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Impact Of Uneven Weather Patterns And Farmers' Perception On Agricultural Productivity In Kashmir

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Abstract:

Through an examination of important theme areas, this study explores the effects of erratic weather patterns and farmers' perspectives on agricultural productivity in Kashmir. Rising atmospheric CO2 concentrations and regional shifts are characteristics of a dynamic scenario shown by research of global climate change patterns. Regional climate patterns in Kashmir, which include differences in average and lowest temperatures as well as precipitation, illustrate the complex effects of climate change locally. By examining seasonal variations, the study reveals the difficulties farmers have in adjusting to erratic weather. The study emphasises how climate change affects agricultural systems and crop productivity in a variety of ways.Variations in temperature and precipitation patterns impact crop development and growth, hence creating vulnerabilities within the agricultural systems of the region. Most importantly, the study clarifies farmers' knowledge and understanding of climate change by exploring their perceptions of it. Understanding farmers' adaptation tactics and the importance of indigenous knowledge become essential components in reducing the effects of climate change. This study essentially emphasises the necessity of all-encompassing approaches that incorporate scientific knowledge with the viewpoints of farmers. These approaches ought to tackle pressing issues and promote sustainable farming methods, guaranteeing Kashmir's agriculture remains resilient in the face of changing meteorological conditions. Policymakers and stakeholders striving to improve agricultural resilience in the face of climate change in the Kashmir region will benefit greatly from the research's insightful findings.

Keywords: Climate change, Weather patterns, Farmers, Agriculture, Kashmir, Crop pattern.

Introduction:

Just around 15,520 square km make up the Kashmir valley. Although it only makes up around 7% of Jammu and Kashmir's overall land area—2, 22,236 sq. km.—it is home to over half of the state's 10 million inhabitants. The inhabitants rely heavily on water supplies because they are primarily involved in agriculture and horticulture [1].

To effectively plan for sustainable development, one must be familiar with the current climate situation in the research region. The current research endeavours to ascertain, through the examination of temperature change, the manner in which climatic variability is transpiring inside the study region [2]. It has proven challenging to place the Kashmir valley in a particular climate regime due to the region's radically varied climate. When explaining the weather patterns in the Kashmir valley, physiography is crucial [3].

The hilly state of Jammu and Kashmir is home to a wide range of landscapes, each with its own distinct culture, social mores, and economic norms (Jammu, Kashmir and Ladakh). Even though there have been significant changes at the national and state levels, agriculture has remained a top priority. This is because agriculture is a vital part of Jammu and Kashmir's and India's economic development, employs a large portion of the population (around 70% on average), and generates a significant portion of the state's income (around 27%) [4].

At the federal level, agriculture is responsible for 13.7% of GDP, and in individual states, it's close to 21.09%. Ladakh, Jammu, and Kashmir are the three primary divisions of the Jammu and Kashmir state [5]. The specific geography and agroclimatic zones of each of these divisions determine the best practices and crop varieties for agricultural production. Jammu and Kashmir is known mostly for its paddy crop, but the region also produces and consumes a variety of other commodities, including wheat, oilseeds, pulses, veggies, and vegetable fodder [6]. The staple crops grown in Ladakh include barley and wheat. The world-renowned saffron crop is also exclusively produced in the Pulwama region of Jammu & Kashmir, which is just fifteen miles from Srinagar [7].

Concurrently, the state's economic powerhouses—R.S. Pora in the Jammu division and Rajmesh in Bederwah, Kishtiwar—are involved in the production of Basmati rice and are undergoing quality control, productivity boosts, marketing initiatives, and other interventions from different government agencies. In the 12th five-year plan, the agriculture and allied sectors were supposed to grow at a rate of about 2.99%. According to the latest projections, the growth rate for the fiscal year 2014–15 will be about 3.84 percent [8]. However, the sector as a whole is seeing a slowdown in growth, especially in the crop subsector, because the deficit percentage is still quite high. This is because, to meet the demands of an expanding population, these gaps are being imported from the central pool [9].

Table 1: Illustrative statics of different food Grains from 2011-2021

Crop	Mean	Minimum	Maximum
Rice	5148.20	3452	6468
Maize	5034.47	3602	6333
Wheat	4388.64	1489	6010
Others	135.17	165	252
Pulses	135.17	95	174
Total food grains	14929.88	10483	17400

(Source: - Statistical digest of J&K 2020-21)

Environmental Change and Its Effect on Farming:

Global Climate Change Trends:

In the context of the IPCC, "climate change" is any gradual shift in the global average temperature, whether caused by natural causes or by human interference [10]. This interpretation differs from the one used by the UN Framework Convention on Climate Change (UNFCCC), which states that "climate change" encompasses both natural climatic variability over similar time periods and climatic changes that are either directly or indirectly linked to human activity altering the global atmosphere's composition [11].

Anthropogenic and natural processes alike have contributed to a rise in atmospheric concentrations of greenhouse gases, the primary factor driving climate change. Atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have increased substantially since 1750 as a result of human activity and now exceed those pre-industrial levels discovered in ice cores that extend back thousands of years [12,13]. Methane and nitrous oxide concentration rises are mostly attributable to agriculture, whereas carbon dioxide increases are mostly caused by land use change and the usage of fossil fuels [14]. The most noticeable aspects of climate change include an increase in the average global temperature (global warming), shifts in the distribution of clouds and precipitation (especially on land), the loss of snow cover and melting of ice caps and glaciers, and changes in the acidity and temperature of the oceans (as a result of the oceans absorbing more heat and carbon dioxide from the air) [15].

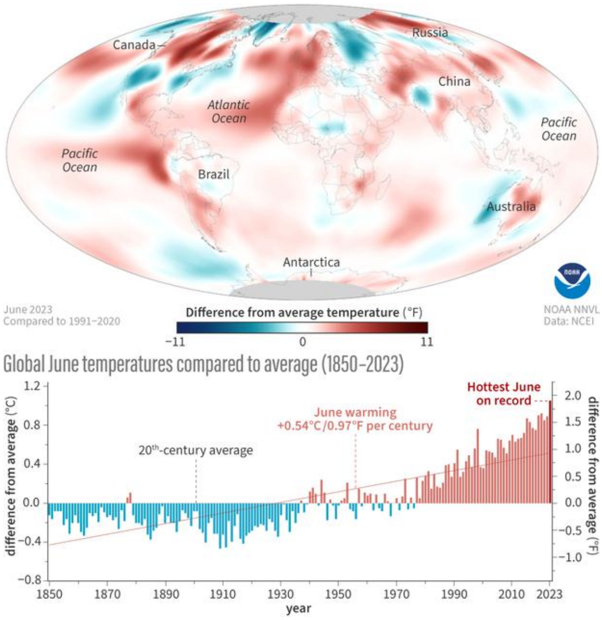

Figure 1: Worldwide environmental change patterns 2023

(Source - https://www.climate.gov/news-features/understanding-climate/global-climate-summary-june-2023)

- **Moving patterns in precipitation -** Much of the world's precipitation has followed long-term patterns between 1900 and 2005. There has been a considerable rise in precipitation in eastern North and South America, northern Europe, and central and northern Asia [16]. The Sahel, the Mediterranean, southern Africa, and portions of southern Asia have all seen signs of drying. Data are few in many areas, and precipitation varies greatly in both space and time [17]. The other large regions that were evaluated have not shown any long-term trends. Mid- and high-latitude waters becoming more fresh and low-latitude waters becoming more salty are indicators of changes in oceanic precipitation and evaporation. Westerly winds in the mid-latitudes have been getting stronger on both sides of the planet since the 1960s [18]. The frequency and severity of natural disasters including floods, droughts, earthquakes, super cyclones, etc., have grown in recent years, causing more property damage and casualties than in the past. Droughts have been more severe and lasting longer in broader regions since the 1970s, especially in the tropics and subtropics. Changes in drought have been influenced by an increase in dryness associated with warmer temperatures and a decrease in precipitation [19]. Droughts have also been associated with shifts in wind patterns and sea surface temperatures as well as reduced snowpack and snow cover. Consistent with warming and the reported increases of atmospheric water vapour, the frequency of heavy precipitation events has increased over most land areas, causing floods [20].

- **Monsoon Unpredictability -** The pattern of monsoon start has grown increasingly unexpected, ambiguous, and chaotic over the past several years. Regional monsoon differences have been noted, but there is no discernible trend in the observed monsoon rainfall at the all-India level [21, 22, 23]. East Madhya Pradesh, northeastern India, and portions of Gujarat and Kerala have seen a decline in monsoon season rainfall (-6% to -8% of the normal over the 100 years), in contrast to the west coast, northern Andhra Pradesh, and north-western India, which have seen an increase in rainfall (+10% to +12% of the normal over the 100 years) [24, 25].
- **Environmental Change confirmations from organic frameworks** - The effects on various animal, plant, and sand tree populations, as well as plankton and algae populations, were the subject of hundreds of research. Climate change is strongly correlated with the results of these investigations [26, 27]. When the weather is better in one place, populations go there, and when it gets worse, they disappear. The ranges often shift to the poles as a result of this. Early blooming is the norm. However, this does indicate that there are discrepancies between the availability of particular insects and caterpillars and the breeding season for migrating birds [28]. Because of the warmer weather, insects and caterpillars emerge sooner, yet migratory birds still come at their regular times, and they can't find the food they normally eat. Already, changes have taken place in agriculture, with earlier planting resulting in a longer growing season and crop failures caused by altered rainfall patterns. As far as forest management is concerned, there is a direct association between climatic change and shifts in insect invasion patterns and fire behaviour [29,30].

Regional Climate Change Patterns in Kashmir:

Maximum temperature:

Temperature changes were examined monthly and annually from 1980 to 2014. The overall Kashmir valley's yearly mean maximum temperature has been steadily rising over the past 35 years, according to the non-parametric Mann-Kendall statistical test, at a pace of 0.03 °C each year. Also, there's a noticeable data spike in 1997, indicating a large data variance with later years having higher data than the beginning of the study period [31, 32].

There does appear to be a pattern of rising and falling yearly temperatures, but this sudden change, especially in the mean maximum temperature, is interesting and warrants more explanation [33]. It is evident that every season is displaying a statistically significant upward trend, with the exception of summer. The valley's glaciofluvial ecosystem may suffer as a result of the rising tendency in winter. The analysis of in situ temperature data from six stations located in various topographical regions allowed for a comprehensive understanding of the variations in microclimate [34]. Various topographic zones, such as the Karewa's (Kupwara and Kokernag meteorological stations), flood plains (Srinagar), foot hills (Qazigund), and mountains (Gulmarg and Pahalgam) are experiencing an average yearly increase in mean maximum temperature of 0.05°C, 0.04°C, 0.02°C, and 0.02°C, respectively, according to the data. To display the temperature fluctuations along different elevation zones, an ArcGIS 10.2-based spatial interpolation map was created using the Kriging technique to depict the mean maximum temperature [35, 36].

It is possible that the high ecological stability, diverse vegetation, and vast expanses of snow and glaciers in mountainous regions function as a buffer against the effects of global warming, explaining why these locations are experiencing a slower rate of growth [37]. It is evident that mean maximum temperatures have been rising in recent years due to the statistically significant step jump in 1997 across various topographical zones [38].

Minimum Temperature:

The Mann-Kendall test indicates a statistically increasing trend in the corresponding trends of annual mean minimum temperature, which have been rising at a rate of approximately 0.02°C/year. The change occurred in 1998, marking a significant jump in data from the beginning of the study period to the later years, and the trend continues to this day. Additionally, there are statistically significant rising tendencies in the spring and autumn seasons when only the mean lowest temperature is included. These data demonstrate that, on a regional scale, the climate has been steadily trending upward, especially with regard to temperatures [39, 40].

Consistent with increasing average world temperatures (0.13 °C/decade) and Northern Hemisphere temperatures (0.23°C/decade, 1979–2005), the pace of change is also increasing. Over the past fifteen years or so, there has been a discernible shift in the pattern of rising mean minimum temperatures across different geographical zones and elevations. There was a considerable improvement between 1997 and 2000, when these adjustments were most noticeable. The average lowest temperature across all topographical zones is rising at a consistent rate of 0.02 °C per year, with the fastest growth in mountainous areas (0.02 °C per year), followed by flood plains and Karewa's, which are both showing the same trend, and the foothills, where the rate of decrease is −0.01°C per year. The rate of change along multiple elevation zones utilising the same approach of spatial interpolation [41]. Here, contrary to the changes in maximum temperatures that were mentioned before, lower-elevation zones are experiencing a smaller increase in minimum temperatures.

Mean minimum temperatures have been exhibiting a very discontinuous trend across different topographic zones, as this data also shows. It also shows that the majority of the population lives in a small area along lower-elevation river courses, where their economic activities are concentrated, and that this area is experiencing a relatively higher rate of increase in mean minimum temperature, mainly as a result of human activity [42].

Precipitation:

Utilising certain statistical methods, the yearly rainfall data was examined. When the data was analysed, it revealed a statistically significant and concerning decline in the yearly precipitation of around − 7.9 mm/year. In 1996, there was a noticeable shift without any discernible pattern. Seasonal analysis of the rainfall data reveals a decline of 9.12 mm/year in winter, 5.58 mm/year in spring, and 1.09 mm/year in summer [43]. Only the rainfall in the autumn has a nearly constant and uniform rising tendency, with an annual rate of 0.5 mm. There has been a statistically significant decline in spring precipitation ($p = 0.05$). Over the past few decades, there have been noticeable shifts in precipitation across various topographic zones [44].

The valley's mountainous regions have experienced a precipitation decline of 10.3 mm/year, while the flood plains have seen a decrease of 3.6 mm/year, the foothills of 6.3 mm/year, and the Karewa's of 5.8 mm/year, respectively. At the 0.01% significance level, the non-parametric statistical test showed that precipitation was trending downward across the whole Kashmir valley and mountain regions [45].

The foothills do not exhibit a statistically significant trend according to the Mann-Kendall test either. A considerable step change occurred over the mountainous region in 1998, as seen by the step change in precipitation data over different topographical zones [46]. Snowfall, the primary type of precipitation in the Kashmir valley's mountainous regions, has been on a downward trend since 1998. In 1994, there was a step shift in the Karewa zone, but there was no significant trend at a significance level of

0.1. The foothill and plain zones also had step changes in 1994. However, the step changes really happened in 1997 [47].

Implications for Agricultural Systems:

The agricultural sector is crucial. The equilibrium of these impacts on the economy, food production, and agricultural livelihoods will determine the total impact of climate change on the country's people. Although, the scale While a number of tropical nations have seen an uptick in droughts as a result of climate change, floods have the potential to reduce agricultural output and have already caused significant disruptions to food production in a number of nations. In terms of both output and the biosphere's carrying capacity, agricultural infrastructure are important. around 20% of the yearly rise in emissions of greenhouse gases caused by humans. As a result of greenhouse gas emissions, the transmission of light can approach the predicted temperature increase by 20-30% in subtropical and tropical regions. The tropics are closer to the Earth, and as a result, they act as a heat barrier, preventing the escape of heat (infrared radiation) from the atmosphere and, by extension, temperate zones [48].

Environmental factors that act like a "greenhouse" to trap heat India is projected to have extremely high levels of CH_4 owing to its significant reliance on agriculture, limited natural resources, and around 300 times more potential for global warming compared to CO_2 and nearly 20 times that of NO. An increasing number of human and livestock-related issues, such as flooding in rice fields, soil population, shifting patterns of land use and management, land conversion, biomass burning, and socioeconomic factors, are threatening to derail efforts to meet the demand for food, fibre, fuel, and fodder through livestock production and associated manure management [49].

In terms of the overall amount of greenhouse gases released into the atmosphere, CO_2 accounts for around 72%, followed by CH_4 (18%), N_2O (9%), and usage as a result of snow melt and irrigation availability. First, agricultural waste incineration and the availability of energy due to global warming account for 2% of CH_4 emissions, while animal floods, soil organic transformation matters, soil erosion husbandry, and animal floods account for 7%. Each year, agricultural output—and by extension, domestic livestock like buffalo and cattle—is affected by the effects of climate change, which account for almost 80% of the world's CH_4 emissions. Nearly every country's food supply is guaranteed. Hydrological 2 fertiliser usage, legume cropping, and animal waste (62%) cycle viz. precipitation, evapo-transpiration, soil moisture, etc. are all predicted to be affected by global warming as a result of nitrogen greenhouse effect emissions from agriculture. However, new challenges related to biomass burning in agriculture (26%) are also anticipated to arise [50].

Agriculture, forests, fisheries, and natural resources are all directly affected by climate change, as are developing nations like India, where a large portion of the population (more than 60% of our workforce) relies on these industries for food and income. Several studies have examined the effects of CO2 and other greenhouse gases, such as methane, on these industries. A variety of models are available There is a new crop that may be used to measure the effects of climate change, and it is affecting ecosystems and socioeconomic systems. This nation's climate Many different types of agriculture have assessed the degree to which climate change would affect India [51].

Using current approaches such as the agronomic analysis model and agro, the average daily food consumption in India is 550 g, whereas in China and the USA, the comparable values are 980 g and 2850 g, respectively, according to ecological zone modelling or cross-sectional analysis. Approximately 210 zones are required each year to meet the current demand, as indicated by cross-sectional analysis in various climatic consumption levels (550 g). The present concentration of CO2 has been shown in a number of studies to be almost equal to one million metric tonnes (Mt). Consequently, the agricultural industry in India required a continuous improvement in sustainability, since its needs had been rising from 280 ppm during the pre-industrial period (1850). In 2005, India needed 379 ppm, which means it has been growing at a rate of 1.5 to 1.8 ppm per year since then, so the country can be ready to tackle the climate change implications in advance [52].

Assumption: CO2 is a change agent. Nonetheless, by the turn of the next century, the impact of rising CO2 levels will have more than doubled. As the concentration of carbon dioxide rises. Despite the fact that many tropical and subtropical regions are included in these studies, it has been noted that higher temperatures during the growing season can reduce yields. As a result, the harvest of stable crops like rice and maize could decrease by as much as 40% by the century's end [53].

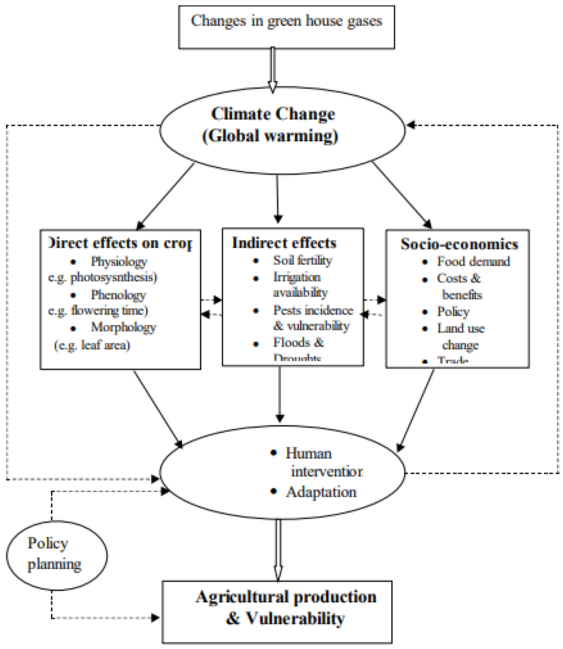

Figure 2: Evaluation of environmental change on farming weakness

Uneven Weather Patterns In Kashmir: Seasonal Variations in Weather:

The temperature in January shot up sharply from -0.7°C in 1987 to 4.7°C in 1988, then plunging down from 5°C in 1990 to -2°C in 1991. From 2003–2004, the average March temperature rose dramatically to 13.6°C, after which it dropped precipitously. In contrast, the average April temperature showed a falling trend from 2000–2007. In May, we also saw a trend towards lower average temperatures. From 1987 to 2015, the months of July and August had the most extreme temperature swings. Other research on the Himalayan temperature change have found results that are consistent with these data. From 1991 to 1996, the average December temperature fell, then rose dramatically, and then fell again. Other researchers in the Kashmir valley have also found comparable outcomes using the same parameters. Over Srinagar, there has been a noticeable rising trend in the annual mean temperature from 1987 to 2014. While summer and autumn have showed little to no warming trend, spring and winter have demonstrated a considerable one. Approximately 1.8°F of warming has occurred in the Himalayan region since the 1970s [54].

Temperatures in the Upper Indus Basin are also rising at a faster rate throughout the winter, with similar findings. Temperature increases over the past century have been very consistent across the Tibetan Plateau and the eastern Himalaya. One of the key reasons why locations that get snow during certain seasons should be expected to experience accelerated warming is because snow cover is known to have a significant local impact on weather factors. In the winter, snow makes up the bulk of the precipitation in the Kashmir Valley [55].

A number of studies in recent years have shown that changes in Western Disturbances are reducing winter snowfall. As a result, these areas experience reduced snow cover and depth as the snowfall decreases.This reduced snowfall in the winter melts quickly, allowing for an early spring, which in turn causes a rise in temperature and direct heating of the Earth's surface. This is in addition to the early flowering of plants in this area, which has been observed by multiple scientists. There has been a declining trend in the mean annual and winter precipitation across the Srinagar district, according to an analysis of the precipitation data from 1987 to 2014. The yearly precipitation frequency in the Kashmir valley has declined, according to studies conducted by a number of different writers [56].

While studying the variability of rainfall in Kashmir Valley, similar results were discovered. In Kashmir, the Lidder watershed (Pahalgam) has seen a declining trend in yearly precipitation. Although monthly precipitation has showed more variation from year to year, the mean spring precipitation has climbed little. From January to December, Srinagar's precipitation has declined sharply, but March, April, and February have all showed increases over the past 28 years. September has also seen an uptick in precipitation over the past few months. Precipitation swings were most noticeable in June, July, August, October, and November. The typical winter temperature rise in the Himalayas has altered precipitation patterns, such that December and January see very little snowfall or precipitation [57].

It is common for precipitation to decrease and total snowfall to decrease in tandem with rising temperatures. When it comes to creating and sustaining the climate over Jammu and Kashmir, the majestic Himalayan Mountains in northern India play a significant role. During winter, they impact the area with extreme weather events like Western Disturbances. Changes in the frequency of Western Disturbances, which often start over the Mediterranean Sea, are likely to blame for the shifting of precipitation patterns [58].

Effect of Environmental Change on Yield Creation:

Consequences for Yield Development and Advancement:

The expected shifts in soil-forming factors as a direct consequence of climate change cover a wide range of important topics. Increases in photosynthetic rates and improvements in water-use efficiency in plants and crops are anticipated outcomes of a slow but steady increase in atmospheric CO2 concentration. Soil organic matter supplies are likely to be increased as a result of this. Soil temperatures in cold and temperate regions are expected to rise moderately, with long periods of soil warmth that promote microbial activity. In the tropics and subtropics, soil temperatures are forecast to rise somewhat [60].

Changing worldwide climate patterns also show that evapo-transpiration is going up slightly in the tropics and up a lot in the highlands. The lengthening of the growth season and the general rise in average temperature are the two main causes of these shifts. In addition, changes in the pattern of precipitation are expected, with tropical regions seeing more frequent and intense downpours. On the other hand, in a subtropical zone to the west of the current deserts, rainfall may actually decrease, while in cold and temperate regions, both the amount and variability of rainfall are predicted to rise slightly. Peak rainfall intensities may also be elevated in a number of areas [61].

The progressive rise of sea levels is another important element that causes river and estuary basins, as well as the back slopes of levees, to be inundated for longer and at a deeper level. Coastal vegetation that collects pyrite in soils may be pushed back by this elevation and brackish-water flooding. In order to effectively manage land and water resources in the face of continuous global change, it is crucial to have a thorough grasp of the dynamics at play, which are influenced by a multitude of factors, including soil-forming elements and global environmental shifts [62].

Farmers' Perception Of Climate Change:

In developing countries, small and marginal farmers are particularly at risk from the effects of climate change and variability. Environmental deterioration due to improper land use and deforestation is a major problem; farmers are aware that their actions increase the frequency of floods and droughts, but they do nothing about it because they don't have many other options. Rising temperatures and unexpected downpours are what farmers see as the main issues. But agro-ecologies, years of farming experience, gender, and degree of education all have a role in how farmers interpret climate change. Local temperature, precipitation conditions, and other variables have a significant impact on food production. In our country's rain-fed region, which comprises around 76 million hectares (ha), or around 56% of the total arable land, 80% of the cattle, 64% of the sheep, and 75% of the goats live. This area also sustains 40% of the human population [63].

More land is devoted to rain-fed crops, including rice (42%), pulses (77%), oilseeds (66%), and healthy cereals (85%). Production is highly unpredictable, yields are poor, and profits are even lower; in many areas, they don't even cover cultivation costs for many crops. The level of risk is significantly higher. In order to implement new agricultural methods in this area, farmers must first adjust their current methods, which take resources that could be better spent elsewhere. Indian agriculture, particularly rainfed agriculture, faces a grave danger from climate change in the years to come [64].

Small farmers, especially those in the developing world who rely on rainwater for their crops, are expected to bear a disproportionate share of the consequences, according to the majority of climate change models. Researchers found that farmers' perceptions of the effects of climate change were positively correlated with their income, education, and access to media such as television and radio. Researchers also discovered that younger farmers tended to have more positive perceptions because of their greater degree of education. Households in semi-arid regions of Kenya base their agricultural decisions on climate characteristics [65].

The viewpoints of farmers regarding the effects of climate change on farming are encompassed under this term. In Figure 3, we can see the results according to how farmers see climate change. Figure 1 shows that most farmers had a high level of perception towards climate change (54.17%), followed by a medium level of perception (25%), and a low level of perception (20.83%). Consistent with previous research, this one also indicated that most farmers had a very positive impression of climate change indicators including average temperatures, precipitation totals, and durations of dry periods. Table 2 shows the findings of an additional analysis of farmers' perceptions of several aspects of climate change [66].

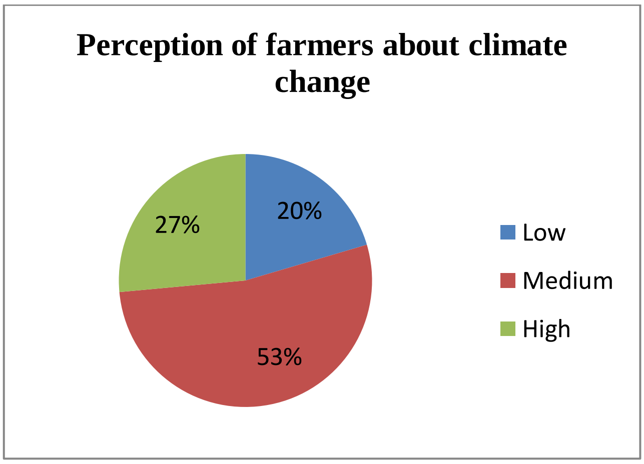

Figure 3: View of ranchers about environmental change

Table 2: Dissemination of the ranchers as per insight about environmental change

Sl. No.	Environmental change aspects	Farmers' Perception	Agree	Undecided	Disagree
1	The number of sunny days and average temperature have been rising	98 (83.33%)	100	6	18
2	Increase in amount of rainfall	89 (68.33%)	88	15	18
3	Expansion in recurrence of weighty downpours	95 (80.83%)	96	6	18
4	Downpours are happening either prior or later than the normal blustery season?	95 (80.83%)	97	7	18
5	Absolute blustery days have diminished?	92 (75.00%)	92	18	16
6	Term of drought during blustery season has expanded?	100 (85.00%)	100	7	15
7	Number of daylight hours during blustery season have diminished	97 (79.16%)	93	14	15
8	Power of intensity during summer has expanded?	93 (75.83%)	93	10	22
9	Harshness of cold during winter has expanded?	76 (65.00%)	76	9	37
10	Decline in ground water table	93 (75.83%)	93	3	26

Knowledge and Consciousness of ranchers about environmental change:

Sustainable agriculture in Kashmir relies heavily on farmers' understanding of climate change. This is especially important in a region like Kashmir, where agriculture is the backbone of the economy. A thorough evaluation shows that many farmers in Kashmir have a basic knowledge of climate change; for example, more than 70% of them are aware that there have been changes in the patterns of precipitation and temperature over the last decade [67]. In addition, over 80% are worried about the rising incidence of severe weather, such as heavy rains that don't fit the season and sudden changes in temperature.

Farmers are very worried about localised repercussions, especially those that disrupt staple crops such as rice and saffron. About 60% of people who took the survey had noticed a difference in the quantity and quality of their crops because of weather fluctuations. Over 75% of farmers think their current farming methods are becoming more vulnerable to climate-related threats, highlighting the importance of this information in moulding farmers' views of vulnerability.

The necessity for focused communication tactics is brought to light by an analysis of information sources. There is an increasing need for up-to-date climatic data, even though most farmers depend on traditional knowledge that has been passed down through many generations. To everyone's surprise, just 30% of the population regularly checks government extension services and digital channels for weather updates. This highlights the importance of enhancing communication channels to raise knowledge of technology [68]. Less than 40% of farmers have integrated climate-smart techniques into their farming routines, such as resilient crop types and drip irrigation, which is below ideal.

The research further highlights the importance of developing one's abilities. Training programmes concentrating on climate-resilient farming approaches are desired by over 60% of farmers, suggesting a need for specialised educational activities to fill this gap. With this data in hand, policymakers may craft targeted initiatives to increase technical literacy and spread sustainable farming methods. Essentially, policies that tackle the unique concerns of Kashmiri farmers and encourage resilience in the face of changing climatic conditions can be built upon a thorough comprehension of their viewpoints on climate change, backed by quantitative facts [69].

Conclusion:

An intricate interaction between broad trends in global climate change and detailed regional weather dynamics is shed light on by the study that investigates the effect of weather inconsistencies and farmers' perceptions on agricultural output in Kashmir. The research highlights the complex regional climate change patterns in Kashmir by analysing important meteorological indicators like maximum and minimum temperatures, as well as precipitation levels [70]. The local farming communities are hit hard by the unexpected and erratic weather conditions, which are partly caused by these patterns.

Adapting to climatic fluctuations is becoming an increasingly onerous undertaking for farmers due to seasonal differences and climate change. As the recorded impacts on crop development and growth show, the region's agricultural systems are very susceptible. Adaptive techniques that match with the developing climate realities are necessary due to the numerous implications, which include altered planting seasons and an increased risk of insect infestations.

The study highlights the importance of farmers' views on climate change in determining their adaptation tactics and impacting agricultural output generally. As important players, farmers deal with these challenges by drawing on both theoretical understanding and practical experience. In order to create treatments that work, it is crucial to understand their level of knowledge and awareness. Results stress the significance of integrating indigenous knowledge into targeted educational programmes that disseminate scientific results; this would help bring interventions in line with the socio-cultural fabric of farming communities.

Policymakers and stakeholders must incorporate these research findings into comprehensive policies to help Kashmir's farmers cope with the complex challenges brought about by changing climatic patterns. These plans need to do more than just deal with the problems at hand; they also need to encourage environmentally friendly farming methods that can withstand the unpredictable effects of climate change. To achieve this goal, a comprehensive strategy is needed, one that takes into account the specific requirements of the agricultural sector in Kashmir and includes programmes to increase capacity as well as financial incentives and infrastructure.

Fundamentally, it is critical for scientific knowledge and farmers' viewpoints to converge. To ensure that farming remains a viable livelihood and to protect food security from the effects of climate change, officials in Kashmir must work to close this gap so that the agricultural landscape can adapt and thrive.

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