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Climate Change and Agriculture Scenario in Almora, Uttrakhand

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Abstract :

Climate change is very dynamic phenomena and it becomes the major concern around the world till 1990s. The world's climate is continuing to change at rates that are projected to be unprecedented in recent human history. The risks of climate change and extreme climatic events such as drought and flood have dramatic impacts on economy and natural systems. The climatic change could affect agriculture in different ways such as quantity of crop production

and quality of crop etc. the change brought serious threat for food security, utilization, availability and accessibility, etc. The Indian Council of Agriculture Research (ICAR), assess the impact on agriculture and it explain in the way that crop yield may reduce for irrigated maize, wheat, irrigated and rain fed rice up to 18 per cent, 6 per cent, 4 per cent and 6 per cent respectively by 2020. The temperature varies from minimum 5^o to 20^o Celsius and maximum from 15^o to 28^o Celsius. The month of May and June records highest temperature in this region. Agriculture in produced under the influence of favorable climatic condition therefore with increase in temperature the agriculture crops which were used to grow in valley region are going to shift or shifted to some extent on upper section of the valley slope. It is because of temperature requirement of agriculture crops.

Keywords : Extreme Events, Crop Production, Monsoon, Climate Change, Agriculture

Introduction :

Climate change has brought climatic uncertainties throughout the world therefore extreme events has been increased. The global climate change considered as change in the statistical distribution of long term weather phenomena. Weather refers to the short-term changes in temperature, wind, and precipitation of a region. Climate change is considered as greatest threat facing by the societies over the coming decades. With increasing scientific consensus that climate change is being enhanced by the human activity (IPCC 2001). Global mean sea level is projected to rise by 0.18 to 0.59 m by the end of the century. Six countries are most vulnerable to climate change in the Asia-Pacific region. Bangladesh tops the list followed by India, Nepal, the Philippines, Afghanistan and Myanmar (Aggarwal and Mall, 2002). In the long way, the climatic change could affect agriculture in different ways such as quality and quantity of crops there are three ways which affect agriculture directly under the influence of climate change. Increase in temperature and excessive rainfall become cause for reducing the amount of water sources and dryness of water body. The excessive rainfall produces excessive amount of water which bring a problem of flash flood. In the disaster like flash flood the agriculture gets affected and crop production decline. Secondly, availability of huge amount of water produces favorable condition for landslide which also destroyed

the agriculture and land and affect crop production. Thirdly the increase in temperature affect the growth of crop and it also affect the process of photosynthesis of other plant species. The increase in temperature due to climate change also increases the rate of melting of glacier. These glaciers provide permanent source of water for irrigation in agriculture field. There are three ways in which the greenhouse effect may be important for agriculture. First, increased atmospheric carbon dioxide (CO2) concentrations can have a direct effect on the growth rate of plants. Secondly, CO2 induced changes of climate may alter levels of rainfall, sunshine and temperature that can influence animal and crop productivity and finally. The atmospheric carbon dioxide (CO2) concentration has increased from 280 ppm to 395 ppm, methane (CH4) concentration increased from 715 ppb to 1882 ppb and nitrous oxide (N2O) concentration from 227 ppb to 323 ppb from the year 1750 and 2012. The global warming potential of these gases i.e., CO2, CH4 and N2O are 1, 25 and 310 respectively. Climate change indicates a rising trend in temperature and precipitation. Climate change is directly impact on food production across the globe. If increase in the mean seasonal temperature can reduce the duration and yield of many crops. Future climate change will likely negatively impact on agriculture and food production in low latitude countries. The average global surface temperature has increased by 0.74 C since the late 19th Century and is expected to increase by 1.4 C - 5.8 C by 2100 AD with significant regional variations (IPCC, 2007).

The climate in Uttarakhand is controlled by two different physiographic features one is hills and second one is plains. Uttarakhand has comprises both the physical features, the upper section of the state has comprised high hills of Himalaya mountains and the lower section share the land with indo-ganga plain. Therefore, the climate also varies according to physiography. The plain areas of Uttarakhand has experience the same temperature like in plain areas of Indo- Ganga basin. This temperature has risen above 40^{o} Celsius during the summer season and ranges between 35^{o} to 40^{o} Celsius. During the winter season temperature falls lower then 5^{o} Celsius in plain areas and in hilly area it falls 0^{o} Celsius. Almora is one of the districts in Uttarakhand in Himalaya therefore the temperature in Almora would not be different from Himalaya. The temperature plays major role in fragile mountains and it always control the rainfall regime in mountains. The temperature rise affects the total hydrological regime of the region. The climate change is responsible for change

in agriculture. The climate change is big issue at present scenario because everything is being affected by climate change rather natural phenomena or human. Climate change is disaster of future which affects the present generation as well as future generation in same manner or would be very scariest manner. The observe data of rainfall and temperature of last 100 years described that temperature is increasing and rainfall is also increasing and glaciers are retreating with rapid rate therefore the source of water is reducing. The small water sources are being drying up rapidly because of absent of continuous source of water. The 90 per cent rainfall is received by this region during the monsoon season and except this whole area this region receives very less amount of water from the clouds. The other source of water is glaciers which continuously retreating and reducing in size.

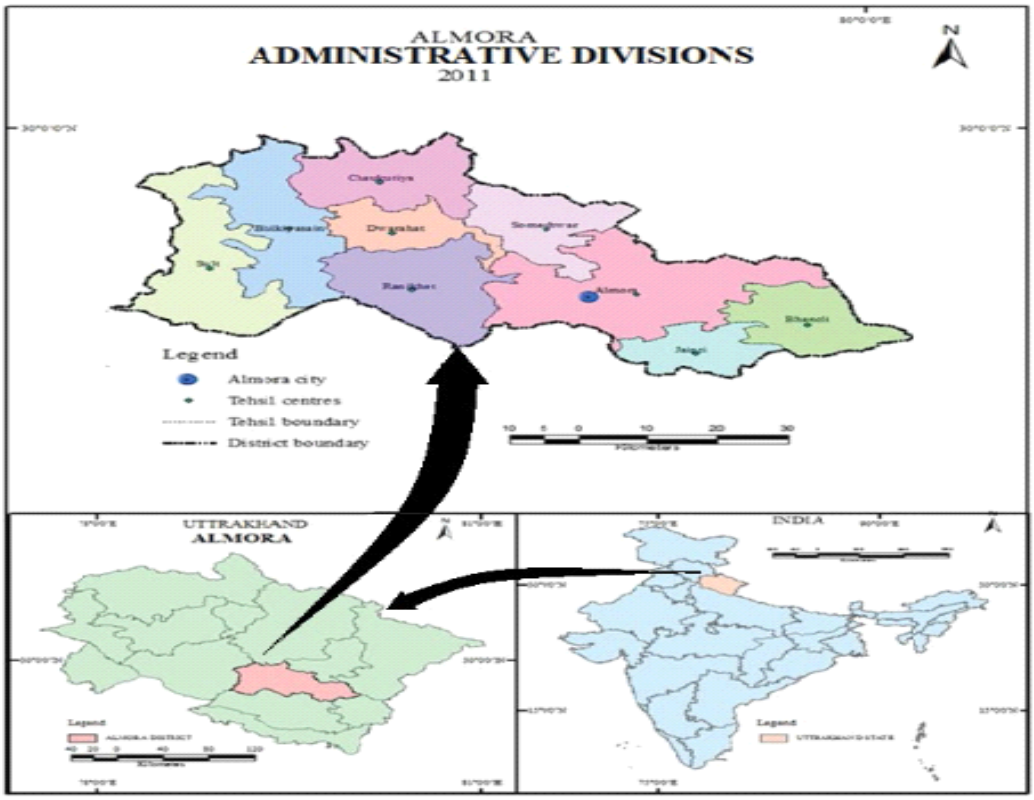
The agriculture required favorable temperature and amount of water for production of crops. But climate change has affected the sources of water and crops as well. The climate change has affected regularity and pattern of rainfall. Previous data shows that, the heavy rainfall is taking place in very short time period which causes for flash flood in this region. Heavy rainfall and increase in temperature together creates problem for agriculture. The temperature rises forced fruit crops to shift upward in mountain areas. The crops and tree line also moving upward. Now tree line crosses the height of snow line in Uttarakhand. The agriculture needed regular water throughout the year and favorable temperature but increase in temperature and rainfall uncertainties affected the agriculture. The shifting of fruit crops upward in valley areas and change in rice cultivation etc. are example which are showing that agriculture is affecting by the climate change. The Indian Council of Agriculture Research (ICAR) assess the impact on agriculture and it explain in the way that crop yield may reduce for irrigated maize, wheat, irrigated and rain fed rice up to 18 per cent, 6 per cent, 4 per cent and 6 per cent respectively by 2020.

Study Area :

Almora is district which lies in Kumaon Himalaya in Uttarakhand in India. Previously, it was part of Almora district. This district lies between latitude 29^{o} 40' and 30^{o} 20' North and longitude 79^{o} 25' and 80^{o} 10' east. This district is bounded by Chamoli district in north and north west, Almora in south and Pithoragarh district in east and it comprises geographical area of 1687.8 km^2 (Census of India, 2011). The accessibility to Almora district is good and it is well connected with

capital of Uttarakhand and it' is near to capital of India Delhi than the capital of Uttarakhand state, Dehradun. The national highways such as 58, 72, 74 and 87 connect it Rudraprayag, Hardwar, Haldwani and Almora respectively. Almora is part of Kumaon division of Himalaya and it comprises four sub divisions which known as tehsils. These are Almora, Garur, Kapkot and Kanda and all these sub-division together comprises total 902 villages and out of which 883 are inhabited and rest of are uninhabited (Census of India, 2011).

Almora comprise two physiographic division i.e. central Himalaya zone and lesser Himalayan zone and both zone lies north and south of main central thrust. This region represents extremely rugged topography characterized by deep gorges and high hills. The direction of slope is towards south. The relief of land surface ranges 3000 meter to 6800 meters in north (Census of India, 2011).



Source: Census of India, 2011

Figure : Study Area

Climate in Almora is sub-humid and temperate and northern part experiences the zero-degree Celsius temperature throughout the year and southern part experiences the warm and humid temperature. Therefore, the northern climate is cold climate and southern climate is tropical or sub-tropical. The January is coldest month with an average maximum temperature of 10^{o} Celsius and minimum temperature is 2^{o} Celsius. Sometime temperature drops to -5^{o} Celsius. The maximum temperature recorded in this district is 43^{o} Celsius. There rainfall is another important element which affects the climate in this district. Almost 75 per cent rainfalls occur in this district during the monsoon season. The monthly rainfall data shows that maximum rainfall occurs in this district is 460 mm which was received in July in 2001(Census of India, 2011). The study focused on the impact of climate change on agriculture in relation with change in rainfall and temperature in Almora, Uttrakhand.

Research Methodology :

This study is based on secondary sources of data which include data related to climate Indicator like rainfall and temperature which collected from Indian Water Portal (IWP) and the agriculture data from district headquarter or agriculture census of India. This region is mountainous therefore the satellite images has been used for processing the generating the information related to agriculture of Almora district. The climate data is processed with help of Descriptive statistical technique in MS excel and multiple graphs and seasonal variation has been derived from the data. The mean and standard deviation has been calculated from the data and its graphical representation is also presented in this paper.

Result and Discussion :

Analysis of Rainfall Data :

The analysis of rainfall data is required to understand the local regime of climate change. Rainfall controls the agriculture in India due to the importance of rainfall is dominant factor. The average and annual rainfall of Almora district for 101 years has been used for analysis. The annual behavior of rainfall has been observed from complete duration of 101 years of rainfall data (Table 1). In which on very few event the rainfall crosses the above 1500 mm rainfall in the whole year.

During the first four decades, the annual rainfall is extremely high and in the year of 1956 the annual rainfall touched the 2300 mm rainfall in year and these four decades comprises the highest amount of annual rainfall 8 times and it was more than 1500 mm per year. After 1960 there were only two time annual rainfall crosses the 1500 mm per years and after 2000 it never crosses the make of 1500 mm rainfall per year in Almora. This time series described that the annual amount of rainfall received by Almora is continuously declining year by year (Figure 3). The rapid rainfall increase but total amount is far from the previous records of annual rainfall received by Almora.

Table 1 : Time series of Precipitation in Almora

Precipitation in mm		
Year	**Annual (Total)**	**Average**
1920	1408.982	117.4151667
1921	1113.447	92.78725
1922	905.408	75.45066667
1923	1393.338	116.1115
1924	969.253	80.77108333
1925	1272.595	106.0495833
1926	963.265	80.27208333
1927	891.396	74.283
1928	1611.633	134.30275
1929	1505.588	125.4656667
1930	1153.088	96.09066667
1931	1272.989	106.0824167
1932	1088.026	90.66883333
1933	1721.899	143.4915833
1934	1455.271	121.2725833
1935	1577.867	131.4889167
1936	1714.873	142.9060833
1937	718.028	59.83566667

1938	1250.292	104.191
1939	1130.361	94.19675
1940	1259.812	104.9843333
1941	1611.461	134.2884167
1942	1202.516	100.2096667
1943	1512.323	126.0269167
1944	1552.369	129.3640833
1945	1172.828	97.73566667
1946	1384.505	115.3754167
1947	990.378	82.5315
1948	1218.228	101.519
1949	1140.785	95.06541667
1950	1386.245	115.5204167
1951	1125.522	93.7935
1952	1643.537	136.9614167
1953	1256.094	104.6745
1954	970.728	80.894
1955	2325.887	193.8239167
1956	1305.19	108.7658333
1957	1354.792	112.8993333
1958	956.908	79.74233333
1959	1043.133	86.92775
1960	857.492	71.45766667
1961	1399.021	116.5850833
1962	1234.719	102.89325
1963	871.341	72.61175
1964	1432.079	119.3399167
1965	1037.338	86.44483333
1966	1190.109	99.17575
1967	1282.955	106.9129167

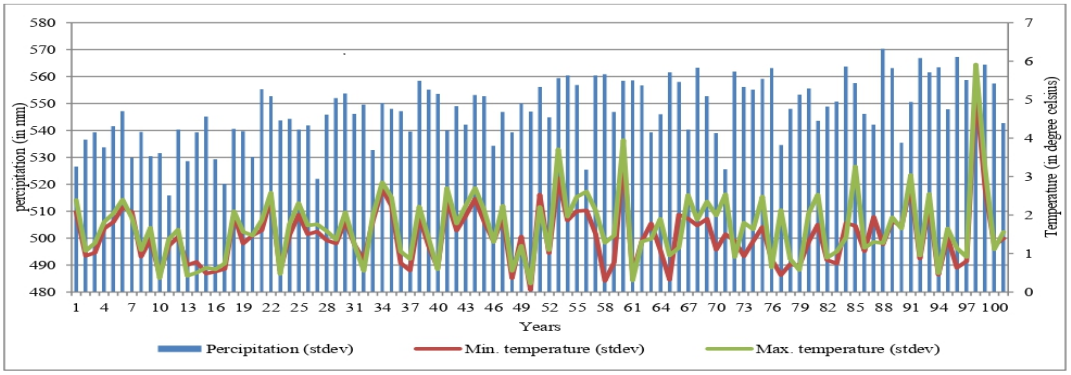
1968	1415.343	117.94525
1969	1331.266	110.9388333
1970	1058.913	88.24275
1971	1080.741	90.06175
1972	1157.486	96.45716667
1973	1275.475	106.2895833
1974	1364.679	113.72325
1975	1090.052	90.83766667
1976	1211.202	100.9335
1977	1409.207	117.4339167
1978	1141.684	95.14033333
1979	1157.019	96.41825
1980	1432.697	119.3914167
1981	1249.709	104.1424167
1982	1337.838	111.4865
1983	1102.11	91.8425
1984	854.94	71.245
1985	1351.456	112.6213333
1986	1127.111	93.92591667
1987	976.37	81.36416667
1988	1558.404	129.867
1989	1027.028	85.58566667
1990	1743.94	145.3283333
1991	1376.016	114.668
1992	1347.571	112.2975833
1993	807.127	67.26058333
1994	1376.362	114.6968333
1995	1330.131	110.84425
1996	1223.269	101.9390833
1997	1278.214	106.5178333

1998	818.531	68.21091667
1999	1851.135	154.26125
2000	1127.393	93.94941667
2001	1068.128	89.01066667
2002	1516.626	126.3855
2003	994.519	82.87658333
2004	1476.538	123.0448333
2005	1329.493	110.7910833
2006	663.366	55.2805
2007	1451.665	120.9720833
2008	1040.175	86.68125
2009	1363.425	113.61875
2010	626.378	52.19816667
2011	948.355	79.02958333
2012	1127.892	93.991
2013	1005.543	83.79525
2014	1412.559	117.71325
2015	1261.474	105.1228333
2016	839.661	69.97175
2017	1185.49	98.79083333
2018	728.183	60.68191667
2019	1021.124	85.09366667
2020	674.689	56.22408333

Source: Indian Water Portal, 2021

Seasonal Relationship between Temperature and Precipitation :

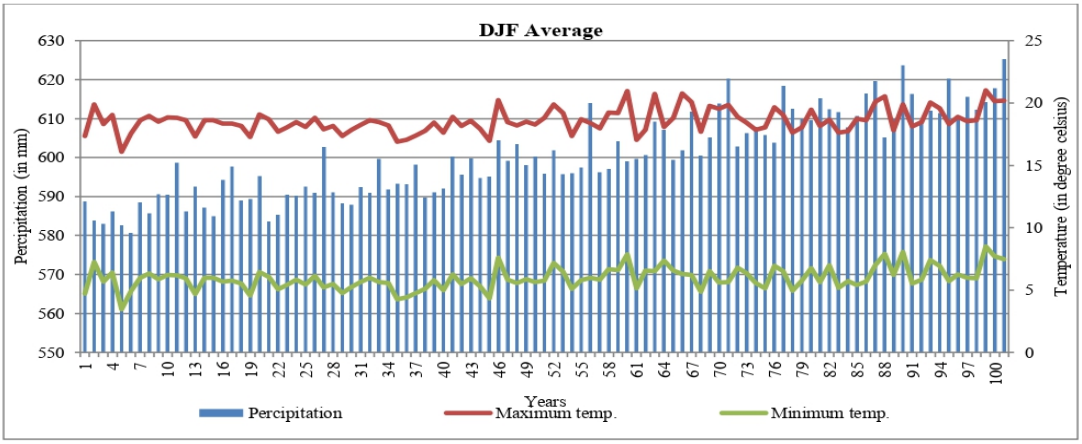
The seasonal study of rainfall and temperature is favorable to understand the agriculture perspective. Therefore, the seasonal variation has been observed from the 101 years of rainfall and temperature data the month of December, January and February has been taken for this study (Figure 1).



Source: IWP, 2021

Figure 1 : Standard Deviation of Seasonal Precipitation and Temperature of DJF

The standard deviation of precipitation and temperature has been showing the deviation in precipitation during the December, January and February month of the 101 years (Figure 1). The deviation in maximum and minimum temperature is very less and the deviation in temperature is continuously rising from 2007. The deviation in precipitation is also increasing continuously and there growth has been observed in rainfall deviation. The average precipitation during this season is continuously increasing and both maximum and minimum temperature is also increasing. The average seasonal precipitation is growing in continuous manner (Figure 2). December, January and February months receives good amount of precipitation in form of ice and rainfall.

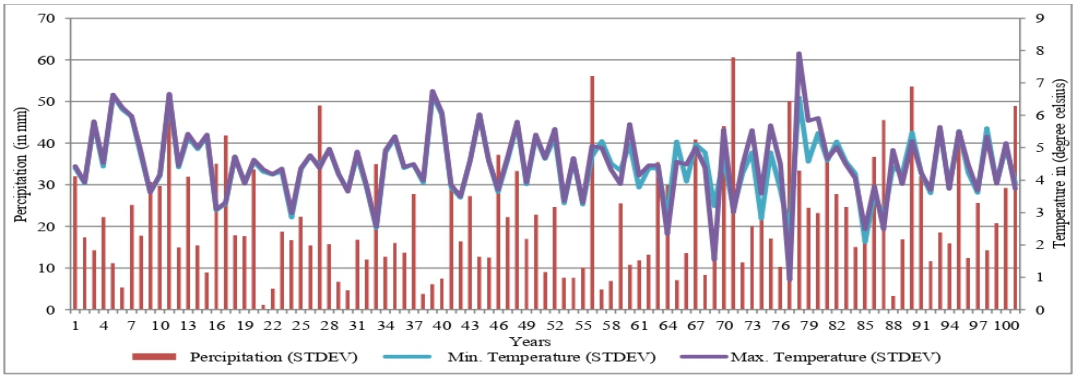


Source: IWP, 2021

Figure 2 : Seasonal Average of DJF of Precipitation and Temperature

March, April and May (MAM) :

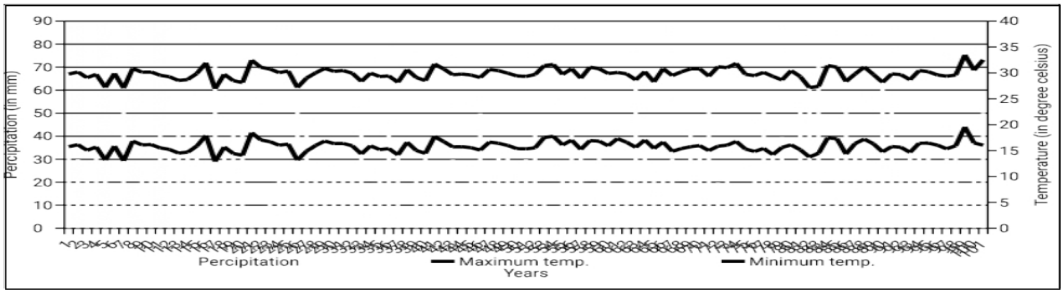
The season like March, April and May is very important of perishable products therefore the study of rainfall and temperature is required for this season. The precipitation and temperature data has been used for this study. The 101 years' data shows that the deviation in rainfall is low and it is not deviated too much in comparison to DJF.



Source: IWP, 2021

Figure 3 : Standard Deviation in the season of MAM in precipitation and temperature

The deviation in minimum temperature is very significant and it achieved the deviation as high as 8^{o} in the year of 1998. After the 2010 the deviation is almost stagnant. The deviation in rainfall is not significant (Figure 3). The average temperature and precipitation of MAM season is also important for estimation of future climate (Figure 4). The 101 years' data is showing the very high variability in precipitation and temperature.



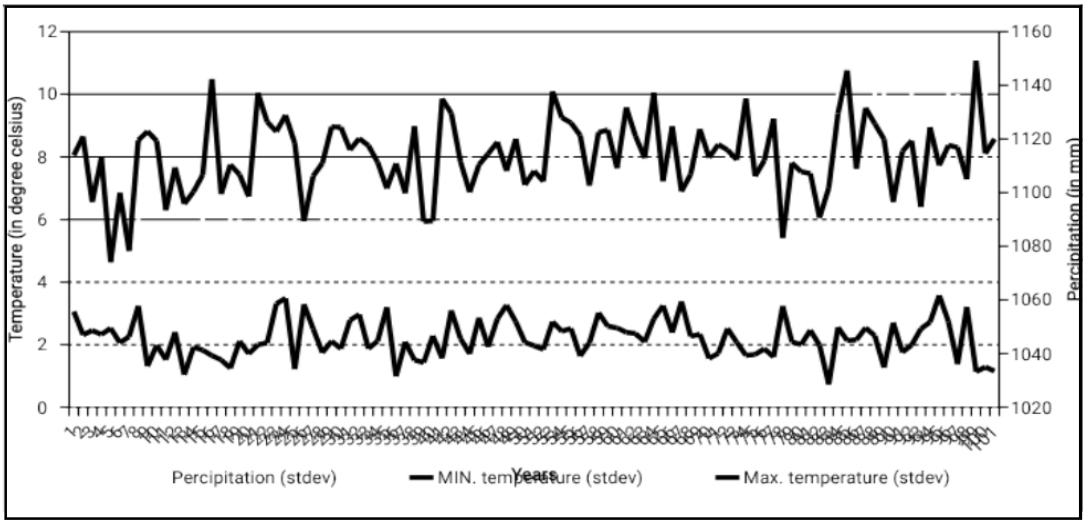
Source: IWP, 2021

Figure 4 : Seasonal Average of MAM for Precipitation and Temperature

During the early eighties average rainfall was high which is very significant because this season is known as dry season. In this average maximum temperature is increasing from 2005 and average minimum temperature in decreasing from 1995. The maximum average temperature is fluctuate nearby the 30^{o} Celsius but after 2010s this is growing and fluctuation is very less.

June, July and August (JJA) :

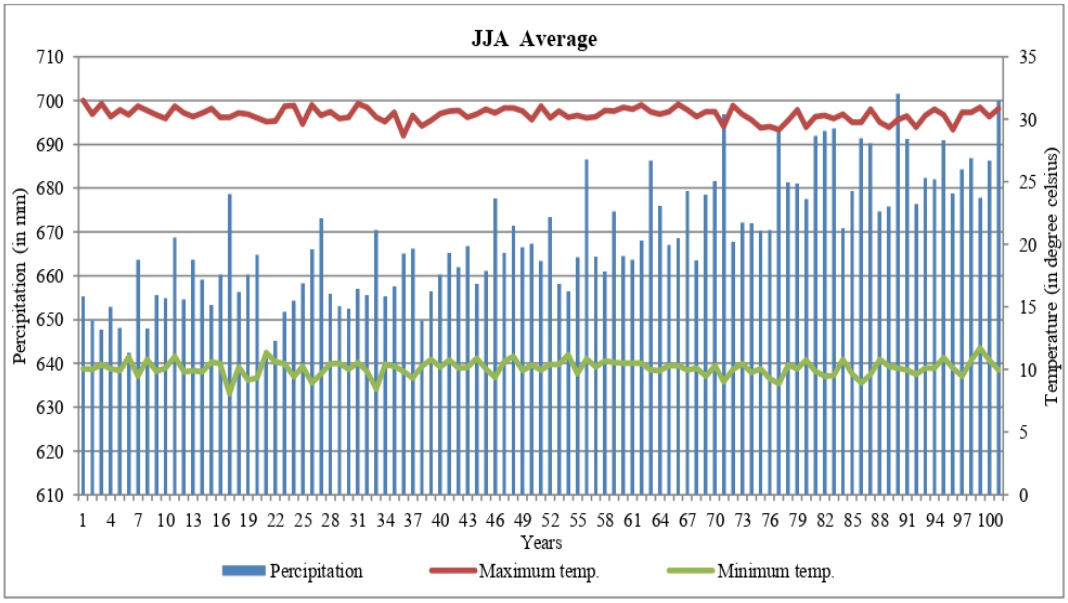
The Almora district experiences the highest temperature is 43^{o} Celsius during this season which comprises June, July and August. This season is peak season, in which most of monsoon precipitation has been occur and almost 80 to 90 percent to annual rainfall has been received by Almora during this season. The deviation during this season is very less but increasing trend can be seen in this figure. This indicates that most of the rainfall occurs during this season due to other season received less amount of precipitation (Figure 5). The deviation in temperature is not significant.



Source: IWP, 2021

Figure 5 : Standard deviation of season of JJA for Precipitation and Temperature

The average annual rainfall is very significant in this region and this season is important for agriculture in mountainous areas because this season alone provide enough amount of water for the whole years. The monsoon rainfall occurs during this period. Therefore, this season is significant.



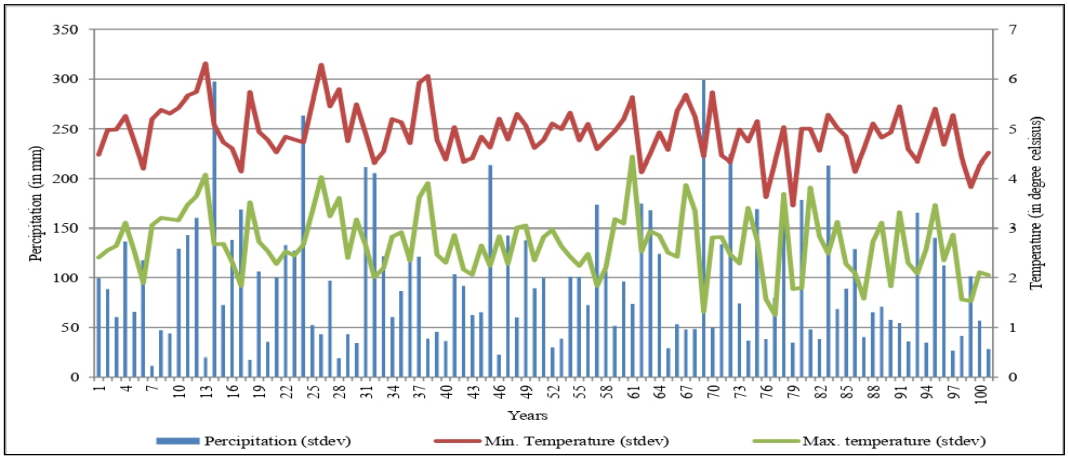
Source: IWP, 2021

Figure 6 : Seasonal Average of JJA for Precipitation and Temperature

The continuous increase in rainfall shows that rainfall is continuously increasing year by year. The temperature during this season is almost stagnant because of presence of huge rainfall temperature never increase (Figure 6).

September, October and November (SON) :

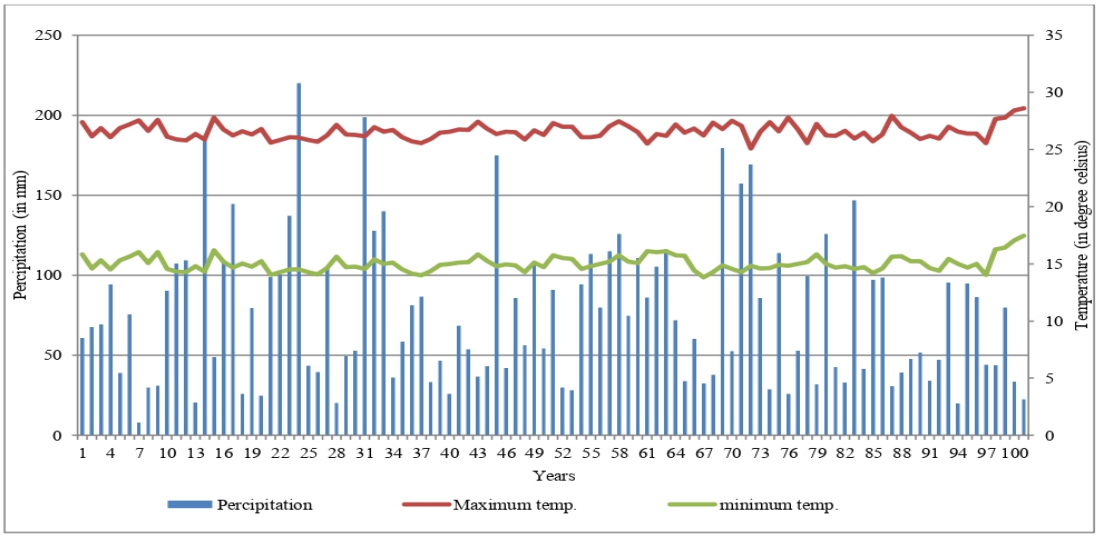
The season of SON is very significant. During this season the barley has been sawing in the agriculture field. The data showing that the deviation in rainfall is very less but temperature is fluctuating with very high frequency. The deviation in temperature is clearly visible in this (Figure 7). The deviation in maximum temperature is less in comparison to minimum.



Source: IWP, 2021

Figure 7 : Seasonal Standard deviation of SON for Precipitation and Temperature

The average temperature of this season is below 30° Celsius and the rainfall is very uncertain or irregular during this season. This season does not receive good amount of rainfall. The maximum and minimum temperature is moving parallel to each other. But average temperature has rising after 1995 during this season (Figure 8).



Source: IWP, 2021

Figure 8 : Seasonal average of SON for Precipitation and Temperature

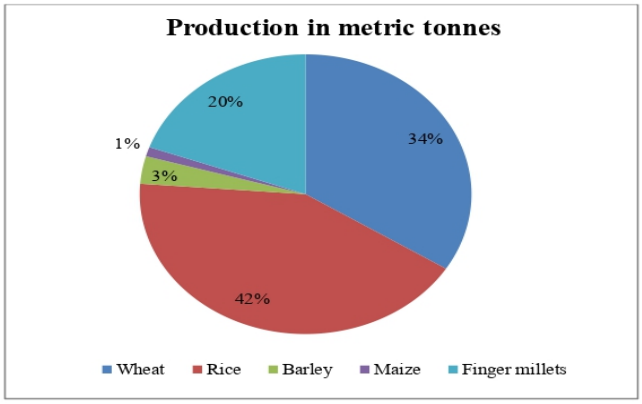
Crop yields and Climate Change :

Crop yields are heavily dependent on the weather - particularly in rain fed conditions. The impacts of climate change on mountain agriculture based on farmer's perceptions are documented below (Negi & Palni, 2010) :

- Reduced availability of water for irrigation extreme events and shift in the rainfall regime resulting in failure of crop germination and fruit set.
- Increase in invasion of weeds into croplands.
- Increased frequency of insect pest attacks.
- Decline in crop yield.

Climate Change and Agriculture in Almora :

Rugged mountains, steep slopes, an immature topography highly vulnerable to landslides and erosion pose serious limitations to agricultural activities. Various climate change studies indicate that marginal and small farmers will be worst-hit due to climate change as they already face enormous social and economic tribulations. The people of Uttarakhand like other mountain regions of the world will not only face problems of food security but are also likely to be affected by the erratic weather patterns experienced in past few years. Without doubt one of the major consequences of climate change is going to be the change in crop selection and increase in the altitudinal range of cultivated land. Delay in snowfall and early snow melt may encourage people to cultivate crops in alpine meadows both legally and illegally. Crops such as potato may expand to become a regular feature at what are now Alpine altitudes. Sporadic cultivation of potato in alpine meadows can be seen even at present. Agriculture is very important for the survival of human being wether it is mountain or plains. This is main occupation in Almora because it is hilly region and agriculture has been practice over the gentle hill slopes with help of terrace farming. The most of agriculture is practiced around the river basin. People grow rice, wheat, mandua and barley in this region (Census of India, 2011).



Source: Census of India, 2020

Figure 9 : Production of Agriculture Crops in Almora

The wheat, rice, maize and sawan are major crops of this district it is mostly cultivated into Garur valley. This region is also known as rice bowl of Kumaun because of high rice production. Rice is the major crop grown in 38% of the net sown area closely followed by wheat, which is grown in 35% of the area (Figure 9). Apart from this, other major crops are mandua (18%), barley (6%), sawan (2%) and maize (1%) (Census of India, 2011).

Correlation between Agriculture Production and Rainfall :

Agriculture in Almora district is totally depending on rainfall. The seasonal rainfall controlled the agriculture system in the region and crop variety as well. The crop production and rainfall are showing high positive correlation. The analysis of last 11-years data shows that; the crop production has increase with increase in rainfall. This relationship shows high positive correlation with value of 0.705 (Table 2). The following table is showing the mean and standard deviation of both the factor that is required for assessment of relationship between them. The 1-year data of both elements has taken for the analysis.

Table 2 : Correlation between crop production and rainfall

Descriptive Statistics			
	Mean	**Std. Deviation**	**N**
Annual Precipitation in mm	1030.5045	224.65892	11
Crop Production in Mt. ton	127194.09	13033.548	11

Correlations			
		Annual Precipitation in mm	**Crop Production in Mt. ton**
Annual Precipitation in mm	Pearson Correlation	1	.129
	Sig. (2-tailed)		.705
	N	11	11
Crop Production in Mt. ton	Pearson Correlation	.129	1
	Sig. (2-tailed)	.705	
	N	11	11

Source: Prepared by author

Reduction in agriculture :

Recent data and observation reveals that the production of crops is being affected by climate change in two ways. First is delay or uncertainty of rainfall and second one is drying up irrigation sources such as streams and rivers, etc. In 2010 cloudbursts destroyed 30% of the crops in Uttarakhand. Some anecdotal accounts based on people's perceptions of climate change are given below :

1. Increased warming in snowfall period, lower periods of snow on ground.
2. Decline in apple yield and upward shift of apple zone due to less snow fall.
3. Successful cultivation of cabbage/pea/tomato in higher elevations.
4. Shortening of maturity periods of winter (rabi) crops.
5. Increased pest infestation.
6. Less rains during March-May - abandonment of millets like *Panicum milliaceum* and decline yield of *Amaranthus*.
7. Shift of monsoon upto October damage the mature crops which leads decline in yields.

8. Shift of winter period delaying the sowing period of winter crops and decline in most of the rabi season crops.

The delay or uncertainty in rainfall is changing the agriculture crop production. Change in rainfall rhythm or delay can affect agriculture in direct manner because it affects the sowing of yield. The erratic or irregular behavior of rainfall have caused for significant loss in crop production because of delay in crop yield. The recent observation reveals that 20 per cent reduction in wheat, 48 per cent reduction in soybean and 45 per cent reduction in garden pen are result of delayed on onset of rainfall. The early ripping of wheat crop is also affected by rising the temperature (Bhatt, 2010). The drying up of irrigation sources are another cause behind the reduction in agriculture production. The agriculture required enough amounts of water but continuous increase in temperature drying up the irrigation sources such as small ponds and streams. Another cause of drying up these irrigation sources are very high intensity rainfall and incidence of cloud burst. In both the situation rain water flows as over land flow from high hills to lower slopes an during this process very less amount of water percolates deep into the rocks to recharge the ground water storage therefore very little amount of water available in the stream to flow during the summer season. Due to the hilly region become dry during summer season and this region left as un-irrigated region which affect the agriculture crop production. The observation also reveals that due to lack of water for irrigation in Almora, paddy production is decreasing considerably and it is continuously decreasing.

Change in Horticulture Belts :

The temperature is responsible for shifting of horticulture belt towards the temperate or high slopes but horticulture crops such as apple which grow in temperate climate is shifting towards the higher altitude. The shifting of vegetation line towards the higher altitude is result of rise in temperature in mountainous region.

Climate Change and Agriculture Change in Present Scenario :

Erratic rainfall patterns and increasing solar radiation also impacts agriculture by changing the geographical distribution of areas suited to different crops. An upwards altitudinal shift in cropping has been reported in cash crops like apple,

rajma, potato and carrot. Some projections speculate on an increase of night time temperature (Dimri and Dash, 2011) which may not only lead to decrease in production of some crops such as rice, but also reduce the winter killing of pests, hereby decreasing crop yields. High temperature, increased humidity and warmer temperatures in from lower regions (500-1500m amsl) may provide favourable condition to pests and insect diseases. Diseases like rust and blight in cereals and potato appear to be on the rise, while legumes like *Phaseolus spp*. May be increasingly infected through the soil borne insects such as *Coleoptera* species (locally known as *Uksa/Kurmula)*. Almora is losing fertile soil at a rate that is 10 times higher than the national average. Land degradation is therefore a serious problem in Almora with up to 1.6 million hectares facing varying degrees of degradation. Intensity of precipitation (concentrated rainfall) and extreme dryness (longer drought periods) are likely causes attributed to the land degradation in Almora.

Adaptation and Mitigation mechanisms :

Adaptation and Mitigation are two broad mechanisms through which climate change can be addressed. Adaptation aims at increasing the capacity of people and ecological systems to adjust to climate change and to increase resilience to these changes, whereas mitigations deal with the measures that aim at decreasing GHG emissions.

Improved soil and water conservation is reported to be most useful strategy in face of climate uncertainty in mountain area (Kandpal and Negi, 2003). Certain simple steps can be undertaken to improve soil and water conservation :

- No tillage farming.
- Promotion of perennial grasses in degraded areas.
- Plowing against hill slope for water retention.
- Mulching seed beds of vegetables to avoid killing by frost.
- Relay cropping, lentil sown (broadcast sowing) about a week prior to harvest paddy.
- Sowing of presoaked paddy seeds to minimize irrigation demand for germination.

- Value addition of local fruits and vegetables.
- Introduction of intercrops with assured market demands will provide higher income to the villagers.
- Initiatives to facilitate storage, transportation and providing quality seeds and train.
- Villagers to conserve water for irrigation.

Conclusion :

Climate change is considered as greatest threat facing by the societies over the coming decades. With increasing scientific consensus that climate change is being enhanced by the human activity (IPCC 2001). The whole study and analysis reveals that rainfall and temperature are playing very important role in climate change. With passage of time temperature is continuously rising and its side effect are found in the form of changing in climate regime. The rise in temperature is increase the melting of glaciers, drying the water bodies, and reduction in agriculture production. The present study also reveals that agriculture is directly affecting by the climate change because of delay in rainfall and heavy rainfall. Temperature rise forces the crops to move higher altitude. All these issues have been tried to touch in this study for better understanding of climate change and its impact on agriculture. There various efforts have been taken place to mitigate the problem generated by climate change but these efforts are not enough to handle change took place due to climate change.

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