Research Article

Climate Change, Livelihoods and Gender Dynamics of Mountainous Communities in Pakistan

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Abstract | The threat and vulnerabilities related to climate change are high among the communities living in mountainous regions due to Pakistan's limited livelihood opportunities. Climate change impact is gendered in the real sense. This study is designed to analyze women's livelihood situation in mountainous regions in the face of climate change with a qualitative methodology. Focus group discussions, participatory observations, and key informant interviews were used in collecting women's perspectives. Flash floods, temperature rise, erratic rainfall, and land sliding were the main climatic hazards perceived by women. During the risks, the most vulnerable people were women and children. Women's household activities burden doubled during the disaster days comparing with their male member's counterparts. Women contribute significantly to adaptation and resilience to climatic extremes. The drivers of their resilience are hard work and diversity of livelihood resources. In changing climate conditions, it is imperative to devise gender-sensitive and region-wise policies and planning.

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Introduction

The region of Hindu Kush Himalayan (HKH) covers the highest mountains in the world. It is becoming a source of the world's largest contributing basin to feed the world with ten major river basins. Altogether, these major rivers of the world contribute to the freshwater supply for approximately 1.4 billion people in terms of volume and extent. The HKH region spans over eight countries: Pakistan, Afghanistan, India, Bangladesh, Bhutan, Myanmar, Nepal, and China, becoming a source of livelihoods for many living in the region. It consists of distinct but interconnected mountain plateaus and ranges and extended for more than 3,500 km. However, the lives of the mountain people in the HKH region are affected by climate change (CC). There is increased duration and frequency of extreme climatic shocks or events, land erosion, land degradation, natural disasters aggravating erosion, the decline in crop yield, and soil fertility. The capacity of mountain people to deal with these growing shocks is limited, which further hurts poverty. Furthermore, these regions are becoming more vulnerable with every passing day (Wu *et al.*, 2017).

Vulnerability is a core issue of climate change that derives from different geophysical, biological, and existing social systems. This can be further defined as the reduced capacity of an individual to anticipate, cope, resist, and recover from the impact of natural or human-made climatic hazards. It's a relative and

dynamic issue (Arora, 2011; Coirolo and Rahman, 2014). In other words, it is mainly about context as vulnerability is determined through indicators such as poverty, inequality, class-wise unequal access to opportunities, food entitlements, marginalization, access to insurance and other resources, etc. (Berkes, 2007).

Vulnerability is associated with natural hazards, poverty, high population, gender-based inequity that enhance higher risk and gendered vulnerability in Pakistan's mountainous region (Mirza, 2011). As a vulnerable country, the mountainous region in the Indus basin situated in the Gilgit-Baltistan province of Pakistan has been affected by extreme climatic events and socioeconomic stressors. These impact people's daily life and livelihood processes disproportionately in different social categories and decrease their adaptation capability to cope with the situation. Under poor socioeconomic conditions and gender structure, women are more likely to be severely affected and suffer than men during and after a disaster in mountainous areas (Abbas *et al.*, 2018).

Because socio-cultural constructed gender roles and responsibilities form men's and women's differential access, control over resources and ownership, and stimulus their capabilities and competencies for the climate change adaptation process (Skinner, 2011). Women's vulnerability to climate change-related hazards is different from that of men to a great degree (Neumayer and Plümper, 2007). For instance, when disasters occurred too much or too little in the community, more women comparing with men die because of lack of timely information, timely communication, mobility, decision-making, access to resources, capacity building training, gender-biased cultural norms, and barriers (Nellemann *et al.*, 2011). However, dominant climate change adaptation approaches and methodologies tend to be gender blind, as biophysical and economic determinants receive greater weight (Nightingale, 2009). That's why it is essential to integrate gendered intersectionality to assess vulnerabilities and impacts of climate change.

In this context, the study has tried to bring out the present scenario of gendered vulnerabilities, capabilities, and adaptation practices of mountainous regions that are mostly affected by the different climatic events.

Materials and Methods

Conceptual framework

Early definitions of vulnerability used within climate change stemmed from the study of natural hazards in which vulnerability was perceived as biophysically induced, the outcome of external hazardous events. Until the 1980s, social scientists primarily utilized biophysical definitions of vulnerability (Adger, 1999). Wisner *et al.* (2003) showed that a paradigm shift began which was a rising appreciation that impacts of dangerous events, even within small geographic areas or localities, are not homogenous and that it is not just the biophysical characteristics of an event that determine vulnerability, rather social structure plays an important role. Social vulnerability reflects that pre-existing internal conditions and structures of a society that determine social positioning results in "the differential capacity of groups and individuals to deal with hazards" (Gerlitz *et al.*, 2014) and the differential impacts of a hazard on a population.

An essential fact of vulnerability is gendered, and it depicts that men and women capability about climatic change and associated hazards react differently (Alston, 2014; Terry, 2009). An emergent body of research material, most of it comes from the gender and disaster literature, delivers plentiful realistic evidence of the countless ways in disaster situations which are not gender neutral and that women and girls tend to be more vulnerable to hazardous events, and even men of particular location or category of society. Furthermore, these impacts can further exacerbate existing inequalities, which can compound vulnerabilities (Bennett, 2005; Neumayer and Plümper, 2007).

However women and girls are not inherently vulnerable to climate change impact (Sultana, 2010; Wisner *et al.*, 2003) because it is not women gender itself that marks vulnerability but rather gender in a specific situation shaped by socio-cultural setting together with gendered roles of reproduction. Gender and gendered differences are socially created, imitating the located cultural and social norms at a specific longitudinal and progressive stage. These structures are not constant but performative, unstable and changing over time to imitate developing realities (West and Zimmerman, 1987). Furthermore, gendered experiences are not homogenous (Sultana, 2010) and the tendency to binaries gendered

experience to simplifications of only male and female do not present realities. Recognition of heterogeneity within male and female and intersectionality is important. When adding gender into understanding vulnerability to climate change impacts then it is more critical to confirm "more agile understandings of men and women" (Resurrección, 2013) that reveal how gendered understandings are the consequence of such intersectionality (Arora-Jonsson, 2011; Alston, 2014).

The conceptualization of gendered vulnerabilities in the climate change context as an interaction of external factors such as market forces, urbanization, consumerism, globalization, infrastructure development and technological intervention in a place and time joined with internal factors such as geo-political, gender structure, social structure, economy and decision making processes and institution, which influence the livelihood options of men and women, in determining the capability to respond climatic and socioeconomic stressors. After linking this conceptual thought to an adapted version, this study adopted the Sustainable Livelihoods framework (see Figure 1) as it aims to look into the gendered impacts of climate change on livelihoods. The Sustainable Livelihoods framework outlines five aspects, which are termed as "capitals" human, social, financial, physical, and natural capitals for livelihoods.

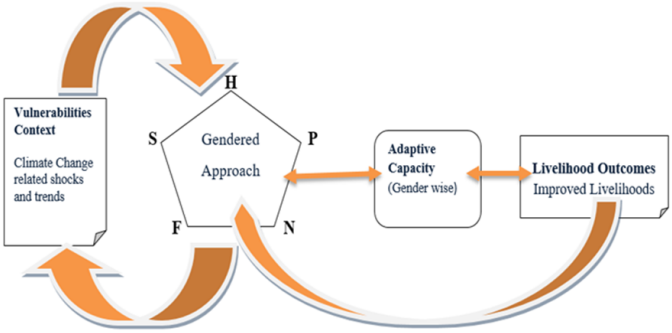

Figure 1: *Adapted conceptual framework.*
Source: *Adapted from Scones, 1998 and DFID Guidance Sheets (1999)*

Description of the study area

The Upper Indus Basin (UIB) is the study area, where climate change trends are anomalous. The UIB is live through since decades with cooling trends in the summer season, and increasing or established precipitations throughout the year (Amin *et al.*, 2018), accompanied by mass gains in the glaciers of the Karakoram (Bishop *et al.*, 2010; Bolch *et al.*, 2012). This study covers three districts namely Gilgit, Ghizer and Hunza (see Figure 2) and these three districts are located in the region of Gilgit-Baltistan (Hewitt, 2005).

Figure 2: *Map of study districts in Upper Indus Basin.*

Since the year 1980, these districts have charted like designs of development, mostly resultant from the implementation of the Aga Khan Rural Support Program (AKRSP) model and have similar socioeconomic and physical characteristics. These are characterized by an arid climate and an extreme environment. The system of agricultural production is only made possible by the high rate of solar radiation, and a complex and difficult indigenous irrigation system that is depending upon the water melting channeled directly from the glaciers and coming to the plane areas at the foot of the valleys. However, the majority of the population is smallholder with possession of small pieces of land that were transferred from generation to generation along patriarchal lines (Benz, 2016). Most of the grazing areas are mutual and allocated to different villages according to accustomed laws. Due to the substantial decrease in per capita accessibility of grazing pastures and agricultural land as a result of the mounting population and climatic hazards, local communities are gradually shifting from an agro-pastoral economy to a joint subsistence labor system (Ehlers and Kreutzmann, 2000). Within the latter system, the households pursue risk prone mountain agriculture with external income-generating opportunities, such as wage labor, labor migration and trade (Wouterse and Taylor, 2008). The income earned from external sources or non-farm sources was facilitated to the essential infrastructure development of the valley. With the increase of literacy level mostly people were employed in government jobs and the tertiary sector (Fowler and Archer, 2006). Yet, most households

cultivate the land and rear livestock on a small scale (Benz, 2016).

Socioeconomic characteristics

From ancient times agriculture has remained the backbone of Gilgit-Baltistan's economy. More than 70% of the living is dependent on agriculture either directly or indirectly. The mineralized glacial water enriches the soil due to that healthy food is available in excess quantity to the people. The land is distributed among the people in such a manner that each one has some of its portion which supports their living along with their families. Potato is considered the most important and cash crop in Gilgit-Baltistan but for the entire Hunza it is a single cash crop for their livelihoods. This crop was introduced by the great network of Aga Khan Rural Support Program (AKRSP) and primarily they provided farming outputs to boost the cultivation of potato in Hunza valley. Due to this, each household has devoted most of its land for potato cultivation. Fruit growing and vegetable production is an essential source of income. Fruits include apricots, peaches, pears, apples, grapes, cherries, while vegetables include potatoes, tomatoes, beans, melons etc. The main food crop is wheat while the other grain cultivated is maize or barley. Due to short cropping season and high altitude, only one crop can be grown, and maize or barley can be cultivated as a fodder crop before or after any main crop. In Hunza-Nagar, around 96% of households have access to agricultural land, and they cultivate both staple and cash crops (CIMOD, 2014). The study conducted by AKRSP shows that agriculture, livestock and forestry together account for 41 percent of household income in 2005 (AKRSP, 2007). The livestock sector is the major contributor with 38 percent share followed by crops and vegetables contributing 35 percent. While income from fruits accounted 16%, and rest 11% coming from forest and forest based products i.e. construction, furniture, pulp, and bio-energy. In UIB, livestock is very important to support the livelihoods of the rural people, especially the pastoral communities with 95 percent of households in the district owning more than one type of livestock (CIMOD, 2014) like yak, sheep and goat. However, buffaloes, donkeys and poultry are also being reared on limited scales (AKRSP, 2007). Horses, mules and donkeys are also raised by the families in the UIB as they are used as beasts of burden in the hilly tract where mobility and accessibility are a challenge.

Data collection and analysis methods

A participatory rural appraisal (PRA) method was applied to collect related information and included techniques were key informant interviews (KIIs), focus group discussions (FGDs) and field observations. Total six gender-disaggregated FGDs were conducted and twenty four key informant interviews were conducted with male and female groups (see Table 1). The primary data gathered on socio-demographic characteristics, household assets (financial, physical, human, natural, social) and climatic hazards. Gender disaggregated date was collected on activity profile with a focus on gender division of labor in on-farm, non-farm and off-farm activities. Further data was collected to understand gender vulnerabilities and capacities. Based on study objectives and framework, a semi-structured approach was followed for the synthesis of qualitative data.

Table 1: *Detail of collected data sites.*

District	Villages	FGDs'	KIIs'
Gilgit	Jutial	2	8
Hunza	Baltit	2	8
Ghizer	Hasis	2	8
Total		6	24

Research findings

The following is the detailed synthesis of key climatic shocks in the study area, gender perception about climate change, gender perceptions about vulnerabilities related to livelihood capitals and lastly gender perception and adaptation practices related to climate change are discussed.

Key trends of climate hazards

The environment of UIB has permafrost with annual precipitation excess of 2000 mm, while the glacier getting annual precipitation of less than even 100-200 mm that extends into semi-arid valleys region. In this semi-arid environment, the summer temperature is frequently over 25°C. During July and August the maximum and minimum average temperature usually cross the 35°C and 15°C, respectively. This region has a chilly and cold winter season which starts from November and continued up to March. The lowest temperature recorded most of the years in January and averages of minimum and maximum temperature reach below 10°C and -2°C, respectively. The months of April and May are considered as a rainy season for UIB and heavy rain is observed during these months

in the valley. Previous trends depict that Astor received maximum and highest level of rain followed by Skardu. It is not true in the case of UIB like in other parts of the country that most precipitation is received from the Indian monsoon cycle but depression arises and moving in from the western part of the valley during the summer and spring season. But sometimes occasional disturbances of monsoon entered through northern areas of the country.

Climatic conditions show that the variability in rainfall is very high and is most likely to impact the agricultural sector, either due to too much water or too little water and also threatened by floods and erratic rainfall patterns in the study areas. In the UIB, the impact of Attabad Lake disaster was severe because this was the biggest disaster for Sarat village in Hunza which washed away everything of the village such as its hutment, orchards, buildings, roads, farmlands and standing crops. Further due to this disaster both types of infrastructure private and the public was 100% damages in public it was included hospitals, schools, dispensaries, road networks, bridges and official buildings, and in private it was included restaurants, hotels and transportation system of indigenous people. This was a massive land sliding which almost filled the Hunza River 2 Kilometers with heavy mass and resultantly blocked the water. The economic cost linked with the agriculture sector due to loss of crops (including wheat and maize), fruit orchards (including apple, apricot and cherry) and potatoes farms were considerably high. However, still this lake is a considerable threat not only for the current livelihoods of the rural but even for future generations if not timely and appropriately managed by relevant authorities (Iqbal *et al*., 2014).

Current major climatic hazards identified by the communities during focus group discussion include flash floods, erratic rainfall, land sliding, cyclone and rise in temperature and these were observations which they recall for the last ten years. These hazards affect the natural resources of the communities especially agriculture and livestock. The increased temperature at certain important crop/fruit stages results in the decline of yield or insect attack. Similarly, the livestock sector also suffers from health issues and declines the milk yield. Erratic rainfall on the other hand also had similar effects on reduction in crop yield, especially heavy rain spell at the time of crop harvest and vegetable flowering stage and most importantly for fruits flowering stage. The most affected group in the communities were the low income and those that were dependent on agriculture and livestock for their livelihood. People in the area do have multisource of income that allows them to come out of the climatic stresses and the losses from these stresses. But this case is only for the well offs among the communities. Table 2 presents the hazard longitudinal trend assigned for each hazard of concern for the last 35 years.

Table 2: *Major trend of climate hazards.*

Jutial (Gilgit)				
S. No	**Name of Hazard**	**1980s**	**1990s**	**2000-2015**
1	Erratic Rainfall	+	+	+
2	Cyclone	+	_	=
3	Temperature Rise	+	+	+
Hunza				
1	Flash Flood	+	+	+
2	Temperature Rise	+	+	+
3	Cyclone	+	=	=
4	Snow fall Decrease	+	+	-
5	Land sliding	+	+	+
Ghizer				
1	Flash Flood	+	+	+
2	Temperature Rise	+	+	+
3	Cyclone	+	=	=
4	Land sliding	+	+	+

Source: *Survey, 2019. +: means trend increase, –: means decrease in trend, =: means no change in trend.*

The trend was finalized by a group of local area respondents who were mature enough to remember the trend of climate change for the last 35 years. A review of historic events assists with this determination. The impact of each hazard was considered in three categories: Impact on the population, impact on agriculture, and impact on livestock. Each hazard of concern was rated in accordance with when this group of local people meet the consensus on one point. The data reveals that trends in erratic rainfall, flash floods, cyclone and temperature rise were on the rise in Jutial village. The trends for Baltit village showed trend in flash flood, temperature rise, land sliding and snowfall decrease was on the rise. While cyclones are almost similar for the last 25 years in Baltit village. The data reveals for Hasis village trend in flash flood, land sliding and temperature rise were on the rise from last two decades. The overall assessment revealed that the increase in temperature, erratic rainfalls, flash

flood and decrease in snowfall in the Upper Indus Basin have gradually increased over the last 35 years. However, the intensity of these climatic hazards had increased during the last 4-5 years and this increased intensity of the events is causing socio-economic and climatic vulnerabilities among the people in the area. Reduction in snowfall in the area results in low moisture contents in soil that affect the fruits/crop yield. Also, number of health issues are emerging in the area due to dry winters. Details is given in Tables 2 and 3.

Table 3: *Overall trend of climate hazards.*

Upper Indus Basin (All three districts)				
S. No	**Name of Hazard**	**1980s**	**1990s**	**2000-2015**
1	Erratic Rainfall	+	+	+
2	Temperature Rise	+	+	+
3	Flash Flood	+	+	+
4	Land Sliding	+	+	+
5	Cyclone	+	+	=
6	Snowfall Decrease	+	+	-

Source: *Survey, 2019. +: means trend increase, -: means decrease in trend, =: means no change in trend.*

Gender perception and adaptation strategies for climate change

Perceptions about climate change are defined as people's awareness about the causes of climate change and its adverse impacts (Rao *et al.*, 2017). Women in this era have proficient knowledge about climate change priorities, its trend and impacts at the local level due to the reason climate change affecting their livelihoods directly in their roles, responsibilities and workplace (Saenz and Thompson, 2017). Through FGDs and KIIs efforts were made to understand women's perceptions of climate change-related vulnerabilities of the mountainous region of Upper Indus. Most of the women voted for more frequent flash flood in the area and they witnessed this increase in recent years with high intensity. The other major climatic hazards mentioned by the women group were the increase in the frequency of land sliding and erratic rainfall. Due to floods and other shocks households' food security was affected by the loss of food stocks.

National and international migration was a common adaptive strategy to reduce livelihood vulnerabilities. However, only male member of the household were adopting migration and women have to deal with all day to day activities. As agriculture is the major contributing sector in this area and this cannot be left unattended after male emigration which further leads towards an increase in the workload of women. According to Gioli *et al.* (2014) district Hunza has the highest rate of immigration in the Gilgit-Baltistan region. Although women were giving full of their potential to maintain this agriculture sector but even then due to migration income from this sector was reduced. The majority of the women mentioned that in recent years due to climate change almost all horticultural crops productivity reduced in the area. They added that to balance the income level some of the households adopted new varieties of fruits and crops on their farms as an adaptation to climate change. Some women mentioned that they changed their farming practices, growing short duration crops, thereby enhancing their resilience to climate change. New crops, including seasonal vegetables, nuts and hybrid potatoes that withstand water stress and have a higher market value were being grown. Women were solely responsible for value addition activities for the horticulture sector.

As migration was the most common strategy in the area and it also came to the knoweledge that due to migration their quality of life improved in comparing with those families who are not receiving remittances. Local women also discussed that with remittances they built new homes, adopt latest technology for household use and their children are enjoying good health and educational facilities. But some women also discussed that migration has a negative impact also such as there is a shortage of male labor force in the area for heavy duty works and migration of a male head of the family resultant in form of increase women workload for that family not only at household level but also at farm level. This adds women's work and now they are engaged in all types of activities that were previously performed by their men such as taking care of farm activities, looking after fruit orchards and all crops. However, the community of Upper Indus Basin is quite sensible and they are cooperative. Due to this women feel independent in their decision-making process. But women from Hasis village mentioned that still due to the migration of their male members they are facing mobility issues and even they can't get proper health care facilities. Further added that there is economic discrimination also because remittances are not directly shifted to women in the house, most of the times it goes into male hands such as the father

in law or brother in law receive money and make the decision about spending that money with the consent of women member. Women from Hasis also demanded the creation of job opportunities at home in order to reduce the hard work of women. They also mentioned that there is also a strong need for awareness for women regarding upcoming hazards in the area.

Due to floods and erratic rainfall patterns, households face food insecurity due to loss of their livelihoods income. Because during the flood losses occur to crops and flood victims face a shortage of daily food items. These hazards also destroy the infrastructure of the area and their vulnerability increases for food due to supply shortage even from other areas. During discussion women mentioned that during climatic hazards households adopt various strategies, like replacing expensive food items with cheaper ones or borrowing from relatives, to reduce the impact of shocks. Mostly were agree with the reduction of their expenses on unnecessary items such as clothing, shoes, etc. and prefer to spend this money on food.

The majority of the women from Upper Indus during discussion come up with the point that due to climate change flash floods and land sliding are becoming a more common issue in the area and these occurred almost every year. However, in the context of vulnerabilities women are more vulnerable as compare to men (Kayani, 2017). It happens because men are better equipped to act in a particular challenging situation as compared to women. Further added that men have better opportunities for mobility while women restrict to remain at home and it contributes to their level of vulnerabilities to further extent.

Gender vulnerabilities related to livelihood capitals

Human capital: Human capital is recognized as skill, knowledge, education, talents, abilities, intelligence, training and experiences that possessed by an individual or groups within a given population. Climate change resulting in phenomena such as floods, river erosion, changing rain cycles, land sliding, heat and cold wave can influence human capital, particularly these have direct impact on their routine lives (Gautam and Andersen, 2016). This has been observed that both men and woman lack necessary skills and knowledge to address the challenges relating to climate change. During our discussions, women participants in particular have shared that changing floods frequency, land erosions and heat wave affect them most. Landslides, soil and river bank erosions adversely affect families and communities, with depriving them from their homes, lands, infrastructure and other livelihood resources. Meanwhile, during the disaster period, household duties are indorsed on women while men were only responsible for saving food items and shelter places for animals and themselves. While women are responsible for cooking, organizing temporary shelters, arranging fodder for livestock and importantly to bring water for themselves, family and their livestock.

Physical capital: Another implication of the lack of availability of physical assets is that in the areas severely affected by climate change, it becomes very difficult for them to re-establish their shelters and lands. Particularly in the UIB, random floods and non-routine rain cycles result in destroying agricultural fields (terraces) and houses. To restore such a piece of land, people can only utilize the traditional tools instead of shovels, tractors, excavators, etc. This resultant in increase the risk level for their lives, the risk for misplacing arable land, loss to crops/production, if not controlled risk of migration to other areas, etc. Irrespective of the provisioning of physical assets, women are more vulnerable as compare to men. Often, it happens that men were better equipped to act in a particular challenging situation as compared to women. The study indicates another important trend that women were found to be under comparatively more stress as they witness a loss in production of their household products such as vegetables, eggs and meat resources products produced within house premises. The loss in production of these items in the event of calamity results in creating higher mental and physical pressure.

Financial capital: Financial capital is referred as the availability and provisioning of monetary solutions to the people. This comprises accessibility of financial elucidations saving, money, loans, investments, capital for starting businesses, etc. (DFID, 1999). Through study, it was confirmed that like the physical assets, the population in the upper basin has poor financial capital to handle any worst economic shock. The usability of the financial capital in the upper basin is limited even on normal days, and in the event of any natural hazard, it becomes almost obsolete.

Natural capital: Resources such as land ownership,

socioeconomic status in the society, accommodation security, food and financial security, water, fodder are termed as natural capital (DFID, 1999). Such capitals are almost the same in study areas but access and control are differentiated according to people's social class, power and gendered dimension (Barrett *et al*., 2001). Across the study areas, people belonging to the respective rich and the middle-income group have agricultural land, have a comparatively better economic condition than extreme poor and poor, etc. Another important segment is of the landless people, who are either working as long term labor on lands owned by others or are given land by the owners to cultivate. These poor people were deprived of even the basic natural capital of the land. In this group, women are more vulnerable compare to men because land and property ownerships are usually attributed by men to men, not women or girls.

Social capital: Social Capital has multiple definitions, explanations and applications which can be found in different literature. It can be defined as the collective behavior of all social networks, bonding similar people and bridging between diverse people with norms of reciprocity (Gautam and Andersen, 2016). In the context of socio-cultural practices, women are the influential actors for the family wellbeing and as well as for society (Rodenberg, 2009). But in the unequal power relationship, asymmetrical gendered dimension and subordinate position in the family and society, women are mostly denied from the outside world (Alobo, 2019). Though poverty pushes them to go out from inside of the home for being independent economically in that point male dominant society limited their space and mobility where men are remaining beyond all the limitations (Drucza and Peveri, 2018). As a male dominated society women are always discriminated and oppressed by their male partners. Women are not discriminated only in their family but also discriminated in their community as well as in the labor market. Wage inequality is another common feature in these villages (Canagarajah *et al*., 2001). Women are working equally with the men labor but get less money from them. On average as wage labor women get 200 to 250 Pakistani rupees take whereas men get 250 to 300 Pakistani rupees per day.

Gender perception of vulnerabilities and adaptation practices

The gender perceived vulnerability matrix classifies adaptive responses to mitigate the climate change risks and defines the level of vulnerability (Cutter *et al*., 2003). For details see Table 4.

Table 4: *Impacts of climate change on livelihoods.*

Assets base and livelihood	Flood (Flash floods)	Rise in summer temperature	Snowfall decrease	Cold wave	Gender role and relation	Adaptive practice and livelihood outcomes
Agriculture	Food insecurity Land erosion Damage to forest and fruit Plants	Resulted in crop disease in potatoes and vegetables	Apple growth affected	Effected the winter crop of wheat during Jan-Feb.	Women y do household chores Education is common Now women education is preffred over male	Migration Adoption of new crops Income reduction Damage to assets
Livestock	Animals go into stress and sometimes run away Fodder demand increases livestock diseases increased Unsufficient veterinary services Increase mortality rate.	No effect as such	animal face serious illness	Cattle and poultry suffers from diseases	Almost 70% livestock work done by women. But selling and control over resources is in the hands of male members	Selling of animals is common Most of the times they are sold at much cheaper rates to livestock dealers and butcher man. Women work load increases
Wage earning	Decrease in causal work availibilty	Number of working hours reduced	Number of working days and hours reduced	Health issues emerge	Male circular labor migration increased Women work load increased inside and outside the house	Circular labor migration Women work load increase for migrant family member

Source: *Survey, 2019.*

Conclusions and Recommendations

Women are the front line observer of climate change and unfortunately, their resilience to endure its impacts is very limited due to limited resources and awareness. Still, it can be built or improved by adopting a combined approach to adapt and mitigate climate change with a gender lens. Women empowerment could play an essential role in building resilience towards climate change. However, women in the study areas are found to active agents of adaptation at the household level and influential contributors as income generation in the community. Voices of women need to be raised and heard as well. There is an urgent need to involve women in climate adaptation strategies and policies. Capacity building through training on Disaster Risk Reduction (DRR), climate-smart interventions, i.e., rainwater harvesting, tunnel farming etc. could increase their resilience. Women are the agents of change who can effectively combat climate vulnerabilities. Women groups should be established in each community where they can come and discuss their issues and suggest possible solutions. Lastly for improving women's livelihoods and strengthening their adaptation level, it will be necessary to ensure women's access, control and ownership towards resources (such as land, financial resources, livestock, property, and income-earning opportunities).

Novelty Statement

This study can be considered as an addition in world literature for area specific perspective. It provides valuable qualitative analysis about climate change impacts on livelihoods with gender lens.

Conflict of interest

The author has declared no conflict of interest.

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