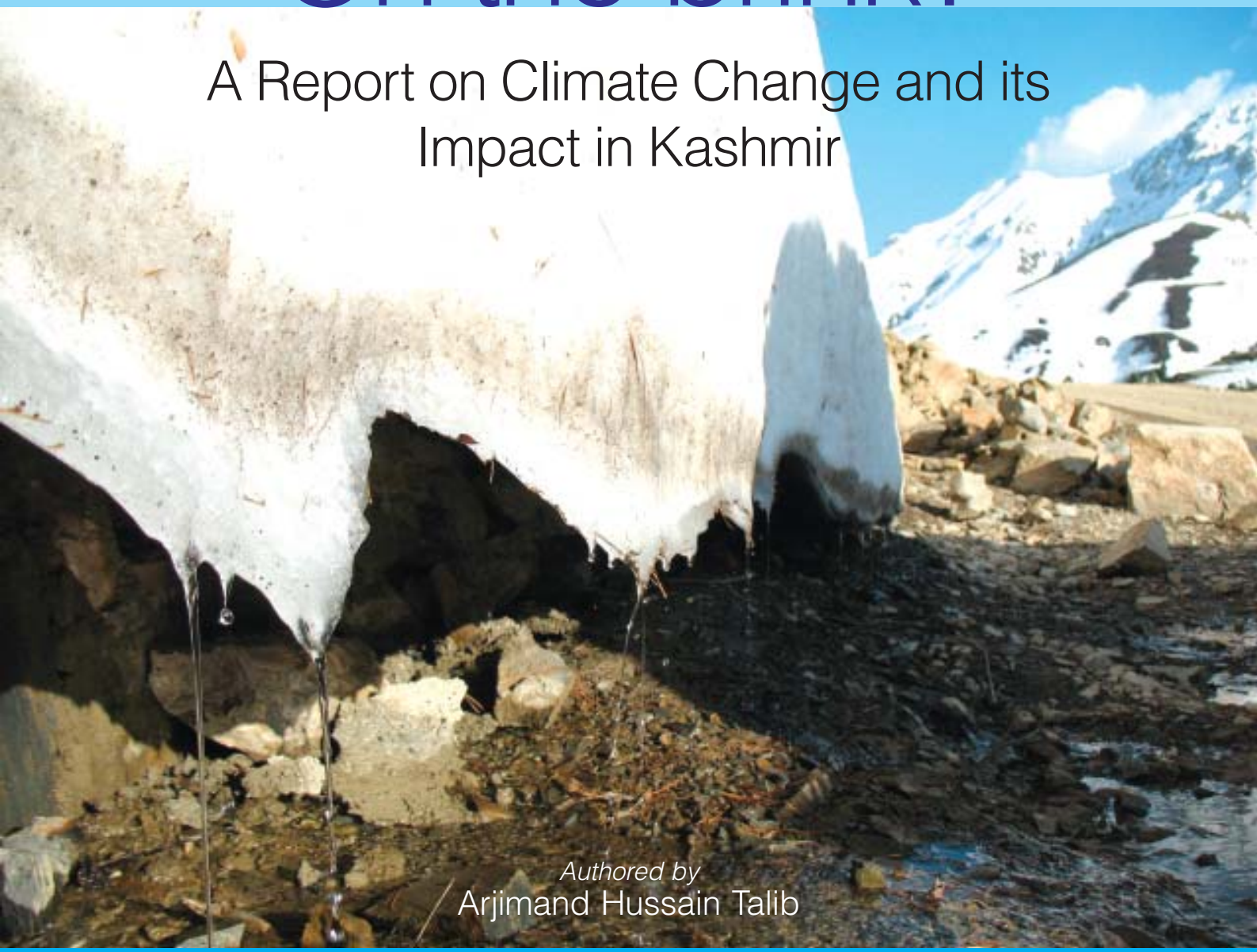
report

On the brink?

A Report on Climate Change and its Impact in Kashmir



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About the author

Arjimand heads ActionAid's Kashmir office and is a regular columnist having over 400 published articles regionally and internationally on issues of political economy, development and environment of Kashmir. He is trained as an engineer, with specialisation in water resource management. He has previously worked with UNESCO (South Korea) on its Culture of Peace Curriculum Project and has contributed three chapters to Asia-Pacific Teachers' Training Manual, including one on Large Dams. He has been a 2004 grantee of the ProVention Consortium and Asian Disaster Preparedness Centre for developing a conceptual framework in trans-boundary natural disaster management system in both parts of divided Kashmir. He has done extensive work on water-related issues and has been recipient of Water Fellowships from Salzburg Global Seminar, Austria and the Centre for Science and Environment, New Delhi.

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Some of the areas and villages covered in the study

Sedow Shopian, Herpora, Mujpathri Keller, Arhama Shopian, Sedaw, Heerpora, Sangarwani Keller, Abhama Keller, Sumbal Dachinan Keller, Zampathri, Pehlipora Keller, Chaklipora Anantnag, Kuthar Anantnag, Aharbal Kulgam, Manzgam Kulgam, Nagbal Budgam, Zowastan/Gulistan, Zinsbal Laam, Shikargah Tral, Karmulla Batnoor,Gujar Basti Gulshanpora, Gutroo Narastan Tral, Kapran Anantnag, Kichama, Nambla, Neloosa, Jambaz Pora, Shutloo Rafiabad, Nadhial Rafiabad, Bandipora, Hadipora, Sialkot, Sheikh Muqam, Ruhama, Aloosa, Guwna Larijungle, Karewas, Watlab, Chandoosa, Nehalpora, Chontpather, Nambalnar Hajibal, Qazipora Tangmarg, Pringal, Kanchan, Kalsan, Choolan, Watergam, Duwara Uri, Paranpilla, Badipora, Muqam Karewas, Doodbug Karewas, Valanvar Shutloo, Aashbal Rafiabad, Khamoh, Brandub, Nilsar Karewas, Chakoola, Chowkibal, Sogam, Bhinpora, Kalaroos, Shumnag, WaderHandwara, Hundi Chowkibal, Diver Lolab, Rashanpora, Dardpora, Kachhama Kralpora, Manzgam Handwara, Kupwara Dolipora, Warsun, Sarkooli, Rawatpora, Bagbella, Naicadir, Batpora, Khowerpora, Konagabra, Nawagabra, Chetterkot, Tetwal, Sadna Pass, Akhal, Cherwan, Satran, Reyan, Gund, Kangan, Sonamarg, Doodhpathri, Verinag, Achabal, Lidder Valley, Kulan Razan, Wangath, Khaimo, Shangus, Chowalgam, Beerwah, Arizal, Khan Sahib, Boniyar, Branwar, Gogji Pather, Lolipora, Tral, Shar, Khrew, Pampora, Zewan, Harwan, Dachigam, Fakir Gojri, Watlab, Wullar Lake, Sopore, Baramulla, Kupwara, Sogam

"ActionAid wishes to wholeheartedly thank the people of all the districts of Kashmir who, during field surveys, rendered support in providing and obtaining information for this study and in many instances spared a few days in leading ActionAid's team members to mountain locations.

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EXECUTIVE SUMMARY

- Deficit in food production in Kashmir region has reached 40 per cent, while the deficit is 30 per cent in vegetable production and 69 per cent in oilseed production for a population of 6 million, putting food security at a greater risk. In 1980–81, Kashmir valley had a food deficit of only 23 per cent for a total population of 3.3 million.

- As more and more paddy land is changed into rain-fed orchards, Kashmir's current 40 per cent food grain deficit is likely to touch over 60 per cent in the coming 10 years if the current rate of change is taken into account.

- Sample surveys reveal that 11909 Kanals of paddy land have been converted into rain-fed dryland in the districts of Kupwara, Baramulla, Bandipora, Badgam, Pulwama, Kulgam and Shopian in recent years.

- As against a revenue of Rs2000 crore from the horticulture sector, Kashmir's imports of mutton, milk and poultry have risen to a whopping Rs16000 crore annually from different states of India , making it clear that among other factors, the impacts of climate change have contributed their bit in reducing the capacity of the local rural economy to produce these essential commodities.

- Large-scale transition from paddy cultivation to rain-fed crops poses risk to food security in Kashmir. In the post-WTO scenario, as foreign fruits – mainly apples – have started flooding Indian markets, demand for Kashmiri fruits is likely to reduce. Low demand could cripple the capacity of poor small farmers to buy food grains from the market.

- According to the recently released report by the Inter-governmental Panel on Climate Change (IPCC), global temperatures are likely to rise by 1.1^0 Celsius to 6.4^0 Celsius by 2100. Such a scenario means that the plains of Kashmir would no longer receive snow and whatever snow the upper reaches may receive would hardly last to feed the rivers of the region throughout the year, threatening livelihoods at a large scale.

- Temperature on an average in Kashmir region has shown a rise of 1.45^0 Celsius while in Jammu region the rise is 2.32^0 Celsius. The Indian Meteorological Department's monitoring reveals that temperatures are increasing in both Jammu and Kashmir valley, with significant increase in maximum temperature of 0.05^0 Celsius per year.

- There is a clear unpredictability of the western disturbances passing over Kashmir , possibly due to factors which could be global in nature, with unusual distribution of rainfall in space and time, shifting patterns of precipitation and sustained deficit of snowfall.

- The study shows that the water level in almost all the streams and rivers in Kashmir has decreased by approximately two-thirds during the last 40 years.

- There is possibility that heat-trapping gases which have reduced snowfall in Khrew-Pampore and some areas of Anantnag could spill over to other areas of Kashmir, resulting in less or no snow in the plains in the coming two decades.

- Hundreds of springs spread all across Kashmir have either dried up or are in the process of

drying up. Although groundwater level in most of the plains does not seem to have been adversely affected, groundwater level on average in Karewas and upper areas has decreased by one-third.

- Actual time period for snowfall has also undergone a change with December and January receiving scant or no snow while February and March witness heavy snowfall.
- Quantity of snowfall in Kashmir has clearly reduced over the last few decades. Although occasionally it does have spells of heavy snowfall, the inability of snow to freeze and develop into hard and longer-lasting crystals

Photo: Irfan Hamdani, ActionAid

A flooded street in Rajbagh area of Srinagar. Flooding due to abrupt meltdown of snow as a result of high temperatures in Kashmir is a usual occurrence now.

owing to higher temperatures has resulted in faster meltdown.

- It has been found that there has been an overall 21 per cent reduction in the glacier surface area in the Chenab basin. The mean area of glacial extent has also declined from 1 sq km to 0.32 sq km during 1962–2004.
- Many of the areas have seen a complete disappearance of small glaciers such as some parts of eastern Srinagar and Pirpanjal mountain range in Pulwama District. In other areas, like Budgam, the height of the small glaciers has reduced to over one-fourth of the original height.
- In the upper reaches of the Sindh Valley in Ganderbal district, the Najwan Akal which was said to be a major glacier, has completely disappeared today. Similarly, the Thajwas, Zojila and Naranag glaciers used to be large enough to last up to October through November some decades back, but today they have considerably reduced.
- While winter and spring water run off has clearly increased due to early meltdown of glaciers, resulting in frequent floods, faster meltdown has resulted in significant decrease in water availability in streams during summers.
- The Fakir Gujri area of Srinagar district used to witness snowfall between December and March. But over the years there is snowfall only in the month of January even as there is snowfall in the Mahadev hills. Locals attribute this to increased temperatures in the area. The area receives about 2ft of snow today as compared to about 10ft about 40 years ago.
- In the Kapran area in Anantnag (Islamabad), the length of the Hangipora glacier has reduced from 35ft to 12ft and the Naaginad glacier has reduced from 30ft to 10ft. In Chaklipora area the Galgudi and Wandernad glaciers have considerably decreased in size since approximately the last two decades.
- In Karnah, which falls between the temperate Kashmir Valley and semi temperate Pakistan-Administered Kashmir, there is greater frequency of flash floods now. Temperatures are also constantly rising.
- In the Kalaroos village the snow levels have reduced from 10ft to 3ft. In Manzgam village snowfall has reduced from 6ft to a maximum of 2–3ft. Similarly, people in Wader area of Kupwara report decrease of snowfall from 12ft to 5ft today.
- It has also been observed that the amount of rainfall during the winter months of December, January and February has also increased in comparison to the past.
- In Choolan area, located in the Shamasbari mountain range in Baramulla district, the nearby glacier, namely Katha, has reduced from about 200ft forty years ago to about 80ft today.
- In Karnah sub-region the glaciers of Shamasbari and Sadhna have decreased in size by more than half during the last 30 years.
- The Budrukot glacier has reduced from 16ft to only 5ft in height over the years. The Khujwan glacier in the mountains of the Kichama area has reduced from 40ft to only 20ft over the years.

The Afarwat glacier around Nambalnar Hajibal area, which used to be 300m long 40 years ago has completely disappeared today.

- In the upper reaches of the Sindh Valley in Ganderbal district, the Najwan Akal which was said to be a major glacier, has completely disappeared today. Similarly, the Thajwas, Zojila and Naranag glaciers used to be large enough to last up to October through November some decades back, but today they have considerably reduced.
- While winter and spring water run off has clearly increased due to early meltdown of glaciers, resulting in frequent floods, faster meltdown has resulted in significant decrease in water availability in streams during summers.
- The 2007 spring floods have largely been a consequence of fast meltdown of snow in the mountains, coupled with the spring rains. In future, any major snowfall in spring, like the one which occurred in March 2007, followed by rainfall stretched over 48hrs could wreck havoc in Kashmir Valley.

INTRODUCTION

In the mighty Himalayan mountain range lies Kashmir,[1] a unique and fragile eco-system, where people are heavily dependent on their natural environment for their sustenance. This rare temperate region in the Indian sub-continent draws about 70 per cent of its Gross Domestic Product (GDP) from the surrounding ecological resources. Livelihood of more than 75 per cent Kashmiris is dependent on horticulture, agriculture and handicrafts with raw material for these being mostly drawn from the natural environment itself. A major land reform in the early 1950s makes Kashmir the first region in the sub-continent to have undertaken equitable redistribution of land. Kashmir is one of the few regions in South Asia which has not faced large scale hunger since the last half a century or so. The main reason for this has been good food security due to highly fertile land and abundant water resources. Even though agriculture cannot take credit for the total food security, earnings from non-agriculture produce to a segment of population that owns land has been ensuring absence of hunger.

Over the years, as a result of certain environmental changes like erratic rain and snowfall and fast receding glaciers due to climate change, water is becoming more scarce. Farmers, especially the poor who own very small holdings, are compelled to shift from agriculture to rain-fed farming and livestock is facing an uncertain future.

The easily discernible impact of climate change is the fast melting and receding of glaciers in Kashmir. Some 40 years ago during summers, women from Srinagar outskirt areas of Dhara and Harwan (barely 15kms in the mountains in the east) would make their livelihood out of selling ice (locally known as *Yakh*) in Srinagar city obtained from glaciers there. They would roam through the city and sing in Kashmiri, *'Wai Yakho! Kamyu Van Volmukh! Ha Yakho, Andrei Golkho Yakho!* (Oh ice! I marvel what forest I fetched you from? Don't melt from inside). For decades, Kashmir's most cherished traditional ice cream maker – Ama Sofi – and his ice suppliers made their livelihood selling traditional ice creams in Srinagar Bohri Kadal area, with the same ice. Today there are no glaciers in the summer months even 40 kms around Srinagar's east-side mountains. Now women selling ice and Ama Sofi selling traditional ice creams from glaciers in Srinagar city are history.

In the course of its work in Kashmir over the last few years – mainly in the remote areas – ActionAid has been perceiving marked changes in both the natural environment as well as the farm practices, which are slowly influencing the socio-economic fabric of Kashmir's countryside. Sensing certain links of these changes with the global phenomenon of climate change we set out to look into the possible factors that were causing these changes in Kashmir. At the start we did not assume that these changes were a direct consequence of the climate change phenomenon. Instead, we sought to rely on people's understanding of the factors that were triggering these changes in the first place.

Putting people's perceptions about the changes and their understanding of the possible contributing factors at the centrestage, ActionAid adopted the Participatory Vulnerability Assessment (PVA) techniques to carry out this study across the Kashmir Valley. This is not a scientific study. Rather, this is a report in which primacy has been given to

people's perceptions and quantitative details, if any, quoted by them only. However, additional information, duly referenced in the report, has been collected from numerous other sources as well. In the course of this study, we have clearly seen that people in the countryside, despite low levels of education, have a fair understanding of the climatic factors precipitating changes in livelihood patterns.

Information from eight districts for this study was collected between October 2006 and July 2007 through interviews with 571 individuals by ActionAid's 91 local team members, who were also supported in a few areas by nine interns from Kashmir University, Tata Institute of Social Sciences, Mumbai; Delhi School of Social Work; Aligarh Muslim University and McGill University, Canada in 61 villages of the districts of Anantnag (Islamabad), Kulgam, Pulwama, Shopian, Ganderbal, Srinagar, Budgam, Kupwara, Bandipora and Baramulla. The issues that have been looked into in this study are the change patterns in water availability, crop cultivation, glacier size, snowfall, rainfall, floods and the impact of all these on the livelihoods of people living in Kashmir. The kind of possible future scenarios quoted in the report by the Inter-governmental Panel on Climate Change (IPCC), based on the changes occurring in the Himalayan mountain regions, also serve to reinforce the findings in this study.

We have taken care to only include those changes in this report which can be directly attributable to climate change. Some of the changes occurring in the livelihood of people in the countryside may also be the result of the introduction of new varieties of seeds, plants and also due to changes in agricultural practices, market dynamics and the socio-cultural changes due to the adverse security situation since the violent conflict began in 1989. The severe fragmentation of the existing land holdings after family expansions and subsequent divisions, coupled with scarcer water availability, is making livelihood out of agriculture an impossibility with each passing year. As a result, the younger generation is finding agriculture an unviable livelihood practice, resulting in mass rural unemployment and giving rise to frustration and suicides.[2]

The June 2007 Kashmir government's confession that against a revenue of Rs2000 crore from the horticulture sector the state imports mutton, milk and poultry worth Rs16000 crores annually from the different states of India has made it evident that, among other factors, the impact of climate change has contributed in reducing the capacity of the local rural economy to produce these essential commodities.[3] It has also expressed its concern over the growing imports of almost all essential commodities, including vegetables, milk, poultry and mutton.

The basic idea behind putting this first-of-its-kind report on climate change in Kashmir in the public domain is to make it act as a wake-up call to governments in Srinagar and New Delhi. However, considering the diverse influences and impacts of these changes in arid, semi arid, semi temperate and temperate zones of Kashmir on people's livelihood we believe there is still a big scope of looking at these matters much more closely, covering more geographical areas in Jammu and Ladakh regions. We also believe the need for the scientific community to look at these

matters from a scientific point of view since the mandate of this study has been primarily to look at impact of climate chang on people's

Livelihood in Kashmir

The findings of this study clearly underline the need for governments to factor in climate change in the policy and planning processes in future so that the uncertainties which climate change holds for the livelihood of millions of people in this region, particularly the poor and those rendered vulnerable by geography and the political division, would be kept in sight. Towards that, a futuristic approach taking into account the current trends in climate changes and also the depletion of environmental resources like glaciers and other water sources, is required. Equally important is the need for vigorous scientific research in the changed conditions in the fields of agriculture and horticulture and taking that knowledge to people at the grassroots level, particularly the poor and geographically vulnerable, by both government as well as independent non government agencies so that Kashmir's food security is not compromised and increasing unemployment in rural areas does not result in further socio-economic problems and deprivation.

Photo: Irfan Hamdani, ActionAid

A drowned houseboat near Zero Bridge in Srinagar due to heavy snow. Untimely heavy snow in March 2007, accompanied by heavy rains, resulted in severe flooding in Kashmir.

TEMPERATURE RISE

A recent report by the Intergovernmental Panel on Climate Change revealed that globally, 11 out of the last 12 years are among the 12 warmest years ever recorded on earth. Despite a dearth of reliable comparative data and temperature recordings across various areas and sub-regions of Kashmir, recent figures from the Indian Meteorological Department (IMD) suggest that in Kashmir there is also an overall increase in average temperatures. On average, Kashmir valley has shown a rise of 1.45^0 Celsius, while Jammu region has shown a rise of 2.32^0 Celsius over the last almost two decades.

IMD monitoring reveals that temperatures are increasing in both the regions of Jammu & Kashmir with significant increase in maximum temperature by 0.05^0 Celsius per year in Kashmir Valley and minimum temperature in Jammu region by 0.08^0 Celsius per year.[4]

Another dimension of climate change in Kashmir is seen in the unusual fall in temperatures in seasons which would normally have a set temperature pattern like in spring. For instance, the month of May in 2007 has been unusually cold in Kashmir. The temperature hovered around 25^0 to 26^0 Celsius during the second fortnight of May, which, according to experts, is 8^0 Celsius below normal.[5] During May, Kashmir should have been experiencing temperatures ranging somewhere close to 34^0 Celcius. Environmentalists attribute this to rise in average temperature, decrease in precipitation and loss of vegetation cover in Kashmir, particularly during winters. Fifty years ago, Kashmir's forest cover was 37 per cent of its total surface area, which has today reduced to only 11 per cent.[6]

During May 2007, while irregular snowfall was witnessed in the upper reaches of almost all mountain ranges in Kashmir, the unusual summer snow at altitudes relatively lower made the mercury dip with night temperature going down to around 5^0 Celsius, which was 10^0 Celsius below normal. Kashmir witnessed at least three days of unusual late morning fog, particularly on 23 May 2007 in Srinagar, which elders said, was a highly unusual occurrence during late May.

In spite of this, according to IMD, the plains of the close-by states of Punjab, Haryana and Rajasthan experienced sudden rise in temperature with no convectional rainfall in the region. This is said to be in complete contrast to the month of May where usual showers brought the temperature down.

Untimely windstorms and vulnerabilities

The intensity of the windstorms that lashed both Indian and Pakistani Administered parts of Kashmir in May 2007, resulting in considerable damage to trees and property is something that people in Kashmir cannot recall having happened before. Although officials in the IMD have ruled out any unusual or alarming situation with such occurrences, elderly people surveyed in Kashmir are unanimous that the May windstorms were unusual and not experienced by them in their lifetime.[7]

"Untimely and unprecedented windstorms in May 2007 wiped out the almond crop by 60 per cent and destroyed trees and homes of the poor," says farmer Muhammad Usman Yatoo of Badipora, Nagam. There was massive destruction of

temporary shelters in the earthquake-affected areas of Pakistan Administered Kashmir (PAK) and North Kashmir. Similarly, other crops that were damaged include cherry, apricot and walnut. Small farmers, mainly those who live on mountains and depend on walnut and pear produce for their livelihood are at greater risk.[8]

According to an article in *Frontline* newsmagazine an important effect of global warming on meteorological conditions is an increase in sea surface temperature (SST) in the oceans around the Indian subcontinent. The resulting greater convective activity will lead to an increase in the intensity or wind speed of cyclones that form in them, particularly in the Bay of Bengal where over 80 per cent of the cyclones originate.[9]

However, there is little or almost no evidence to show that such phenomenon in the Bay of Bengal or the Arabian Sea would impact wind factors in Kashmir. Study of geographical and meteorogical conditions reveal that Kashmir is not usually a recipient of large wind systems from either the Arabian Sea or the Bay of Bengal. But rise in average temperatures across regions surrounding Kashmir and the sudden temperature variations between the plains and the high altitudes of Kashmir are areas that require in-depth research to understand the May 2007 windstorms in Kashmir.

According to the meteorological data studied by ActionAid, generally air does not flow directly from high to low pressure but it is deflected to the right in the Northern Hemisphere. As such, the small and short-lived systems which are created due to temperature difference in close proximity in this region seemingly tend the wind to flow directly from high pressure to low pressure.

The ignition of the May 2007 windstorms around Muzaffarabad in Pakistan Administered Kashmir Valley – travelling towards east to Kashmir Valley – need further investigation and understanding by the scientific community in the backdrop of the newly evolving temperature gradients. In case such new phenomena persist in Kashmir, poor farming communities depending on single produce in a year for their livelihood would face even more uncertain future.

NEW TRENDS IN RAIN AND SNOWFALL

As per the testimonies of people across Kashmir, the quantity of snowfall in Kashmir has clearly reduced over the last few decades. Although occasionally it does have spells of late snowfall, however, the inability of snow to freeze and develop into hard and longer-lasting crystals owing to higher temperatures right from the plains to higher altitudes has resulted in faster meltdown. On the higher altitudes, it has been observed, inability of snowflakes to turn into hard crystals due to higher temperatures has severely impacted glacier formation.

In areas from where information has been collected, it is observed that the amount of snowfall has reduced by over half to one-fourth of what has been witnessed in Kashmir about four decades ago. What is discernible is that the actual time period for snowfall has also undergone a change with months of December and January receiving scant or no snow while February and March witnessing heavy snowfall. What has also been observed is that the amount of rainfall during winter months of December, January and February has also increased in comparison to the past. This can be attributed to higher temperature prevalent closer to the earth's surface in the plains and the *Karewas* areas, thereby constraining snowfall in the Kashmir Valley.

In most of the areas the snowfall months have reduced from four months a year to only two months a year. This is especially true in the districts of Anantnag, Kulgam, Srinagar and some areas of Ganderbal and Pulwama.

To understand the exact macro-level trends in precipitation in Kashmir, it is essential to take into account that data at smaller scales is constrained due to unavailability of accurate data in the various sub-regions and geographical locations of this region. Given the fact that the easterly-directed cloud systems arising from the Western Disturbances are responsible for over 70 per cent precipitation in Kashmir region, the knowledge base available on Monsoons in the Indian sub-continent is not fully relevant to understand the precipitation patterns in Kashmir. Some recent studies on long-term trends of the monsoons indicate that while there is no evidence of any change in the rainfall pattern in the gross scale in India, changes are discernible at smaller scales of space and time.[10] Same is the case in relation to Western Disturbances in Kashmir. These have not been studied in a desired manner due to inaccessibility in Kashmir owing to the ongoing conflict. There is a clear unpredictability of the Western Disturbances passing over Kashmir, possibly due to factors which could be global in nature, with unusual distribution of rainfall in space and time, the shifting patterns of precipitation and deficit of snowfall.

Testimonies of people living in various parts of the valley substantiate this. For instance, in South Kashmir villages of Chaklipora and Kapran, the amount of yearly snowfall has reduced by more than half.

In Baramulla district, villagers in Hadipora area say that they used to receive about 6ft of snow annually but today they barely get 2ft, and this melts away fast. In Rohama area people say they have seen reduction in snowfall in their area by one-third of the original snowfall. The Parampilla village in Uri has seen a reduction in snowfall from about 3ft to only 0.2–0.4ft in the past 40 years.

The same situation has been reported by people in Shatloo village of Rafiabad area. In the Karewas area of Baramulla, Ghulam Ahmad Reshi of Gulwana Lari Jungle says that the snowfall levels have reduced from 7ft to only 3ft in that area. 60-yr-old Muhammad Maqbool Lone of Janbazpora village says that the snow levels have fallen from 7ft to 1ft only.

According to Ghulam Ahmed Malik, Naib Sarpanch Bagbela, Karnah, which falls between the temperate Kashmir Valley and semi-temperate Pakistan-Administered Kashmir, "There is greater frequency of flash floods now in that area than in the past. Temperatures are constantly rising."

In the upper Karewas areas of Budgam, according to locals, snowfall levels have considerably reduced. In Beerwah village of Budgam, villagers report a fall from 5–8ft of snowfall 40 years ago to 0.5–0.10ft today.

In Kangan area of Ganderbal district, villagers say, there used to be at least 5ft of snow about 40 years ago but now hardly half a foot falls. Ali Muhammad (55) of village Wangath says that snowfall levels have fallen from 6ft to half foot during the last 40 years. 55-yr-old Muhammad Ashraf Mir of Hari Ganwan village cites a two-third reduction in snowfall in their area.

In Hundi village of Kupwara people say there has been a reduction of about 4ft of snow in the area over the years. In Chowkibal area, people face the same situation. Dardpora village, close to the Line of Control in Kupwara, normally used to have snowfall from November to March. But during the last few years there is no longer any specific time for snowfall. In the Kalaroos village the snow levels have reduced from 10ft to 3ft. In Manzgam village snowfall has reduced from 6ft to a maximum of 2–3ft. Similarly, people in Wader area of Kupwara report decrease of snowfall from 12ft to 5ft today.

Mohammad Jamal Gausi, 72 years, of Zinsbal Laam in Tral area of Pulwama district says that the snowfall levels in his area have gone down from 6–8ft to1–1.5ft today. In Mujpathri village people say snowfall is down from 4–5ft to only a few inches today. Similarly, in Zowarstan, villagers report a major decrease in snowfall over the last 40 years: from 6–8 feet to 1–2 feet as of today.Naik Mohammad aged 76 of Sangarwani area says that the snow has come down from about 12ft to only 0.5 to 4ft in their area.

In Shopian, 85-year-old Mohammad Rasheed Wani of Sedow village says that snowfall has gone down from 10ft to 1ft only in their area. Sedaw has been traditionally a high snowfall area situated in the lap of Pirpanjal mountain range near the famous Ahabbal falls. Abdul Hameed Wani, 50yrs old, of Heerpora area says he has seen snow steadily dwindling from 12ft to a mere 3ft today.

In Fakir Gujri area of Srinagar district, locals say the area used to witness snowfall between December and March. But over the years there is snowfall only in the month of January and February, even as there is snowfall in the Mahadev hills. Locals attribute this to increased temperatures in the area. The area, locals say, receives about 2ft of snow today as compared to about 10ft about 40 years ago.

It can be concluded from the analysis of people's testimonies and firsthand information collected on rain and snowfall that there is a greater unpredictability of rainfall over space and time in comparison to the set pattern of the district seasons in Kashmir in the past. There is also a drastic decrease in snowfall as compared to 40 years ago. This situation is likely to result in greater livelihood vulnerabilites for the poor farming communities. People of almost all the sub-regions and geographical locations voice the concern that rainfall today no longer has any fixed season and that unpredictability has increased.

Arjimand Hussain, ActionAid

The picture shows blooming of flowers amidst snowfall in Srinagar in February 2007. Early blooming of fruit blosoms and flowers due to warmer temperatures during February and March in Kashmir has been damaging fruit produce as sudden late snows in February and March devastate blosoms.

IMPACT ON GLACIERS AND FUTURE SCENARIOS

The findings of this study based on interviews held with local people in remote locations of Kashmir show that the glaciers in most of the areas have decreased in size. Many of the areas have seen a complete disappearance of small glaciers in some parts of eastern Srinagar and Pirpanjal mountain range in Pulwama District. In other areas like Budgam, the height (averaging 15–20ft) of the small glaciers has reduced to over one-fourth of the original height as seen in summer months when villagers venture into highland pastures for grazing their sheep.

Barely 20 years ago, the snow line in Kashmir valley's east was just above areas like Pahalgam and Sonmarg (3200m). Currently the line has receded to Shiashnag area which is at an altitude of 5000m only. Same is true of the Pirpanjal mountain range in the west where the snow line was above Kongwatan and Zaznar (3000–3500m). It is now around Kounsernag and Pirpanjal Pass (4000–4500m).[11]

Most of the glaciers of the Great Himalayan range from Harmuk to Drungdrung including Thajiwas, Kolahoi, Machoie, Kangrez, Shafat have receded far back (4000–5000m) during the last 50 years when a comparison is made between their extent from Survey of India (SOI) sheets which are 50 years old and latest satellite imageries.[12]

While considerable research is being undertaken to study the extent and factors of depletion of glaciers in the Himalayas in Nepal and in the Indian states of Himachal Pradesh, Uttaranchal and Uttarakhand, owing to the precarious security situation in Kashmir Himalayas with high level military presence and militant activities, very little work has been done in monitoring glaciers here.

Scientists at the Indian Space Research Organisation's Space Applications Centre (SAC) in Ahmedabad like Anil Kulkarni and others have investigated the glacial retreat in the Chenab basin in Kashmir, largely by using data from the Indian Remote Sensing satellite and field expeditions and thereby comparing them with the 1962 topographic surveys by the Survey of India. The study has shown an overall 21 per cent reduction in the glacier surface area. According to the SAC, the process of deglaciation has also led to the fragmentation of the larger glaciers. The mean area of glacial extent has also declined from 1 sq km to 0.32 sq km during 1962–2004.[13] From a study of winter run-off – which is only on account of snowmelt – the scientists found that accumulation during winter has declined between the late 1990s and the turn of the century.[14]. Also, the snow accumulation pattern had changed significantly. Likewise, they found that the winter run-off had increased by as much as 75 per cent between 1966 and 1995. If additional areas start melting in the middle of winter, less snow will be available for summertime stream run-off that feeds the rivers.[15]

This is already happening in Kashmir. While winter runoff has clearly increased due to early meltdown of glaciers, faster meltdown has resulted in significant decrease in water availability in streams during summers.

The Chinese Academy of Sciences, in April 2007 stated that if the rate of temperature rises does not change, glaciers on the Qinghai-Tibet plateau will rapidly shrink, perhaps from 500,000 square kilometres (193,100 sq miles) in 1995 to 100,000 square kilometres (38,600 sq miles) by 2030.

Glaciers across the Himalayas and the Qinghai-Tibet Plateau are a major source for some of the rivers, like the Indus in Kashmir. It also warned that the glacier-fed rivers could swell as the ice melts but then dry out as the ice disappears[16]. This is what has already been witnessed in Kashmir. The recent spring time floods have largely been as a consequence of fast melt down of snow in the mountains, coupled with the spring rains. In future, any major snowfall in spring, like the one which occurred in March 2007 in Kashmir, followed by rainfall stretched over 48 hours could wreck havoc in Kashmir.

A study by the United Nations Environment Program (UNEP) and the International Center for

Saudia Qutub, ActionAid

This formerly paddy land has been converted into an orchard in Khan Sahib Karewas due to water shortage. Similarly, thousands of *Kanals* of irrigated paddy land have been converted into dray land.

Integrated Mountain Development (ICIMOD) reveals that the temperature in the Himalayan region has risen by almost 1 degree Celsius (1.8 degrees Fahrenheit) since the 1970's. This shift in climate has caused meltdown of snowfalls and glaciers - at the fastest rate in the world (50 feet/15 m per year in northern India) - even in winter, causing icy water to accumulate in lakes hedged by unstable dams of sediment and stone[17]. Kashmir Valley – with a poor flood management system and landlockedness – faces the perils of a real catastrophe in case in future Spring-time snow and its subsequent meltdown due to higher temperatures is coupled with prolonged rainfall activity.

According to Ghulam Mohammad Lone (69) of Kapran area in Anantnag (Islamabad) district length of the Hangipora glacier has reduced from 35 feet to 12 feet and the Naaginad glacier has reduced from 30 feet to 10 feet. In Chaklipora area the Galgudi and Wandernad glaciers have considerably decreased in size since the last about two decades, locals say.

According to testimonies of villagers in Choolan area, located in the Shamasbari mountain range in Baramulla district, the nearby glacier, namely Katha, has reduced from about 200 feet forty years ago to about 80 feet today. Similarly, as per the people living around Tangmarg and Gulmarg, Budrukot glacier in the area has reduced from 16 feet to only 5 feet in height over the years. The Khujwan glacier in the mountains of the Kichama area has reduced from 40 feet to only 20 feet over the years. The Afarwat glacier around Nambalnar Hajibal area, which used to be 300 feet long 40 years ago has completely disappeared today, says a local, Lal Din.

"Glaciers are disappearing before our eyes – the Shamasbari and Sadhna glaciers in Karhah are now half the size they were 30 years ago," says Master Shabir Ahmed of Nawagabra village in Karnah sub-region.

In the upper reaches of the Sindh Valley in Ganderbal district the Najwan Akal was said to be a major glacier which was a source of water for many villages in the area. But villagers interviewed in Wangath say the glacier has completely disappeared today. Similarly, the Thajwas, Zojila and Naranag glaciers used to be large enough to last up to October–November some decades back but today they have considerably reduced.

In Kupwara district information collected reveals that in Bhonpora area three glaciers, namely Kaker Seen, Phodala and Godayali have reduced in height from 10ft to twoft. The Novan top glacier in Kalaroos village of Kupwara has reduced in size from 20ft to 10ft. In Wader area of Kupwara district the height of the Shinnord glacier has reduced from 12ft (30 years ago) to only 2ft today. According to villagers in Rashanpora area, the Duth glacier has reduced from 20ft to only 4ft in a period of 40 years.

Interviews held with people living in Pirpanjal mountain range in the Keller block of Pulwama district reveal that glaciers there have reduced by half in size. Most of the testimonies were obtained from shepherds who take cattle for grazing in the highland pastures during summers. According to Kamaal Dar (60 years), the Panchal Naad glacier of Zowartan area has decreased from 50ft to 18ft only.

"The Nandyan glacier used to be over 120ft and the Tratnaal glacier at least 150ft. They now can't be seen at all in summer," says 65-year-old Mohammad Jamal Gaursi of Zinsbal Laam area.

In Shikargah area of Tral, Abdul Majeed Bhat says that the Ari glacier which was earlier about 150ft long has completely disappeared since 1990.

In Shopian area, Abdul Hameed Wani (50 years) of Heerpora village says that the Zuznard and the Ropali glaciers in the upper reaches of the Pirpanjal connecting with Rajouri district used to be big enough to last until the next winter. "But since some years they are hardly there until Autumn comes," he adds. Villagers also recall the snowstorm of April 2004 when Gujjar nomads along with their cattle were caught unawares in the highland pastures when they had already gone there after the winter was over and snows had melted. "We lost many people and cattle in that unexpected snowfall. God seems to be angry with us to bring in such unexpected things," says Muhammad Hussain Gorsi, a shepherd who travels across Pirpanjal mountain range regularly on foot. Muhammad Sharref Naikoo (70) of Sedow village speaks about the Gurwattan glacier in the area which he says, "used to have a normal size 40 years ago." "But today," he says, "the glacier is only half of its original size."

In the Harwan area of Srinagar district near the Dachigam National Park, Lassa Bhat, a villager, points towards the Mahadev peak and its adjacent mountains saying that the glaciers which he used to see 40 years ago in his youth are hardly there today. Similarly, Munsher Khan of Fakir Gujri village, who used to move around with his cattle in the Mahadev mountain range, says that although he has not gone to the Tarsar Marsar lake area since many years due to security reasons, he has heard from his fellow shepherds that glaciers in that area are fast disappearing.

DEPLETING WATER SOURCES

Interviews held with people across Kashmir clearly indicate that there is not a single water stream in Kashmir today which has not witnessed water depletion over the years. Analysis of the data collected from the eight districts of Kashmir in the course of this study show that the water level in almost all the streams and rivers has decreased by about one-third, in some cases even by half, during the last 40 years. It is the water flow in the small streams and tributaries that finally determine the overall water availability in Kashmir's three main rivers, namely Indus, Jhelum and Chenab, which finally flow into Pakistan.

Over the last few years, sudden rise in temperatures (usually 4–5^0 Celsius above normal) in the months of February, March, April and May has resulted in faster melting of glaciers, thereby flooding most of the streams and rivers in these months. These are the months when the water of almost all the streams and rivers goes waste in the Kashmir region due to non availability of storage sites and flows into Pakistan where large reservoirs on the streams of Jhelum, Chenab and Indus help that country to store waters. However, based on the testimonies of people who have been heavily dependent on these streams in various parts of Kashmir for agriculture and other livelihood activities, it is clear that the net water availability in all streams and rivers has considerably reduced.

In Kupwara district the net availability of water in streams, according to the local residents, has clearly diminished in the last forty years. Says Abdul Ahad, a social activist in Kupwara town, "When we look at the Taler stream in the Bhinpora area of Kupwara the water level has reduced from about 5ft to 1ft during summer time." In Kachhama area of the district water level in the Darnar and Manzemnar streams has reduced from 6ft to hardly 2ft. In Chowkibal area, the Kehmil stream, according to locals, has reduced from 5 feet to 3 feet. The same stream in Manzgam village downhill has reduced to hardly one-and-a-half feet. The Darnar stream of Kachhama has gone down from about 6ft to only 2ft.

In Baramulla district, interviews with local people in and around the Wullar Lake and analysis of various versions put by them about the reduction of its height reveals that the depth of the lake has come down from 40ft to an average of 20ft. Although there are other factors like siltation, growing plantation inside the lake area and disruption of the normal ecological and livelihood activities of the local people in the lake due to its take over by the Indian Navy, overall loss of water in the Wullar lake is certainly a reality.

In Watergam area the water level of its Dahgaam stream, according to the locals, has reduced from 6ft to hardly half a foot during summer times. Villagers in Pringal block and Parampilla village of Baramulla say that water availability in the Jhelum river has considerably reduced over the last 40 years and so has their approach of navigation and other chores of life.

Quoting his elders, Shahnawaz Ahmed of Baramulla town says, "Water in Jhelum used to be as high as 20ft during average flow times but now it is hardly 4–5ft." He recalls how during his childhood days it was very difficult to cross the river by swimming during summer days but now youngsters easily cross it in the same season.

Muhammad Maqbool Lone (60 years) who has lived all his life in Janbazpora, Baramulla, says he has seen the Jhelum waters receding drastically during the lean season over the last 40 years. At the Duwara village near Uri, elderly villagers say the Jhelum water level has reduced by about 10 ft since the last 40 years. Babul Canal is an important irrigation stream which originates from Tangmarg and flows through the Kreeri and Pattan belts of Baramulla. At Chontpattar, Baba Reshi, locals say there has been a 4ft-water drop in the Ningli *Nallah* over the last 40 years or so, resulting in large swathes of paddy lands being turned into horticulture lands. According to the locals they had proposed a plan for revival and water adjustment of the Babul Canal to the government but owing to

Arjimand Hussain, ActionAid

A dried out spring amidst illegally felled trees near Doodhpathri in the Pirpanjal mountain range in May, 2007. Illegal felling of trees and dwindling natural water sources have resulted in drying up of hundreds of springs in Kashmir.

the objections by the Indian Indus Commission, the project was not approved. Shujaat Bukhari, a prominent journalist of Kashmir, belonging to a farmer family from Kreeri, says that hundreds of *Kanals* of land has dried out with people switching over to other agricultural and horticultural activities in that area.

In Choolan area of Baramulla streams like Kulsum and Cholu completely go dry during summer season now. Similarly, in Hadipora village water in the Vijinalla stream has reduced from about 5ft to only about 1ft today. In areas like Tangmarg, streams like Ferozpora *Nallah* have seen major water reduction over the years. It is completely dry in summer and autumn seasons. In other areas the study indicates that streams are completely drying up during early summer. The Reshi Kul stream of Aloosa Bandipora which used to have about 4ft of water does not carry any water during summer and autumn times these days. Similarly, in Rohama area, the Wigi and Dakli nallas have almost completely dried up, except during rainy days. The Zafar *Nallah* in Nehalpora area of Baramulla has seen depletion of water flow from an average 5 feet to almost no water today during Summer and Autumn times.

In Anantnag (Islamabad) district, water levels in almost all major streams and rivers there, as per the analysis of the collected data, shows that water flow during Summer and Autumn seasons has reduced by more than half since the last 40 years. This is clearly reflected from testimonies from people living around the Aripat and Gamed streams of Kulhar village and Thimran *Nallah* & Bradi *Nallah* of Chaklipora villages. According to locals, water flow in the Mudbal Naad stream of Kapran area in South Kashmir has reduced by more than half during the last 40 years.

In Shopian district, things are hardly different. According to 70-year-old Muhammad Shareef Naikoo, the two streams of Aharbal and Watig flowing in Sedow area have clearly reduced. Locals make comparisons of Nallah Vishav by referring to the amount of water flow at the Aharbal waterfall 40 years ago and today. At Heerpora village, Abdul Razaq Lone (75 years) attributes decrease of water flow in Rambiara and Kawkul streams to 'deforestation and climatic change'. When asked what makes him to attribute this decrease to climate change, he talks about the amount of snow the area used to get 40 years ago, the longer duration of freezing of snow and slower melting than what happens today. "I can tell you we clearly used to have better water flow for most of the time of the year," says Razaq.

In Budgam district, villagers from Arizal and Khan Sahib areas have said that the water levels in Sokhnag, known downstream as Ahji, and the Zaim stream have seen depletion by two-thirds during the last two decades or so. People commonly talk about less water availability for their paddy fields and change of paddy lands into drylands. Water has also clearly receded in the Shaliganga stream as well. "Today one can clearly see water depletion in streams of Badgam affecting agricultural and livelihood practices," says Ahmed Ali Fayaz, a prominent Kashmiri journalist who has been brought up in a farmer family from the same area. People living around Romshi and Manshi streams in Nagbal area say that water has considerably reduced and no longer meets the needs of the people there.

In Pulwama district, Naik Muhammad of Sangarwani area in the Panpanjal mountain range in Pulwama district re-collects that Hakdiyagi stream in the area used to have sufficient water flow throughout the year during his childhood 40 years ago but today it dries up in July till November or December. According to Ghulam Mohiuddin Wani of Karmulla Bhutnoor in Tral area, water availability in the Budwhat Nalla has significantly reduced, making it dry from June until December.

A conversation in the foothills of the mighty Mahadev mountain overlooking Srinagar with Lassa Bhat of New Theed in Harwan village is hardly different:

"The Mawas stream used to have so much water 30 years ago back that children could not cross. But today to him, children easily cross the stream any time, except during flash floods," he says.

Munsher Khan, the headman of Fakir Gujri village, further up in the same mountain range, talks of the Darwani and Fakir Gujri streams. "These streams were once the major source of water for paddy fields downstream. They also fed Dal Lake. But now, they have hardly any irrigation value," says Khan.

Zaffar Ahmed Bhat, a young engineer, from the same area points to the Sarband water reservoir bordering Dachigam National Park at Harwan and says that through a special effort, by diverting water upstream from a stream, increased embankment water has been retained in the reservoir during 2007. "Otherwise it was completely dry as there was no water since more than 10 years in it," adds Zaffar.

Moulvi Mehboob-ur-Rehman (70 years) of Wangath village, Ganderbal district says, "The Gangabal stream in the area has markedly dried up early this year." Muhammad Ashraf Mir of Hari Ganwan village says that water in the stream of the village has reduced from 4ft to 1ft in the peak flow time and there is almost no flow during summers.

The official hydrological data of all main rivers of Kashmir Himalayas and their major tributaries show that today the discharge of these rivers and tributaries has almost halved as compared to only 50 years back – be it in Jehlum, Chenab or any other river or in major tributaries like Liddar, Sandren, Vishow, Rambiara and others. Today the discharge of Chenab is less than half of what was 60 years ago and the discharge is diminishing year after year. Fifty years ago Chenab basin used to have about 8000 sq km area under glaciers, permanent and ephemeral snow cover which would contribute huge quantities of water during summer to this river through numerous perennial tributaries as compared to the present 4100 sq km snow cover area.[18]

Another peril that is in store for the Jammu & Kashmir States is in the form of flash floods. Many areas of all the three regions, as seen in the floods of the last three years, are vulnerable to flash floods. Spring rains coupled with fast melting of snows on high altitudes could wreck havoc with our plains in Jammu, Kashmir and the valleys of Ladakh.

IMPACT ON AGRICULTURE AND HORTICULTURE

ActionAid surveys conducted in various areas of Kashmir indicate that the impact of climatic changes is being felt in a variety of ways. One of the most critical is the influence on farm practices. In the Karewas areas there is a general pattern of farmers switching from paddy cultivation to rain-fed horticulture and low irrigation crops such as maize, oats, grazing grass and vegetables. Inadequate natural irrigation from glacier-fed streams coupled with low returns on rice crops are influencing people to risk turning to markets to buy their rice while investing their land and hopes on financial returns from rain-fed crops.

For instance, in Kangan area of Ganderbal, the locals say there has been loss of mustard crop because of less water availability. According to Abdul Jabbar (60) of Hadipora, Baramulla mustard, alsi, apricot, and cherries were fast disappearing in that area due to erratic rains and water availability. In Chowkibal area in Kupwara, which is the last inhabited geographical area in the temperate Kashmir Valley linking it to sub-tropical Pakistan administered Kashmir, locals say that due to general temperature rise and less availability of water, summer varieties of rice like Nick Cheena and traditional Kashmiri apples have almost disappeared from the area.

According to information made available by the Department of Agriculture, Kashmir, the region has 44 per cent deficit in food production, 30 per cent in vegetable production and 69 per cent in oilseed production. Most of the deficit is covered either through the Public Distribution System (PDS) or the open market. Kashmir grows a number of temperate fruits and nuts. An area of 1.75 lakh hectares is under these crops with an annual production of 12.28 lakh metric tons.

The effect of climatic changes on food production and fruits in Kashmir has different facets. Over the last few years, there has been distinct slow growth in production, some factors of which can be attributed to climate change. While growth and output of some crops, like Saffron, have been badly affected, low returns from other rain-fed crops in Kashmir's Karewas areas, like maize, etc., are posing challenges to communities living between mountains and plains in their food security and support to livestock. Although shifting from paddy to high yielding cash crops and fruits has yielded better economic returns in many areas, particularly in the Karewas areas of Kupwara, Baramulla, Badgam and Pulwama, food security has been compromised as failure of returns from new cash crops means loss of both secured rice as well as income from the newly-adopted crop.

The extreme sudden rise and fall of temperatures since the last few years, especially during 2007 is said to create metabolic disturbances among crops. According to the Director of the Agriculture Department, Ghulam Hyder Bhat, if the fluctuation in temperature continued in the Valley for more time, the overall production yield of paddy, which is the main crop of the Valley, may fall by 15–30 per cent.

He further says that if the weather conditions remain unstable in otherwise stable seasons, then the paddy seedlings will not get the necessary time required to mature. "The fluctuation of temperature affects the normal growth of the seedling, which in turn will affect the overall production of the paddy," says Bhat.

According to information obtained from the Department of Agriculture, Kashmir, there is a growing deficit in percentage terms of food grain production in relation to population growth in Kashmir. In 1980–81, Kashmir valley had a food deficit of only 23 per cent for a total population of 3.3 million. In 2005–06 Kashmir's valley's food deficit has risen to 40 per cent for a population of 6 million. The deficit trend can be seen from the table given below:

Year	Production	Population	Requirement	% Deficit
1950–51	206.30	1795304	307.00	32
1980–81	486.92	3269276	559.05	23
2005–06	620	5985340	1023.49	40

Production/Requirement: As per Minimum Nutritional Standards of Cereals = 420 gm/day/head, Pulses = 50 gm/day/head

Source: Agriculture Department, Kashmir

According to agriculture experts, paddy seedlings need at least 120 days to fully mature and give good output.

The severe fluctuation in temperature during 2007 has been making crops vulnerable to disease. During April and May 2007, extreme fluctuation gave rise to diseases like tip burn, yellowing and foot rot in nurseries raising tree saplings in Kashmir.[19]

The Department of Horticulture, Kashmir warned in June that the fluctuation in temperature may delay the growth of the fruits as the required humidity and temperature were missing for some time in Spring and early summer, threatening good growth and yield.

The Director of the Horticulture Department, Kashmir, Dr G S Naqash says that generally 'Kashmir used to have well defined seasons until the 1990s while the post-90s period has witnessed altering climates, followed by drought years from 1998 to 2003'.

"This year what we observed: we had abrupt rainfall and heavy snowfall in February. At that time, our almond crop was just blooming. Due to snowfall, we lost 60 to 70% of our almond crop," says Naqash.

In April 2007, Kashmir witnessed unprecedented heat for the season. According to experts in the Horticulture Department, fruits including cherry, plums, peach and apricot had begun to mature very well at prematurely high temperature. However, in the absence of normal rainfall, nutrient intake from the soil was reduced, preventing normal growth and development of the fruit.

The month of May witnessed unusual hailstorms and windstorms. Fruits like cherry, plum, peach and apricot were damaged. According to sources in the Horticulture Department, 40 to 50% of the crop was lost. The unprecedented windstorm that lashed Kashmir on 11 May 2007 resulted in the grapes being cut off from their trees, resulting in 70% crop loss.

Ghulam Mohammad Lone (69 years) of the Kapran area of Anantnag district attributes the disappearance of almond trees from that area to temperature rise and less water availability. In Heerpora area of Shopian, which is popular for its potatoes, Abdul Razaq Wani (50 years) laments that the increasing loss of red potatoes and beans from that area was due to factors which were unknown to them. In Heerpora area, over hundreds of acres of forests have been indiscriminately cut and turned into fruit orchards by local people who are increasingly losing their traditional livelihood drawn mostly from the forest produce.

In Karnah sub-region, over the years there has been less yield from paddy and maize. Says Muhammad Syed Sheikh, Sarpanch of village Khudpora, "Due to less water in the stream of Bat Moji during summer time, there is not adequate water for irrigation as surrounding glaciers are melting fast."

Over the years there has also been a trend of introducing many new crop varieties in Kashmir for better productivity and also for adaptability to the changed environmental situations. Certain changes in the crop cultivation patterns are attributed to factors which are not directly linked to climate change, like introduction of new kind of seeds, genetically modified crops, trees and imported crop varieties. But there is another aspect to the introduction of these crops in the valley. Many of the new crop and plant varieties have been introduced since there is a market demand for these. It has been found that the traditional Kashmiri apple has almost disappeared from Kashmir. Other varieties of apples such as Delicious Apple, American Apple and Bulgarian Apple have been introduced which now constitute more than 70 per cent of the total produce from Kashmir. Similarly, according to farmers, new varieties of rice such as Farmi, K-39, etc., have been brought into Kashmir. In Diver and Kalaroos areas of Kupwara, locals say that with the introduction of new varieties of rice, traditional varieties have almost completely vanished.

In the productive *Kerawa* belt of Kashmir, the effects of environmental changes like rise in average temperatures, erratic snow and rainfall and dwindling natural irrigation water are observed the most. Surveys undertaken in various areas of the *Karewas* show that rise in average temperatures and early and fast meltdown of glaciers in the Pirpanjal mountain range have severely affected water availability to a great extent during the last one and a half decades. This has decreased the agricultural output of the area and thus certain crops have either completely failed or are being replaced by low-water fodder. Sample surveys undertaken during this study in the *Karewas* of Badgam district reveal that saffron yield has decreased to almost half since the last ten years.

In the Sindh Valley of Ganderbal district through which flows one of the most important tributaries of the Jhelum – the Sindh *Nallah* – people have spoken about failure of plant nurseries. Says Moulvi Mehboob-ur-Rehman (70 years) of Wangath area, "Nurseries of poplar, apple and apricots in our area have failed due to less rain and snowfall." He has also pointed out to fast depleting water flow in the tributaries of the Sindh *Nallah* due to early meltdown of snow in the upper reaches of the Sindh Valley. Munsher Khan, headman of Fakir-Gujri village in Srinagar district has said that due to depleted water in the streams and reduced rain, the yield of maize and cherry has gone down by more than half with people cutting their cherry trees to switch over to less water-intensive crops and trees. Villagers in the Sogam area of Kupwara have lamented the loss of *Shool* pulse and *Zag* rice in their areas. What has been a consolation though is the introduction of the K-78 variety of paddy which farmers say has helped them to offset production losses due to environmental factors.

Change in crop patterns

As mentioned in the previous chapters, there is a clear trend of switching over from paddy and other traditional irrigation-based crop cultivation to rain-fed fruits or cash crops in Kashmir. Although reduced availability of irrigation water is one prime reason for the shift, the potential of higher income from the new crops is a clear incentive. There is another dimension to this. The fragmentation of landholdings in Kashmir over the years among family members has decreased the average landholdings in the countryside by more than one-fourth in the last three decades or so. Now, on an average, a family hardly owns four *Kanals* of land, making it economically unviable for them to grow paddy. Although in economic terms, under ideal conditions it does make better sense for many farming families holding small land and facing water scarcity to switch over to fruits, such a transition has another peril in it. This switch over is based on certain assumptions like favorable climatic conditions, no major diseases, sustained yield and market demand. However, in case Kashmir's climate continues to slide

Gulzar Ahmed, ActionAid

With dwindling food security due to failure of crops, mainly in Karewa areas of Kashmir, more and more communities are becoming dependent on markets and Public Distribution System (PDS) for obtaining their foodgrains. Geographical isolation makes Kashmir vulnerable to food insecurity in the event of any major natural disaster or a large-scale armed conflict or war.

into uncertainty, endangering yield from fruits and cash crops, another danger could well be in store: that is food insecurity. As more and more land under paddy cultivation is changed into orchards, Kashmir's 44 per cent food grain deficit is likely to touch over 60 per cent in the coming 10 years if the current rate of change is taken into account. Such a situation could pose serious food insecurity in Kashmir in the face of its landlockedness and frequent closure of its only surface link with rest of the world due to natural disasters. Due to the raging conflict in the region many remote areas like Ladakh, Kargil, Gurez, Karnah, etc., could face serious food insecurity in case the present public stocking system and road linkages break down. In case the current markets for Kashmiri fruits and cash crops reached the saturation level in India, and the traditional Srinagar-Muzaffarabad trade route remaining continuously closed, competition from foreign fruits would escalate. As a result of lowered trade barriers on farm products there is a possibility that demand and prices would fall. This kind of a situation would be a real economic catastrophe for the poor farmers of Kashmir.

District	PADDY land being changed INTO RAIN-FED HORTICULTURAL LAND (In Kanals*)
Pulwama	*2500*
Budgam	*1112*
Anantnag	*3700*
Kulgam	*1250*
Bandipora	*695*
Baramulla	*1152*
Shopian	*1500*

** The figures given by respondents are approximate.*

In the course of this study, we have been able to come up with an indicative data on the extent paddy land is being converted into rainfed horticultural land. Although this data is not exhaustive, however, it is reflective of an overall pattern.

Factors responsible for the change

As the data was being collected from farmers in various paddy-growing areas, those who had resorted to this switch over came up with a number of reasons for the same. The major reason put forth has been irrigation water scarcity. They have also spoken about the inconsistency in weather conditions at the time of plantation and harvesting times. Other reasons being cited by farmers are poor quality and lack of availability of seeds, affecting crop yield. What is also attracting farmers towards the switch over are better economic returns and lesser input in terms of labour and maintenance.

Says Mohammad Sultan, a farmer from Phajiwara in Anantnag district, "It is because of water scarcity that our paddy land was changed into orchard land." Abdullah Dar from Kulgam attributes the change-over to better profits than that in paddy. However, in areas such as Loolipora, Achabal, Mujepathri and Rafiabad, where sufficient irrigation water is available, farmers have stuck with their traditional crops.

However, there is another dimension to this problem and that is change from horticulture to rain-fed cereals such as maize, oats and various types of grazing grass. Says Abdul Ahad Wagay (65) from Sangarwani area in Pulwama district, "We had to give up horticulture as for many years we had very less rainfall and high temperatures. Now we

grow cereals in our land instead." Due to very small land holdings averaging five *kanals,* the produce is usually of no commercial value and gets domestically consumed. Ghulam Hassan Thokar (70 years) from Padpowan and Mohammad Abdullah Bhat (62 years) from Boorihalan areas of Shopian district attribute the change-over to scant water and failure of governments to provide quality seeds and guidance.

Lack of irrigation water

In view of the limits put by the India-Pakistan bilateral Indus Water Treaty (1960) on the amount of water Kashmir can draw for irrigation of its agricultural land from its own rivers, the increase in net irrigated land since 1960 has almost been negligible.[20] There are instances, as mentioned in the previous chapters, when newly-conceived irrigation projects have not been cleared by the India-Pakistan Indus Commission. As a result, the scope for increasing irrigation in Kashmir continues to be extremely dismal. Echoes Abdul Ahad Magray (60 years) of Bandipora district, "Government doesn't pay any heed for providing irrigation to our lands. We have simply given up."

Impact on livestock

In the course of information collected for this study in the upper Karewa areas, communities in almost all the areas have said that heavy military presence and militant activities in the upper reaches in most of the areas have constrained their access to highland pastures. But owing to early meltdown of snow, the time period of access to highland pastures, mainly in the Pirpanjal range (except for Tosha Maidan which is under army control) has increased by about 1–2 months. However, Dr Farooq Ahmed Kalloo, Deputy Director, Animal Husbandry Department, Kashmir, has environmental concerns on this. "In the past when the access to highland pastures was naturally regulated by the season cycle there was a natural ecological balance, but now with increased access to some highland pastures, mainly in the Pirpanjal range, there is great level of depletion of flora and fauna."

CRISIS IN SAFFRON BELT: PAMPORE-KHREW CASE STUDY

One distinct geographical area in Kashmir famous for its production of saffron is the Pampore-Khrew belt. It has been witnessing a highly unusual phenomenon over the last two decades of receiving the least snowfall in entire Kashmir. This condition is strange given the fact that even when the areas in its close vicinity on the same altitude – barely 15–20 kms away in Srinagar and Pulwama – receive 1–2ft of snow, this geographical area receives either rain or 1–3 inches snow only. We took up the Pampore-Khrew plateau as a special case study to understand the reasons for such an unusual situation. We traveled through Pampore, Wuyen, Khrew, Khonamoh, Shar areas and spoke to people to understand their perception about this phenomenon.

One of the prime reasons attributed by the locals is the industrial units which have come up in the area since 1982. The smoke and dust particles exuding from these factories stagnate in the local atmosphere for a longer time because the area is surrounded by high mountains from two sides in the east and north. Since the normal wind in Kashmir Valley blows from west to east, ActionAid's investigations in the area have revealed that the smoke remains trapped for a longer time, increasing the temperature in its lower atmosphere because of larger amounts of warmer gases present in the air. The absence of any tree cover over the surrounding mountains compounds the problem, the presence of which could have offset the excess carbon content in the air. Although normally in hotter regions aerosols are believed to have a cooling effect on the lower environment, in the case of a cold region like Kashmir, investigations have shown, extreme cold temperatures and cloud cover during winter do not make aerosols create a cooling effect on the sunlight falling on the earth's surface.

The kind of coal used in the cement factories in the area has high sulphur and carbon content and the percentage of ash is also high. As a result carbon and heat get trapped in the lower atmosphere.[21] Experts warn that in case more carbon gets accumulated in the valleys of Kashmir, snowfall may also be impacted in other parts of Kashmir.[22] With South Kashmir, mainly the plains of Anantnag district already witnessing lesser snowfall as compared to other areas of the Valley due to its proximity to Khrew-Pampore area, and spillover of heat trapping gases to other areas of Kashmir, the possibility of less or no snow in the plains cannot be ruled out.

During precipitation in winters, when rest of Kashmir receives snowfall, ActionAid's investigations have revealed that this area has a higher temperature in the local atmosphere melting down the snow flakes on their journey to the earth's surface, resulting in rain in the area or scant snowfall. There is also faster melting of snow on the ground in the area. Locals say that even the scant snow that they receive is usually greyish in colour.

One important factor that has decreased saffron yield in the area by about 70 per cent could be this localised climate havoc that industrial activity and lack of tree cover in its surrounding mountains have done. "Eight kanals of land used to fetch me 1.5 to 2 kg of saffron before 20 years but now it is only 200 grams," says Abdul Hameed, a local farmer.

According to the locals, the area has also witnessed near extinction of some herbal and crop varieties like Krathi Dal, Oats, *Alish, Shool and Wishik*.

According to Haji Mohammad Maqbool (75), a retired teacher, from Shar Shali Pampore, water in Grate Kol has decreased by more than 50 per cent. He says the local water table has also gone down and springs were either dried up or are drying up.

People in these areas have largely shifted from paddy to maize. However, if adequate rains fail, they grow some grass for fodder use of domestic animals. The net sown area, according to the locals, has receded due to scarcity of water.

There is also a change in people's lifestyle in a sense because they have to now buy foodgrains largely from open markets. In this area, like in many other areas of Kashmir, blooming of almond and other fruits happens now in February in comparison to March or April in the past. Vulnerability of blossoms to fall due to spring winds has increased, interviews with the local people in the areas reveal.

A retired government employee, 72-year-old Abdul Salam Bhat of Khrew village says, "Water flow availability in the springs of the area namely Shala Nag, Nagbal Nag, Mada Pokhri, Nagrad, Gruptuk Nag, Khar Nag, Wani Nag, Dhaiwa Nag has reduced from half to absolute zero.

He says that while the productivity of new improved varieties of crops and plants in the area is good, cultivation was not possible due to scarcity of water in the area.

According to the locals, the stream of Nagabal dries down completely during summer times. The locals have another worry. Due to early blooming of fruit flowers, production gets impacted as late spring hail- and windstorms take away a large number of flowers.

In the nearby Khanmoh area, the Batnag, Diwa and Bungam Nag springs are already extinct. The area also receives, if at all, 2–3ins of snow annually. Less returns from saffron is making people shift to apple cultivation.

In the Sharshali area, streams like Grati Kol, Hari Kol, Shah Kol and Raitrag Nag have seen depletion of water by more than two-thirds. Wahab Kol has completely dried out. According to the elders in the village, the mountains overlooking the area used to have a glacier, Mastinibal, which used to stretch to the bottom of the village about 50 years ago. But today it has disappeared.

RECOMMENDATIONS

- Although some of the factors of global warming are global in nature, like climate change, Kashmir needs to take steps locally to minimise emission of greenhouse gases. It has been observed that most of these heat trapping gases get trapped in Kashmir valley due to high mountains on all sides.
- The environmental and social impact assessment regime for big projects needs a complete overhaul in Kashmir. The current social and environmental impact assessments carried out at governmental level do not address all areas of concern regarding adverse environmental impact of big projects.
- Kashmir valley remains highly vulnerable to trapped gases in its environment. Kashmir government needs to review its policy decision to trade its carbon credits in international markets and also address the growing concerns about underestimation of emission of greenhouse gases in Kashmir, particularly in Kashmir valley. Stringent laws need to be put in place not only for checking emission from private vehicles and industrial units, but also for large-scale emissions from government/ military establishments, from charcoal based heating systems in winters.
- Currently hundreds of heavy military vehicles in over 300 convoys and other paramilitary and government vehicles move throughout Kashmir everyday, producing a high level of green house gases. They are outside the purview of the law enforcing agencies in pollution control. The Government must create a mechanism to bring all non-civilian entiries within the ambit of State law to prevent this pollution as the military vehicles move through the most ecologically sensitive areas of Kashmir.
- Government as well as non government agencies need to study the impact of WTO and trade liberalisation policies on the marketing vulnerability of Kashmiri fruits. Any major change in market demand or pattern of demand would render thousands of poor farmers of Kashmir without sufficient income to make a livelihood.
- There is a real danger of loss of food security of more than 4 million people living in vulnerable Karewa areas and enclaves like Uri, Gurez, Karnah, Drass, Ladakh and Doda in case of failure of fruits or lack of demand. A Food security monitoring mechanism at the governmental and non governmental levels, taking into account present and future vulnerability, is required.
- All though creation of large storage dams or reservoirs on the large rivers in the state under the Indus Water Treaty are not permitted, special focus needs to be put on innovative rain water harvesting techniques, creation of small checkdams and reservoirs to prevent runoff during rainy season. Such water conservation measures would help in making water available during dry summer times.
- Although promotion of tourism is one of the major priorities for government, a shift of focus from infrastructure intensive tourism to eco-tourism is a dire necessity. Horizontal economic benefit to poor communities through eco-tourism would have better economic benefits in comparison

to vertical economic benefit to a few corporate houses. This would also help in economic benefit to the poor and marginalised people in areas like Bungus (Kupwara), Gurez valley, Bhaderwah, Lolab valley, Naagberan (Tral) , Rajori, Pounch, Doda, etc.

- Promotion of large-scale pilgrim tourism in ecologically fragile eco systems, which results in tremendous pollution of water bodies and generation of huge amounts of carbon-di-oxide, remains a matter for deep concern. Urgent steps are required to be taken to address environmental concerns voiced by the State Pollution Control Board (SPCB) on large-scale pilgrim tourism in the State from time to time.

- Government needs to seriously pursue reopening of traditional road links of the Kashmir valley with the outside world to help reduce people's vulnerabilities to climate change and natural disasters. Kashmir valley happens to fall under the highly vulnerable Zone V of the seismic zone. Any eventuality of another major earthquake and subsequent breakdown of road communications and collapse of bridges due to landslides could result in a major humanitarian catastrophe, especially for many land-locked and isolated areas. Growing food insecurity as a result of shift to horticulture could pose additional risks in such a situation, especially for the poor.

- The Sheri-Kashmir University of Agriculture Sciences (SKUAST) needs to undertake rigorous research on locally appropriate climate resistant crops and take that research to the farming communities. Although currently SKUAST, Agriculture and Horticulture Departments do undertake such activities, community based organisations and NGOs need to be involved to engage with village level bodies for popularising climate resistant crops and livelihood avenues.

- In view of the scarce land in the Kashmir valley and growing fragmentation of landholdings due to family expansions, it is estimated that 80 per cent of the existing landholdings in Kashmir valley would fail to sustain the food security of a 6–10 member family beyond six months of a year in the next one decade or so. Policy planners in the state need to factor in this slow onset change to make necessary changes in their futuristic planning.

- Despite erratic rain and snowfall, defying the season-based precipitation pattern of the past, the water table in the plains of Kashmir is still high and there is a tremendous scope for exploiting groundwater in the state. Formulating a policy on ground water extraction and its usage would help in overcoming water scarcity during lean periods of the year. This would also help in catching the lost runoff during winter season to make the best use of the available water for agriculture purposes.

- Desilting of all major rivers in Kashmir is an urgent necessity to prevent flooding of the valley. Opening of all flood channels for desilting and issue of licenses to soil mining companies are a must for reducing flood vulnerability and current mining of the fertile *Karewas*.

- The growing tendency of communities living on the fringes of forests to eke out a living from illegal forest produce trade due to falling returns from traditional farming is a matter of grave concern. Joint Forest Management (JFM) needs to be restructured to suit the socio-economic and geo-political conditions of the State for making it more meaningful.
- Lack of access to some highland pastures due to heavy military presence and security concerns has constrained development of livestock, impacting traditional livelihoods and increasing dependency on costly imports. A new pasture management policy, guided by the current socio-economic needs and geo-political scenario is long overdue.
- The State Pollution Control Board (SPCB) needs to be armed with greater powers to ensure across-the-board environmental compliances in both civilian and non-civilian domains.

Irfan Hamdani, ActionAid

Villagers near Arizal in Pirpanjal mountain range sharing their experiences with climate change in the course of this study.

ENDNOTES

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The cover photo shows melting glaciers on 29 April 2007 at Sadhna Pass in north Kashmir situated at an altitude of 10,000 feet.

Cover Photo: Arjimand Hussain Talib, ActionAid