Shakya). Highest precipitation in this region occurs during the summer monsoon in between the months from June to September, which comprises of 75%-85% of annual precipitation [26]. The winter precipitation occurs during the month of January to March and is influenced by mid-latitude westerlies (Lang & Barros). The local precipitation in different areas of the municipality varies depending on elevation and topography, and differs from 500 to 2,500 mm (Thapa & Shakya) [27]. The Khumbu region is also home to 278 glaciers, which covers the around 44% of the area, which is 482Km² (Mool, Bajracharya, & Joshi). The snow cover in different places varies seasonally and can extend below 3,000m (Thapa & Shakya). Also, the maximum glacial accumulation occurs at elevations above 5000m (Ageta & Higuchi) [28].

Out of Khumbu's total residents, which is about 3,500, 90% people are Sherpa, while the remaining 10% of people are from Rai, Tamang, Brahmin, Dalit or Chettri communities (Sherpa & Bajracharya). All the

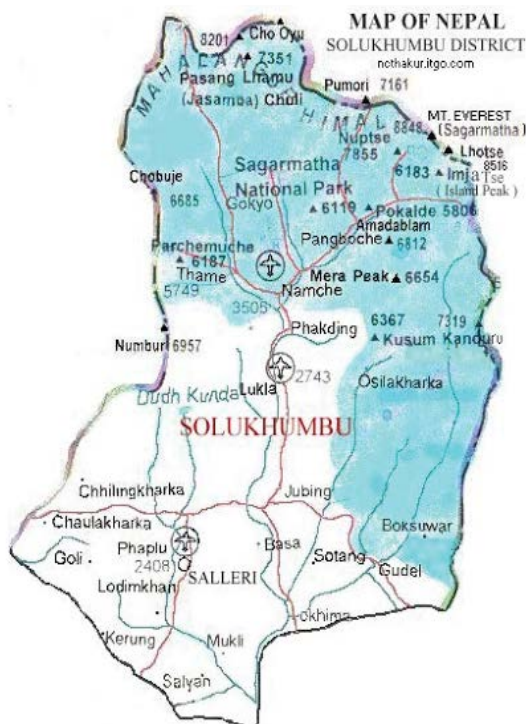


Figure 1: Map of Nigeria Coastal Zone.



Figure 2: Satellite Image of Study Site.

respondents to this particular research are from the Sherpa community [29]. Most of the livelihood in the entire Khumbu Pasanglhamu municipality is based on agriculture, pastoralism and tourism (Sherpa & Bajracharya). Previously there was high dominance of agro-pastoral system that was dependent and varied based on elevation, seasonally determined cropping and grazing patterns (Stevens). Even the settlement is not always permanent in the entirety of the Khumbu Municipality, where they are dependent and defined by bioclimatic locations [30]. The mid-elevation settlements are permanently occupied, also referred to as 'Yul', which usually have 80-170 households. High-elevation summer places are called 'Yersa' and low-elevation winter place are called 'Gunsa' (Mcdowell, Ford, Lehner, Berrang-Ford, & Sherpa) [31]. In this, Lukla is a permanent small town, which consists of yearlong stay, however, mostly during winter, and during less tourism inflow season, some people migrate towards Kathmandu and other places. This seasonal migration towards Kathmandu has been reported in

earlier studies too, where people travelled to Kathmandu and brought income directly or through remittance to relatives living in Khumbu (Stevens) [32].

The Khumbu region has been shown to have a high ecological sensitivity, very high Glacial Lake Outburst Flood risk, and has high multiple risk index (Ministry of Environment). On the other hand it has low infrastructure adaptation capability, making the combined adaptation capability very low (Ministry of Environment) [33]. The landslide vulnerability of the region is also quite high, and the overall vulnerability of the region is high. This estimation has been done based on the integration of combined sensitivity, combined adaptation capacity, and specific and combined risk exposures (Ministry of Environment). Based on this vulnerability mapping, the Khumbu region is a prioritized district for adaptation against GLOF and also landslide (Ministry of Environment) [34].

Results and Discussions

A Community Vulnerable but Unaware about the Impacts of Changing Climate

This is a very interesting case of where people are perceiving changes in the climate, without having knowledge or even hearing about the ongoing climate change and associated crisis. Out of the 23 households in Lukla that were interviewed, respondents from only 3 households reported to have heard of climate change [35]. But, when they were asked if the climate of the area was different than that of 25 years ago, then the response was uniform; that they do see the changes in the climate of the place [36].

Most of the changes in the climate seen and reported by the respondents in the area were reduction in snowfall, increase in temperature along with increase in rainfall [37].

The Department of Hydrology and Meteorology lacked the meteorological data from the meteorological station in Lukla, which is a barrier for efficient climate change analysis, and that the localized effects in regards to the changing climate on Khumbu region remains yet to be well understood (Sharma, et al.) [38]. While there was a lack of meteorological data from the department, the perception of the people regarding these changes does correlate with the reports and other literature reviews regarding the same [39]. There was a rise of mean annual temperature of 0.057 °C a⁻¹ across the Himalayas

between 1971 and 1994. (Shrestha, Dibb, & Mayewski) [40]. There has also been reported trends of decreasing total precipitation, which also showed change in precipitation phase, with lesser precipitation falling as snow in the north-western Himalayas between 1996 and 2005 (Bhutiyan, Kale, & Pawar).

Cultural reasons as a cause for changing climate

More than half of the respondents from the household survey mentioned that they have no idea about the reason behind the changes that they have perceived. This is also parallel to their response about not knowing about the term climate change either [41].

According to them, the natural system has always been there before the human, and therefore, the changes are something that cannot be influenced by human, and neither controlled. Only a couple household respondents were aware about industrialization and use of fuel wood as contributors [42].

During the household survey, one of the respondent claiming religious and spiritual reasons behind the changes was a monk, and the other was a local respondent [43]. However, during many informal discussions and talks with the local people, many individuals supported religious and spiritual reasons behind these changes [44]. The people believed that any disobedience to Buddhist principals would result in negative impact to the place and the people. The same fact was also shown by Allison in his studies of spiritual significance of glaciers, who stated that for Sherpa melting of ice and snow is an apocalypse which will occur if they are inattentive to their Buddhist practices (Allison) [45]. They strongly associate this to the sacrifices of animals, and believed that whenever any animal was sacrificed in the vicinity of Lukla, it would anger the gods and bring about disaster [46]. This is also an indicator of how inflow of other religious/social groups of people result in varying opinions about rituals. While for Sherpa it is a sin to sacrifice, some new groups in the area sacrifice is a necessary cultural ritual [47].

Moderate impact perceived due to changing climate

Nearly 80% of the respondent claimed that they feel the impact of the changing climate is moderate as sometimes their crops have collapsed as a result of storms [48]. However, they might have not felt the impact to be high despite the crops failure because their higher income dependence is in tourism sector. Only one person claimed to have had his roof blown away during a wind storm [49]. And only two people felt like the impact of climate change was high because their entire field of crops was destroyed because of erratic rainfall [50].

Also, people do not perceive a big impact on the natural assets that they have. In fact, according to the locals, the environment around them, including the forests has never been better, since the community people came together to conserve their forests decade ago [51]. According to the people, decades ago the forest around the area was completely devastated, to use the wood for building their houses. However, once the people realized that the degraded forest resulted in decrease in water source and increased risk of disasters, the people came together and made rules for conserving the forest [52]. And now, they still have that strategy and afforestation programs in place, and the majority of the locals feel that there has been no impacts to their forest, or to the water system. Most of them mentioned that their “daily life has always been like this, have not noticed anything about changing weather and about any different future scenario” [53].

In Lukla region itself, people have not seen lives claiming disaster relating to climate, as Lukla lies in a sheltered region away from major icefalls, glaciers, and its river system lies below the settlement area, thereby protecting them from flood (Figure 3) [54]. However, they do mention the risk of avalanches higher up. All the people responded to decrease in snowstorm incidences, along with decrease in snowfall. Majority of people also responded to decreasing forest fire, drought, hailstorm and diseases [55].

Women have often been regarded as more vulnerable to the impacts of climate change and challenged to cope with the associate hazards of changing climate (Anup) [56]. This is often time because of gender inequality. However, as the respondents during the Focused Group Discussion with the Women’s Group pointed out, in the case of Lukla, and in Sherpa culture, there is no gender bias, and the workload is distributed equally [57]. But having said that, the women also pointed out that usually when the men go on longer treks and mountaineering expeditions, then the responsibility of farming and maintaining the household comes to them. However, the decision power regarding any activities would be in their hand more than in the hand of their male counterparts [58, 59].

Mr. Phuri Kitar Sherpa, who has been in tourism business for three decades claims that there are many threats to tourism in the future [60]. He notices changes in the snow amount in the trekking routes, and also the increasing temperature. He claims to notice visible changes around Mera Peak, which now has very less amount of snow, believes that mountaineering in the future will be very risky with the increasing temperature, as it is now reducing the density of the snow [61]. He mentioned that with the reduction in the density of the snow, there will be more accidents, as during mountaineering, the climbers have to dig their equipment in the snow. He also believes that the Khumbu icefall will continue to be more dangerous in the future [62].

Alarming ignorance regarding future climate change impacts

People here believe that climate change will not increase and cause impacts in the future. The reasons given were that weather fluctuations are natural, and they will not cause any serious effects, or that being

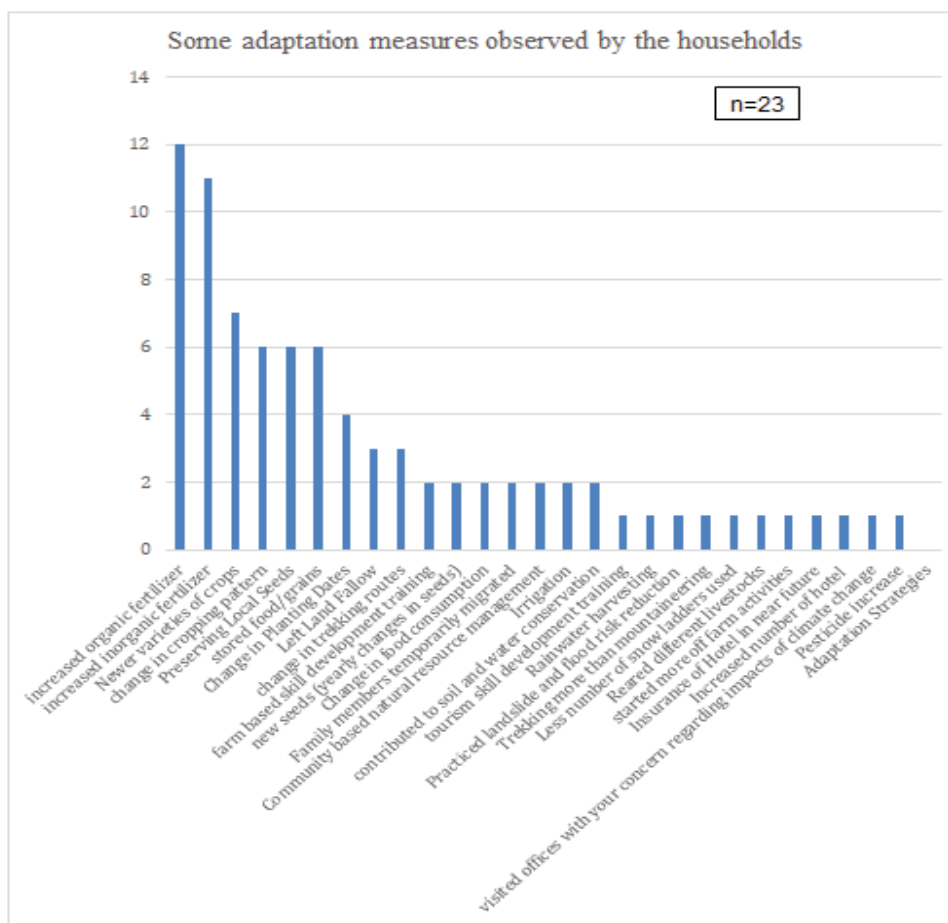


Figure 3: Graph Showing Adaptation Strategies Adapted by the Sherpa Community People in Lukla.

under God’s grace, they would be safe [63]. The key informant interviewees and focused group with the high school students showed that they believed the changes would continue to increase and so would the impacts [64]. The focused group discussion with local leaders also showed their belief in increasing impacts, however the majority of local people do not feel threatened by the changing climate [65].

There are many reports that point otherwise; that point towards the fact that the climate change impacts on the mountain community is projected to keep increasing [66]. Not only the local communities, but the entire countries in many places of the world dependent of mountain for water are in a risk of decreasing water availability in the future, because of climate change leading to extinction of permanently cyrospheric areas (Barnett, Adam, & Lettenmaier), (Viviroli, Dürr, Messerli, Meybeck, & Weingartner), (Bolch, Pieczonka, & Benn), (Kääb, Berthier, Nuth, Gardelle, & Arnaud), (Soncini, et al.) [67]. As the temperature of the world increases, the impacts are projected to hit the Hindu Kush Himalayan region including Nepal, and as the global temperature rise by 2°C continue to disrupt climate system and biodiversity, it would also cause resulting warmer days, changing rainfall patterns, extremes, high altitude ecosystem destruction in the Asia along with glacial melt and forest degradation and shifting of tree line with biodiversity loss (Dahal, Ojha, Baral, Branney, & Subedi). Also the IPCC also state that by 2050, 25% of the global mountain glaciers would disappear (IPCC, 2014) [68].

How people perceive the climate change is very important in determining the steps they are willing to take to cope in the short term and adapt to the changes in the long term (Deressa, Hassan, & Rangler) [69].

The perception of Lukla Sherpa people regarding the changes in climate is alarming as in people are not threatened by the impending future impacts which is clearly shown by the reports, therefore, without being aware about the future scenario they are going to face, the adaptation strategies adapted by them would not be sufficient [70].

Autonomous adaptation as household adaptation strategy in Lukla

The survey done with the 25 households in Lukla showed that the autonomous adaptation is the response to climate change so far. Also, the key informant interviews with different organization and with the local leaders also showed that the adaptation strategies are done by the household themselves without any policy or strategic interventions, and that the activities like afforestation and water management, has been done without that being a priority for climate action [71].

1. Adaptation for agricultural sector: Most of the adaptation strategies done by the community in Lukla has revolved around agriculture. Among all the respondents, the most common response as adaptation to agricultural sector was adopting tunnel farming.

According to the respondents, the tunnel farming was started around 4-5 years ago, when one person started it, and they all saw the benefit of growing more variety of vegetables in the cold climate [72]. The respondents said that they started doing the tunnel farming in order to fight the naturally cold climate of the mountain region, and so that they could have more varieties of crops [73]. Historically, the staple diet of these mountain communities were usually potatoes, but they now claim that tunnel farming is helping them have more option of produces [74].

2. Adaptation in water shed management: The local Sherpa residents in Lukla are also very conscious and active about water management [75]. While their response during the household survey could not shed light into the fact, field observations, informal discussions and participation in community meeting that the author got chance to attend showed that the people give a very high importance for water conservation and water shed management. According to the local people, the major source of water in the area is a spring water source, which is called the Dongbu Chukpu, which is a Sherpa word that translates to Dongbu- Tree and Chukpu- Rich, so Dongbu Chukpu is the rich tea, or the money tree (Figure 4) [76]. They believe so because the tree provides them abundance through providing water, which is needed for their life. And also because the tree is the biggest in the whole region. Spiritual significance is also given to this tree, and believe that the tree is the God of Snakes providing water to the people. Therefore, they conserve and worship the tree to prevent any harm to themselves [77]. The ritual of worshipping this tree and the water shed was always there, and now the people see the ecological significance of conserving the water shed too. And do so by creating barriers, preventing waste disposal and ensuring protection of trees [78]. The people here stated that they learnt first-hand the importance of conserving the water shed and the surrounding forest when they faced the decreasing amount of water and resources due to forest degradation [79]. The people also put up pipes from the Dongbu Chukpu water source and channeled it to their households (Figure 5). They have also placed prayer wheels along

these water streams, so that they keep rotating and releasing positive energy to their area. Because of the high importance of Dongbu Chukpu for the people, in terms of water service as well as spiritual and cultural significance, the local government could channel a fund of a million NRS for protecting the Dongbu Chukpu [80].

Need for concrete plans for future adaptation option in the region

The respondents from Lukla stated that they do not perceive climate change to be a major threat in the future. Therefore, their adaptation strategy so far has been an autonomous response to climatic conditions (Figure 6). However, it is also very important to take into consideration the future climate change scenario while preparing adaptation strategies and sustaining the development outcomes, because the impacts in the future is projected to keep on increasing, due to mitigation not taking place as needed (Eriksen). But many a times, the adaptation strategies being taken by the communities are not enough because the impacts or climate change are faster than the natural process can help in sustaining, and also faster than the time it takes to incorporate adaptation, which is interlinked with range of social as well as economic along with political processes. That is why the vulnerable communities have a strong need for responding to climate change immediately for enabling conditions to keep up with the ongoing as well as future impacts of the changing climatic system (Regmi & Bhandari) [81].

Adaptation to the changing climate can have two broad components, of coping and adapting with the impacts for short term, or for the longer term and also taking benefits or opportunities from the favorable situations (Regmi & Bhandari). In the case of Lukla, the adaptation that the people are taking with the climate change scenario shows more short term response. For example, making the greenhouse for agriculture is done with the sole purpose of getting variety of vegetables for consumption [82-84]. There has been instances of pests, but the people have not taken up effective measures to prevent them in the present or even in the future. There is also very little household



Figure 4: The Dongbu Chukpu (Rich Tree).



Figure 5: Prayer Wheel kept along water channeling.

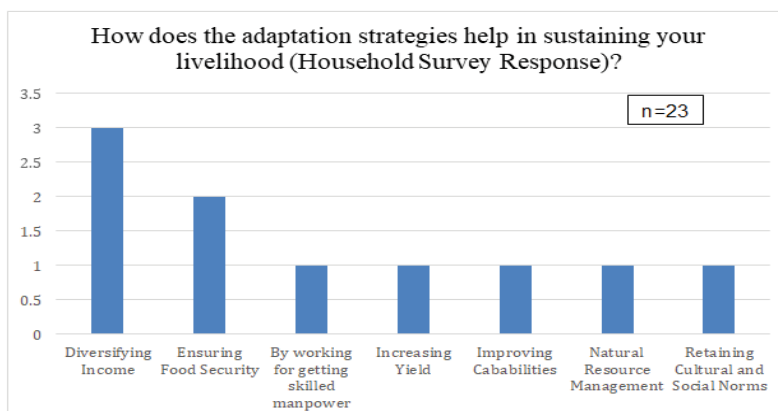


Figure 6: Perception regarding how adaptations help in sustainable livelihood.

storage systems, which the Sherpas have been practicing due to the harsh climatic condition anyways. However, in order to tackle present and future climate change impacts, the ultimate goal of the adaptation should be to build long term resilience of the communities so that they will also be able to overcome extremes (Regmi & Bhandari) [82].

According to the respondents from the household survey, there has not been any programs in the past about climate change awareness or adaptation. Some of the respondents mentioned that there was some trainings relating to climate change and agriculture in a village quite near to them, but that it never reached them. The monk, who was one of the couple people who had heard of climate change, also stated that he know more about climate change when he attended related training in another village. However, in Lukla there has been no such programs to date [83].

The focused group discussion with the local leaders also shed light on this. According to them, there has not been any program

specifically focused on climate change in the area, and no formal adaptation strategies adopted. Some of the afforestation programs and water management programs that they have conducted could have some relation to help adapt from climate change, however they stated that the main purpose was not directly related to adapting to climate change, but more towards protecting the ecosystem and ensuring their services to the people [84].

Communities' perception about linkage between adaptation and sustainable livelihood

A little more than 50% of the respondent from the household interview stated that they feel the adaptation strategies that they have adopted helps them in sustaining their livelihood. However, nearly 50% of the respondent also replied that they have no idea about the concept of sustainable livelihood. Despite explaining the concept of sustainable livelihood as a mean of securing their livelihood option, for the present and the future, the respondents stated that they do not

really foresee about future scenarios as they believe it will just continue like it always has.

This also points out to the gap that while the Everest Region has been regarded as being very vulnerable to the changing climate by the national and international reports, no programs or concern relating to climate change has ever reached Lukla, limiting the perspective of the people regarding the issue. Also, as mentioned by many literatures, slow onset events can be very difficult to be detected by people, making it of least concern until people feel impacted by it (Matias).

The 55% of the respondents from household interview stated that adapting to climate change would help them in sustaining their livelihood by retaining the livelihood that they have, and protecting them from getting lost, by diversifying their income, and ensuring yield. And one person each stated other ways of sustaining livelihood as being skill development, increasing yield, improving capabilities, ensuring natural resource management and retaining cultural and social norms.

When the author asked during focused group discussion with the women group what they thought the situation will be like in a 100 years, when the group did not understand the concept of sustainable livelihood, one of the respondent replied that "we will all be dead". This points to the studies that have showed that people have more concern about noticeable and immediate threat, rather than long term threats, and when people do not really experience strong influence or noticeable and serious consequence of climate change (Weber) [85].

High awareness about climate change among high school students

During focused group discussion with the high school students of a local school in Lukla, they were highly aware about the cause behind climate change being global green-house gas emissions. This shows how good curriculum regarding climate change helps in imparting knowledge about the issue. Most of the older respondents did not know about climate change in the area, but all the students from the high school were highly aware about the fact.

The necessity of knowledge regarding climate change is quite necessary to give importance to adaptation, which is also seen by the perception of high school students. The 35 high school students present for focused group discussion all were very positive about adaptation being important for sustaining their livelihood. As the students pointed out, their livelihood is very dependent on tourism and agriculture, and climate change is impacting and will continue to impact these sectors in the future, therefore adapting to the changes would help them in ensuring that they get agricultural produces and tourists in the future. However, the fact that the students were aware about climate change but their guardian were not, shows that there is limited communication between the students and the guardians about what they learn [86].

Conclusion and Recommendation

This case study among Sherpa of Lukla shows classic example of how slow onset events that is happening in the mountains can be very difficult to be detected by people, making it of least concern until people feel impacted by it (Matias). As the interviews with respondent showed, majority of them have not heard about climate change, and do not think it will be a serious threat in the future. This contrasts highly to the opinion of experts from key informant interviews, and also from scientific reports. This gaps shows that programs relating to climate change would help the people here in knowing about this global issue.

The case study of Lukla showed that there has been autonomous adaptation in the region, mostly in the case of agriculture and water shed management, without any policy or strategic interventions. This owes to the fact that the people in the area have not heard about the ongoing climate change, and therefore, would not make adaptation their necessity.

As Lukla is highly focused on and dependent on tourism, it is important for them to understand how the tourism industry might change in the future, and what repercussion climate change has to mountain tourism. The impacts of climate change, like increasing avalanches and icefalls is a serious concern to immediate and long term safety of the people. Therefore, similar trainings and knowledge is important to be disseminated to the people, so that they can equip their capabilities better. Similar is the case with agriculture too. Nepal government has now made it mandatory for each municipality to have an agricultural support center in each municipality, but according to the respondents, the center is yet to reach Lukla. As the people are already welcoming newer farming practices like tunnel farming, centers like those could help the farmers in addressing the concerns relating to agriculture, increasing pests, or climate resilient farming. Also, as Nepal has shifted to being federal republic, and there is a new municipality being built in the study area at the moment, this can be a good opportunity to integrate climate change into policy and strategies. The National Adaptation Program and Climate Change Policy of Nepal already recognizes the need for local level adaptation strategies, so Lukla can pave a road for it. According to the respondents, any new programs in the region that is proposed is also discussed together with the community members and the local leaders, which shows that community has a major say in the programs that are coming to their village. The municipal office of the Khumbu Pasanglhamu municipality is also now being constructed near the study area, which can be advantageous for the local residents, to take their concern to. As such, it can play an important role in mobilizing necessary resources and training relating to adaptation to the local community.

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