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Local perception on climate change and its impact on livelihood: a case study from Poonch district of J&K, India.

Percepción local sobre el cambio climático y su impacto en los medios de vida: un estudio de caso del distrito Poonch de J&K, India.

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ABSTRACT

Any change in the earth's climatic conditions occurring over a prolonged period of time is known as climate change. It is one of the severe environmental threats expected to affect ecosystems and natural resources by intensifying the effects of various ongoing threats such as overexploitation, habitat destruction, deforestation, pollution and invasive of exotic species etc. Local inhabitants of Poonch district are generally agro pastoral in nature and their livelihood is primarily based on the agriculture and livestock which is affected by the droughts, unseasonal snowfall and other climate related problems in the region. The present study is based on the available literature and the perceptions of local inhabitants of Poonch district on climate change and strategies adopted to withstand the hardship due to changing climatic conditions. The study observed that there is some consistency between local perceptions and scientific evidence. The present study reveals that there is significant need to strengthen information on various aspects of climate change in this region of Pir Panjal Himalayas as no significant work has been done in this fragile area. Moreover the available data on climate change in the region is very scarce and inadequate to meet the requirement of climate change research.

Key Words: Climate change, Perception, Poonch, resources, impacts.

RESUMEN

Cualquier cambio en las condiciones climáticas de la Tierra que ocurre durante un período prolongado de tiempo se conoce como cambio climático. Es una de las graves amenazas ambientales que se espera que afecte a los ecosistemas y los recursos naturales al intensificar los efectos de diversas amenazas actuales, como la sobreexplotación, la destrucción del hábitat, la deforestación, la contaminación y la invasión de especies exóticas, etc. Los habitantes locales del distrito de Poonch son generalmente agropastores en la naturaleza y su sustento se basa principalmente en la agricultura y la ganadería, la cual se ve afectada por las sequías, nevadas fuera de temporada y otros problemas relacionados con el clima en la región. El presente estudio se basa en la literatura disponible y las percepciones de los habitantes locales del distrito de Poonch sobre el cambio climático y las estrategias adoptadas para resistir las dificultades debidas a las condiciones climáticas

cambiantes. El estudio observó que existe cierta coherencia entre las percepciones locales y la evidencia científica. El presente estudio revela que existe una gran necesidad de fortalecer la información sobre diversos aspectos del cambio climático en esta región del Pir Panjal Himalaya, ya que no se ha realizado ningún trabajo significativo en esta frágil área. Además, los datos disponibles sobre el cambio climático en la región son muy escasos e inadecuados para cumplir con los requisitos de la investigación sobre el cambio climático.
Palabras clave: Cambio climático, Percepción, Poonch, recursos, impactos.

INTRODUCTION

Climate change is one of the severe threats for the humankind in the present era. It has surfaced as a crucial scientific, development and economic challenge due to its possible impacts on all life forms, ecosystems and on national and overall economies[1]. Climate change occurs either due to natural forces or anthropogenic activities. Naturally occurring greenhouse gases and water vapours has resulted in the slow rise in earth's temperature, which is necessary for earth to become habitable. But on the other hand due to various anthropogenic activities there has been a considerable and systematic increase in the levels of various greenhouse gases in the atmosphere. Since 1950, concentrations of various greenhouse gases have increased manifolds. In earlier periods, the overall atmospheric concentration of gases has increased from 280 ppm in 1753 to 400 ppm in 2013[2]. Due to increase in CO_2 levels, the global temperature has also increased by 0.74^oC[3]. The recent studies have shown that earth's environment is changing and the overall atmospheric concentration of CO_2 may increased up to 1250 ppm and temperature might increase by 7^oC by 2100 as compared to 1750[4]. As climate has changed right through the Earth's history, all living individuals have had to adapt, migrate or die out. When climate change steadily, ecosystems and species evolve together and got the opportunity to adapt to new conditions. However if climate changes rapidly the capability of species to adapt or relocate remains a big concern. Due to increasing temperature regional climates are affected in different ways. Change in climate has been stated to cause the death of 0.4 million people and universal financial loss of more than US$1.2 trillion every year[5].

Some parts of South and Southeast Asia are witnessing heavier monsoons and increasing sea levels whereas other areas such as southern Africa and American Southwest are witnessing severe droughts and crop failures. Heavier snowfall, hurricanes, severe heat waves, tremendous rainstorms and flash floods have become common phenomenon throughout the world.

Climate change is recognized as one of the several threats to soil, water resources and biodiversity. Human-induced climate change is accepted as a major factor contributing to land degradation, altering soil property and limiting its ability to sustain healthy plant growth. Degradation in quality of soil due to climate change has also become a concern for global food security[6]. Global climate change has exerted a far reaching impact on hydrological cycle which consequently affected the available water resources. The variation in rainfall pattern, floods, droughts and evapo-transporation rate over different regions is caused by climate change. The Intergovernmental panel on climate change has also reported that water resources are adversely affected due to changing pattern of precipitation and temperature[7]. Biodiversity and natural resources are also threatened by human-induced climate change. Plants and animals become endangered due to increasing

temperature and global warming. It is expected that the altitudinal distribution of plants is expected to move to upper elevation and species with restricted climatic ranges limited to higher reaches possibly become vanished because of destruction of their habitat or reduced migration ability[8]. Climate change is also affecting the competitiveness of many species by changing growth, death rates and regeneration success rates[9]. Dwindling natural resource accessibility and uncertainty induced by climatic variability is perceived to threaten the livelihood of the communities depending upon the natural resources. Climate change will also results in severe impacts on human health in the form of spread of various vectors, vector borne diseases and deterioration in the quality of air and water etc. It has been expected that impacts of climate change are early felt on mountain ecosystems[10]. Mountains play a significant part in environmental sustainability, financial upliftment and in providing livelihood to people both at local as well as global level. At the same time these are recognized as the storehouse of biodiversity, water and the suppliers of other goods and services[11, 12].

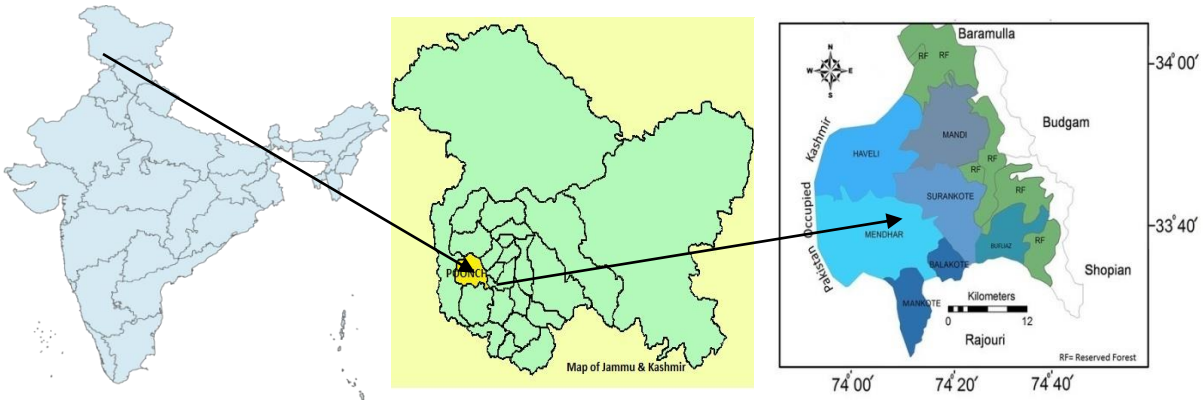
Excessive deforestation in the mountainous region may result in decrease in precipitation level and increase in global surface temperature thereby changing the whole global climatic model[13]. This change is directly connected to ecosystem services and to all communities using natural resources. Moreover due to climate change most of the mountainous areas shall experience increase soil erosion and reduction in the slope stability[13]. The mountainous areas of Jammu and Kashmir have vast natural resources which play a vital role in supporting the economy and livelihood. Jammu and Kashmir also holds a significant position in terms of biodiversity and ecological-wealth. According to Indian Network for Climate change assessment, on an average the number of rainy days in the Himalayas might increase by 5-10 days in 2030s, with an additional increase of more than 15 days in the eastern part of the Jammu and Kashmir region[14].

Being located on the southerly foothills of the Pir Panjal Himalaya, Poonch is the remotest district of Jammu and Kashmir, India. Topographically area is strongly course to hilly, with most of the inhabitants living in isolated villages[15]. The life of the people in the area is dependent on the natural resources and the environment. The environmental, societal and financial impacts of climate change are primarily felt by the communities who live in these areas. People in the area have experienced vast changes in the climate and have adopted different traditional means to cope with it. In the present study an attempt is made to understand and record the perception of local people on climate change, its impacts and how these people overcome different hardships produced due to climate change in the region.

MATERIAL AND METHODS

Study area: Poonch district of Jammu and Kashmir, India is geographically located within 33.77^{o} N Latitude and 74.1^{o} E longitudes with an average elevation of 1070 meters above the sea level. In the north and eastern side it is surrounded by the Pir Panjal range, southern side by Rajouri district and the western side by Pakistan occupied Kashmir (PoK) (Fig.1). Poonch district has an area of 1,674 km^{2}and is comprised of six tehsils with 178 villages (170 Inhabited and 08 uninhabited). District comprises of 90,261 households with a population of 476,835 constituting 91.89% rural and 8.10% urban population. District has a sex ratio of 893 (Rural 907 and urban 746) and literacy rate of 66.74% (Male 78.84% and female, 53.19%). About 41.12% of the individuals are in the working section including 46.72% males and 19.43% females. About 36.93% of the

population belong to schedule tribe and 0.12 % belongs to schedule caste category[16]. Study area is drained by the Punch River, Mendhar nallah, Surran nallah, Mandi river and other small rivulets. Perennial springs are numerous in the district and form the principal source of surface water supply. Climate of Poonch is humid subtropical. Study area is divided into three agro-climatic zones namely sub-tropical, intermediate lower and intermediate higher zones. Being mountainous nature of the district very little land is available for cultivation and is mainly confined to the terraces on the lower slopes and on the bank of the rivers and streams forming narrow valleys. The average land holding is 1.24 hectare. Maize is the staple food of the people followed by rice and wheat. The average temperature range in the area varies between 3°C to 39°C. Annual rainfall in the area is recorded to be 929.2 mm. Maximum rainfall occurs in the monsoon whereas scanty spring-rainfall occurs in March. Precipitation in the higher reaches is in the form of snow during winter months. The vegetation in the area generally comprised of Chir-pine forests, broad-leaved deciduous forests and broad- leaved evergreen forests, scrub forests, intermingled with numerous grasslands and meadows. The grasslands in the higher reaches are commonly known as Margs. During summer numerous nomadic tribes including Gujjars and Bakerwals along with their cattle, sheep and goats migrate to these higher reaches grasslands and stay there for 4-5 months. Notable among these grasslands are the Shaker Marg, Pir Marg, Khari Marg, Kori Hill, Sarota Marg, Jari Marg, Rupri Marg, Bela Marg, Raviwali Marg, Phanjari Marg etc. The crest of Pir Panjal range in Poonch is covered with snow and several peaks with an altitude between 15290-16000 ft above the sea level like Dhakyar, Kotoria, BudhalPir, Brahma, Tatakuti, Sunset, Kagha Alana, Handoo peak etc. exists in this region. More than two dozen high altitudinal lakes commonly known as Sars exists in this region, notable among these are the Simar Sar, Akal Daksni, Nandan Sar, Chandan Sar, Katori Sar, Bhag Sar, Neel Sar ,Kaunsar Nag, Chamar Sar, Sukh Sar, HanduSar and the Raviwali Marg Group of Lakes. Various mountain passes at an altitude between 11500 Ft to15000ft above sea level exists in this region which connects Rajouri district, Poonch district and Kashmir valley, notable are like Gali Maidan, Jamina Pass, NurPul Gali, Chor Gali, Choti Gali, Pir Gali, Ruperi Pass, Handoo Pass etc. In higher reaches sky touching peaks covered with snow and lush green surrounding presents stunning scenery.



India Jammu and Kashmir Poonch District

Fig: 1. Maps of study area

Methodology: This study is primarily based on the data collected through a comprehensive household survey conducted in Poonch district from August 2019 to January 2020. However various secondary sources of

information like books, journals and various proceedings are also taken into consideration for understanding the key results of field research. For the collection of primary data on people perceptions and their adaptation to climate change, a total of 600 respondents from six tehsils of district were randomly chosen irrespective of caste and sex. Respondents include 500 local elderly people, farmers and 100 members of local transhumance communities. A semi-structured questionnaire consisting of questions on different aspects of climate change was used as a tool for gathering information (Table.1). Respondents were asked questions and their responses were recorded. Responses of transhumance community were recorded separately. For the substantiation of primary data, survey was conducted both in plains as well as in higher reaches of the area. Group discussions and personal interviews were also conducted. The survey was conducted in local languages spoken in the area for better understanding so as to confirm the genuineness and validity of the questions.

The aim of the study is to perceive the observations of the inhabitants regarding the changes in surroundings and the measures being adopted by them to cope up these changes.

Table.1.Variables used for collection of data.

S. No	Variables	Responses	
		Yes	No
01	Do you know, what is climate change?		
02	Is there any rise in temperature?		
03	Unpredictable and uneven rainfall		
04	Unpredictability of snowfall		
05	Noticeable changes in the seasons or not		
06	Increased Incidence of floods and droughts		
07	Decrease in water resources		
08	Drop in agricultural and land productivity		
09	Invasion of exotic weeds and infestation of crops by different pests and diseases.		
10	Drying up of grasslands and pastures		
11	Increase in vector borne infections		
12	Change in flowering and fruiting time		
13	Degradation of local forest biodiversity		
14	Shift in the range of different plant species		
15	Change in the behavior of wild fauna		
16	Occurrence of Man-wildlife conflict		

RESULT AND DISCUSSION

Poonch district of Jammu and Kashmir, India has vast natural resources and is one of the unique and fragile eco-systems in the western Himalaya where more than 85% of the population primarily depend upon natural resources and environment. The present study focused on gathering information on the experience,

observations and the perception of local communities on climate change and the strategies being adopted by them to mitigate the effects of climate change.

Perceptions of local people on different aspects of climate change: Data obtained from the questionnaire survey indicated that about 78% of the respondents are well aware of climate change and its various aspects. They are aware enough that the climate has changed because of their long experience with the realities of the local environment. 84% of the respondents stated that there is increase in average temperature which has resulted in negative impacts on natural resources like water, agro biodiversity and other vegetation. 80% of the respondents stated that they have noticed unpredictable and intermittent rainfall as duration; timing and amount of rainfall have changed significantly. According to them change in the timing and pattern of rainfall has resulted in reduced agricultural productivity leading to the shortage of food and fodder in the area. They also reported the incidences of heavy rainfall in the area resulting in floods thereby causing loss of infrastructure and property. 64% of the respondents reported that due to increase in temperature and unpredictable rainfall there is increase in the incidence of floods and droughts in the area. 69% of the respondents reported that they have witnessed unseasonal snowfall in April rather than in January and February, as winter season in the study area usually prevails from November to March. 61% of the respondents reported noticeable change in the seasons which have affected the sowing and harvesting of their agricultural and horticultural crops.

The mountains in the region serve as a vital source of water for the people through numerous perennial streams and springs. Mountain springs in the Pir Panjal region have been reported to show decrease in the water yield capacity and in some areas have become dry primarily due to massive deforestation and unpredictable rainfall in the recent decades[17]. The retreating of glaciers and decrease in ice cover in the last century particularly in mountain glaciers is perceived as an indication of climate change[18]. Precipitation pattern have changed in the recent decades and the winter rains have also become uneven and lower in quantity. Alteration in water flow due to climate change may lead to social conflicts, scarcity of drinking water, desertification, land degradation, reduction in hydropower generation and also put at risk biodiversity, forestry, agricultural-based income and general wellbeing of the people. 80% of respondents in the study area reported that there is fluctuations and decline in the water level in the streams, nallahs, small rivulets and reduced discharge of springs in the area. The main causes for decline in water resources in the area as per them is the climatic change in the form of increase in temperature, longer dry spells, monsoonal unpredictability, irregular rainfall, landslides, deforestation etc. Reduced water availability in the area affects their livelihood as they have to struggle hard in getting water for household use, livestock and irrigation. For meeting the need of water people are practising traditional rainwater harvesting methods by storing water in ponds, ditches as well as by delaying the sowing season.

Agriculture in the region is mainly rain fed and is mostly restricted to terraces carved out of hill slopes and is highly affected by changing climatic conditions. In higher reaches snow is a significant source of moisture and important for farming and growth of grass. The crops in the area are adapted to the local environmental circumstances and have the inherent qualities to resist various environmental threats thereby certifying the food requirement of the inhabitants from generations. However the area under conventional agriculture in the

hilly region has declined considerably in the last three decades and many of the crops are at the verge of extinction[19].The climatic change driven factors may lead to the overall loss of rich repository of agro biodiversity, change in crops and cropping pattern in the area.

87% of the respondents reported that due to climatic changes like rising temperature, erratic rains and snowfall, water is becoming a scarce resource in the area. Therefore supply and availability of water for agricultural purposes has become a significant problem thereby forcing the marginal farmers to shift from paddy cultivation to rain-fed farming. Moreover, the livelihood out of agriculture is becoming unfeasible due to the severe disintegration of the existing land holdings after family expansion and subsequent divisions. As reported there is drop in agricultural production due to failure of crop germination, change in land use practices, reduced availability of water, erratic rainfall, loss of soil moisture and degradation of soil.

90% of the farming community reported that there is increase infestation of invasive and exotic weed species along with new forage within the agricultural fields and other areas including pastures and grasslands. Warm temperatures and scarcity of water has affected the agro biodiversity in the area by enhancing the growth of insect pests and exotic plants such as *Parthenium hysterophorus, Lantana camara, Ageratum conyzoides* and *Xanthium strumarium* etc. Moreover any severe change in climate can help pests or diseases to expand their normal range into new areas thereby increasing losses and disturbing natural plant communities[20]. According to them high temperature, increasing precipitation and decreasing agricultural practices like crop rotation and mixed cropping are responsible for this. They also reported the increased incidences of crop infestation by different pests and diseases along with the changes in their distribution and frequency. For mitigating the effects of climate change on agriculture, people have started the practice of agroforestry, improvising with cash crops, delaying sowing, crop rotation, less area under cultivation, increased use of fertilisers, herbicides/pesticides and above all start depending on markets for food and fodder.

78% of the respondents reported that there is drying up of grasslands and pastures along with the reduction in grasses and other forage in the area which has resulted in the shortage of fodder for livestock and attributed these changes to changing temperature, reduced water availability and droughts. They further told that due to this people has shifted to smaller livestock and are practising pasture management. 72% of the respondents reported that due to warmer temperature and more precipitation along with humid conditions there is increase in infection rate of various vector borne diseases on human beings leading to economic burden on them. 74% of the respondents stated that due to high temperature, low rainfall and change in the timing of rainfall there is change in the phenology of many fruiting and flowering plants. The plants flowers at the time when climatic conditions do not favour for their growth and existence. They further stated that in order to cope this people have started delaying sowing and are practising crop rotation pattern.

Forest plays an important role in supporting livelihood in the area. People in the area directly depend on local forest produce to meet their daily needs of timber, firewood, fodder, leaf litter and non – timber forest products etc. The area has vast oak forests with *Quercus leucotrichophora* and *Quercus incana* being two multipurpose dominant plant species growing in the region. These forests have high species diversity, stratification, litter production and soil fertility. About 81% of the respondents stated that the forest cover in the vicinity of villages has decreased and got degraded. They further reported that degradation of oak forests

in the area has limited the availability of fuel and fodder thereby effecting the productivity of livestock. Oak forests as perceived by people help enhancing groundwater recharge in the region. Sustainability of these forests is essential for any environmental conservation effort in the region as any change in the distribution and composition of forests will have an adverse impact on water resources, agriculture, biodiversity and environment etc. The reasons cited by them for depletion of forest diversity are the adverse weather conditions, reduced rainfall, increased duration of dry spells, road construction activities, increased fuel wood consumption, loss of vegetation, overgrazing, landslides, forest fires and decreased regeneration rates of trees.

Variation in the climatic conditions can have many ill effects on the existence and distribution of plant communities[21, 22]. 59% of respondents reported that there is shift in the range of different plant species in the forest areas due to extreme climatic conditions like increasing temperature, erratic rainfall, unseasonal snow and unpredictability of monsoon. The climate change may affect flora of hilly areas by reduction of cooler zones at higher elevation and shifting of tree line[23]. Change in climatic condition shall also favour the spread of various thermo-philous species and decrease in the populations of low-temperature dominant plant species[24].

Poonch region, being the part of Pir-Panjal range of Himalayas region is likely to experience higher rate of temperature increase than the global average. It is expected that about 35% to 40% of plant species will experience shifting of their range in future due to increase in temperature[25] .Out of the forest types in the area, sub-tropical deciduous forests are likely to shift at a higher rate of 42% to 47% than moist evergreen forests. There shall be the noticeable growth in temperate deciduous, cool mixed and conifer forests at the cost of alpine grasslands which are expected to get shrink. There shall also be the decrease in socio-economic and significant plant species like Deodar, Fir and Spruce and increase in Blue Pine and Chir Pine etc. It is expected that increasing temperatures, changing vegetation pattern, deforestation and shortage of water, habitat destruction and fragmentation may turn out to be the great threats for the wildlife in the area.

69% of the respondents stated that they have observed various changes in the behaviour of wild fauna in the forest around the villages. It is also reported that the wild animals have shed their natural fear and started roaming close to the human habitations and agricultural fields. As reported there is random movement of Himalayan black bear, wild boar, monkeys and porcupines near agricultural fields and human habitation. 66% of respondents stated that man-wildlife conflict has become a regular phenomenon in the area due to crop damage by wild animals. To minimize man-wildlife conflict and incidence of animal attack on agriculture, crop replacing is done depending upon the season. The reasons cited by the people are the increase in wildlife population.

Transhumance Community Perceptions about Climate Change: As the study area is agro-pastoral in nature. People rear buffaloes, sheep and goats to meet there needs. For feeding the livestock people traditionally depends on agricultural residues, fodder from forests, grasslands and pastures. More than 36.93% of the population of the area comprises of tribal and migratory communities practising transhumance. Every year during summers these people migrate with their livestock to the upper alpine grasslands and pastures for grazing. To share their views and perception on climate change and the hardship faced by them, 100 people from transhumance community were selected as respondents. Unease is rising among tribal population over change in earlier weather conditions observed in the transhumance areas. The community members stated

that climate change is already occurring with its impacts being felt by most of the people, particularly transhumance population, which are more susceptible to its effect as they depend on livestock production which is highly weather sensitive.

80% members of the tribal community revealed that decrease in the precipitation rate for the last 20 years has affected water sources and availability of water for human consumption as well as for their livestock production. They stated that their transhumance calendar has shifted as the rainy season has become unpredictable which force the community to move early to the summer pastures in the higher reaches in the Pir Panjal region. 86% of the tribal's stated that temperature has increased over the past 20 years which has resulted in drying up of the water resources around there winter pastures. 84% of the members of tribal community stated that over the last 20 years there is unseasonal snowfall in higher reaches areas. They further stated that in May 2009 they witnessed heavy snowfall for fifteen days for the first time which has resulted in the death of 50 community members and more than one lakh animals. Moreover in April 2018 and recently in May 2020 severe and unpredicted hailstorms have killed more than 1000 sheep and goats in the area. 78% of the tribal's stated that droughts have become severe for the last two decades resulting in decline in the quality of the grasslands. They also stated that frequency of the droughts has been increased for the last few years which force the community members to migrate from one pasture to another in search of grass to graze their animals.

As conclusion, the study based on people perception on climate change reveals that the region is witnessing various changes in temperature and rainfall pattern. In addition, changes in hydrology, cropland production, phenological changes in wild and cultivated crops together with the change in wildlife behaviour are common observation. It is well observed that Climate change have critical impact on the livelihood based on forestry, farming and animal husbandry. The local inhabitants were observed to react optimistically to changed situation and have adopted certain measures to resist the adverse impacts of climate change.

Due to lack of information and appropriate data on the extent of climate change and its impacts, a standard monitoring system must be developed to document and evaluate climatic change and its potential impact on ecosystems and natural resources in the area. There is also urgent requirement of suitable institutional method for protection, scientific management, conservation and development of the available natural resources in the state. Awareness and educational programmes for the growers, modification of present agricultural practices and use of efficient, eco-friendly and traditional practices are some of the solutions to minimize the effect of climate change in the region.

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