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Climate resilient and apple production in Kullu valley of Himachal Pradesh

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ABSTRACT

A small change in the local weather of the fragile mountain ecosystems can bring about large scale changes in the form of soil erosion, land slides and flash floods etc. The rise in average temperature, long spells of drought during summer and less snowfall during winter have reduced large area supposed to be marginally suitable for apple cultivation unfit for the same forcing farmers to shift to cultivation of other cash crops. Apple cultivation has been adversely affected in lower areas of Kullu and Mandi districts and as a result of this the farmers have shifted to cultivation of vegetables like tomato and peas and other viable fruits and hence the apple belt is shifting towards the higher altitudes. The precipitation in Kullu valley was showing no significant trend but increasing frequency of extreme events. The temperatures were increasing with more pronounced rate in minimum temperature. The area under apple and its production is increasing but yield is showing somewhat decreasing trend.

Keywords: Climate resilient; temperature; apple; Kullu valley

INTRODUCTION

Climate change is a global phenomenon but it is being felt more in mountainous regions owing to the fragile nature of ecosystems. The diverse relief aspect and slope further increase both temporal and spatial variability (Bary 1994). One of the anticipated effects of climate change is the possible increase in both frequency and intensity of extreme weather events such as hurricanes, floods, droughts, heat waves, cold waves, tropical cyclones, tidal waves and severe storms (De at al 2005). Weather fluctuations and variation in micro-climate conditions are becoming evident in the form of untimely and irregular precipitations and extremes in temperatures and other weather events. The Indian monsoon rainfall is showing an inter-annual variability (Kriplani et al 2003). Analysis of long-term rainfall data over different locations of India indicated that monsoon rainfall is trendless and mainly random in nature over a long period of time (Rupa Kumar et al 1992). In 2007 January went totally dry that never happened in the Himachal Himalayas but in the year 2008 the same month received 250 mm of rainfall which indicates the striking of climate change

in the region. According to the Inter-governmental Panel on Climate Change (Anon 2001) the increase in global temperature and several extreme weather and climate events will continue with increasing frequency in the 21st century as a result of greenhouse gas emission. The economy of the people of this hilly region largely depends upon this golden crop and the size of apple market in Himachal Pradesh is estimated at ₹ 2000 crore. But farmers are still dependent on seasonal rains which are highly variable both in time and space and this variability is further boosted by the global warming. Reducing snowfall, delay in start of winter, threat of floods, hails, drought and wind storms are some of the major impacts of climate change. Agro-climatic conditions prevailing over the area provide ideal conditions for the production of temperate fruits of which apple takes a major portion. The global warming has caused loss of vigour, fruit bearing ability, reduction in size of fruits, less juice content, low clour, reduced shelf-life and increasing attack of pests resulting in the low production and poor quality apple crop.

METHODOLOGY

The daily data of rainfall, maximum and minimum temperatures were collected from observatories of IARI, Regional Research Station Katrain (32°N, 77°E and 1550 m amsl) for the period 1962 to 2009 and Hill Agricultural Research Station, Bajaura (31°10'N, 77°6'E and 1090 m amsl) for the period 1973 to 2009. The collected data were compiled on monthly, seasonal and annual bases. The data of apple production and area were collected from the Department of Horticulture, Govt of Himachal Pradesh. Simple statistical/ mathematical tools were applied for the analysis of the climatic and the apple yield data to see the trend in rainfall, temperature, apple production, yield and their interrelationships.

RESULTS AND DISCUSSION

Trend in temperature: The annual mean maximum temperature at Seobag was 24.7°C with coefficient of variation 3.3 per cent and the mean minimum temperature was 9.6°C with the coefficient of variation 7.3 per cent. Similarly the annual mean maximum temperature at Katrain was 19.9°C with coefficient of variation 4.6 per cent and the mean minimum temperature was 9.7°C with the coefficient of variation 14.6 per cent. It shows that the both maximum and the minimum temperatures were more variable at Katrain in comparison to at Seobag which may be due the cold wave effect from the Rohtang heights. Also the annual mean minimum temperature was more at Katrain though it is situated at higher altitude in comparison of Seobag which may be due to the reason that the moisture content of the air is decreasing from Katrain to Seobag ie from north to south direction in the valley.

The global mean temperature may increase between 1.8°C to 4°C and on the Indian sub-continent it could rise between 3.5°C to 5.5°C by 2100 (Anon 2001). Even greater increase is assumed for the Tibetan plateau. The stations like Srinagar, Leh and Shimla showed a significant increasing trend indicating a general rise in temperatures by about 0.65°C to 2.3°C and the North-western Himalayas about 0.5°C in the last century (Bhutiyani et al 2002). The increase in minimum temperature is more pronounced as compared to the maximum temperature. The average maximum temperature of the Kullu valley rose by 0.58°C from 1963 to 2008 and the average minimum temperature rose by 2.75°C. The average minimum temperature during December, January and February has gone up by 2.27°C, 2.68°C and 3.63°C respectively (Meena et al 2008). On the similar line monthly and annual analysis of the climatic data of Kullu valley showed an increasing trend in maximum and minimum temperatures (Fig 1) confirming to the global trend. It is also seen that inter-annual variability in temperature which was limited prior to 1940s has increased substantially after mid sixties.

The effect of global warming in the valley is more pronounced from the 9th decade onwards. It was found that from 9th decade (1988) onward the maximum and minimum temperatures were slightly higher than the previous decades (Fig 2) on annual as well as monthly bases during February, March and December. The average monthly temperatures are also slightly increasing. However the minimum temperature was found slightly increasing during January and February months in 8th and 9th decade onwards. The seasonal analysis of maximum temperature (Fig 2) indicates that the warmer seasons (summer and WSM) showed a smooth and slight increasing trend whereas the winter seasons (post-monsoon and winter) showed a more variable higher increasing trend.

Trend in precipitation: The process of the forms of water particles whether liquid or solid that fall from the atmosphere and reach the ground is known as precipitation. It is not uncommon for precipitation amounts to vary widely over a very small area. It is more pronouncedly in hilly areas for instance in Kullu during the winter. Heavy snows downwind of the Rohtang often accumulate to several feet but along a narrow corridor of the Beas River downward may receive only a few inches of the snow.

All the months showed the increasing trend in rainfall except August, November and May. Season-wise highest increasing trend was observed during the winter season followed by post-monsoon and summer seasons. The south-west monsoon season showed a decreasing trend in last 50 years. This shifting of the rainfall from summer to winter confirms the effect of global warming in the Kullu valley.

The statistical analysis of last 50 years precipitation record for three centers (viz Bajaura, Seobag and Katrain) indicate no trend in precipitation in the valley but increasing (Fig 3) inter-and intra-annual, seasonal, and monthly variability.

The decadal average of precipitation at Katrain and Bajaura showed a decreasing trend which was sharper at Katrain as compared to Bajaura. The station Seobag falling in between these two stations showed an increasing trend. It means that the trend of precipitation in higher altitudes is in deceasing and in the lower ie toward the plains was increasing.

Extreme weather events: The warming of the earth under the climatic change scenario may fuel interaction between the ocean and atmosphere that will amplify the frequency and intensity of extreme weather events which is the anticipated effects of climate change. Weather events can be classified as extreme based on economically, socially and environmentally the impact it has. Year to year deviation in the weather and occurrence of climatic anomalies/extreme events can be classified as: (i) floods, heavy rains and landslides (ii) droughts (iii) cold wave, fog, snow storms and avalanches (iv) hailstorms, thunderstorm and dust storms (v) heat waves (vi) tropical cyclones and tidal waves. It is hard to escape the perception that extreme weather events are increasing. Ask people and they are likely to recall a storm, flood, heat-wave or drought that was the worst in their recent memory. A survey was conducted in the Himachal Himalayas and cent per cent of people contacted accepted that the climate is changing and it is not coming at its proper time means the extreme events are increasing. VP Mishra, a glaciologist at SASE, said, 'Snow cover has been reduced in Beas and Parbati valley for the past 20 years and can be attributed to rise in temperature and the increased human activity.' Dr JC Kuniyal, a senior scientist at GB PIHED said, 'The Kullu valley has witnessed a rise of over 1°C in its temperature in the past 100 years. It in turn has contributed the climate change and receding snow cover in the Beas valley.'

Trend in apple production: The relation of snowfall, rainfall and annual apple production has a direct correlation. Snowfall in 1995 has been above normal and between 1995 and 2000 the annual average snowfall has been almost consistent throughout varying from 5 to 20 cm. Beyond 2000 there has been extreme variation with few years noticing no snow or very less snowfall in the region. These extremes coincide with the drought and rain deficient years and consequent fall and rise in apple production throughout (Fig 4). Years 2003-06 saw a good spell of snowfall and apple production saw a consistent growth for these four years. But in 2007 the snowfall failed and the corresponding apple production too saw a downfall. In 2008 again the snowfall (chilling hours) was fairly