DOI: 10.15740/HAS/AU/12.TECHSEAR(6)2017/1730-1734 *Agriculture Update*
Volume **12** | TECHSEAR-6 | 2017 | 1730-1734
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A CASE STUDY :

Farmers' perception on climate change - for better policy making and mitigating risks in apple farming : A case study of Himachal Pradesh

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ARTICLE CHRONICLE :
Received :
17.07.2017;
Accepted :
01.08.2017

SUMMARY : Apple farming is an important activity and profession of farmer communities in the Himalayan states of India. At present, the traditional apple farming is under stress due to changes in climate. The present study was undertaken in an Indian Himalayan state, Himachal Pradesh, with the major aim of studying perceptions of farmers on the effects of climate change on apple farming along the altitudinal gradient. Through questionnaire survey, the perceptions of farmers were recorded at low hills (≤2500 m), mid-hills (2500-3000 m) and upper hills (≥3000 m) amsl as a whole. At all elevation ranges the majority of farmers reported that there were concerned about the drastic climatic changes and their impact on the apple farming. At mid hills apple diseases and at low hills pest attack on apple crops are considered as the indicators of climate change. The change in land use practices was attributed to climate change and in many areas the land under apple farming was replaced for production of coarse grains, seasonal vegetables and other horticulture species. Scientific investigation claiming changes in Indian Himalayan climate corroborates perceptions of farmers, as examined during the present study.

KEY WORDS :
Climate change, Farmers' perception, Policy making

How to cite this article : Kireeti, K. Sharma, L.R. and Sharma, D.D. (2017). Farmers' perception on climate change - for better policy making and mitigating risks in apple farming : A case study of Himachal Pradesh. *Agric. Update*, **12**(TECHSEAR-6) : 1730-1734; **DOI: 10.15740/HAS/AU/12.TECHSEAR(6)2017/1730-1734.**

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BACKGROUND AND OBJECTIVES

The impact of global climatic change on agriculture has recently become a subject of increasing importance (Glantz, 1988). The mountain ecosystem is one of the most vulnerable ecosystems to the climate change. Though, the Himalaya harbours rich biodiversity and is one of the most vulnerable mountain ecosystems to climate change (Basannagari and Kala, 2013). Mountains are early and important indicators of climate change which depict far-reaching consequences on our ecosystem, agriculture and livelihood of the farmers (Singh *et al*., 2010). Apples constitute a major part of the economy of Himachal Pradesh, with a turnover of over Rs. 3000 crore and accounting for almost 10 per cent of the gross domestic product. In the post-independence period especially after the statehood in 1971, there has been a strong backing from the state for apple plantations. Consequently the area

under apple cultivation has increased substantially from a mere 400 hectares in 1950s to 114939 hectares in 2011-12 (Kireeti, 2013). Most studies, however, confine their inquiries to the biological and physical domains, concentrating mainly on representing the responses of crops to various changes in climate. Studies focusing on the socio-economic aspects of global climatic change are sparse and have almost exclusively restricted their analyses to the impact of environmental modifications on agricultural production (e.g. Parry 1978; Lamb 1985; Parry *et al.*,1989; Scott *et al.,* 1990 and Chmielewski, 1992). Therefore, the individual farmers' understandings and perceptions of climate change assume decisive significance. Our study is based on the premise that any research aimed at understanding the impact of climate change and variability and the resulting socio-economic responses, should take into account farmers' awareness of weather fluctuations. Moreover, farmers' perceptions tend to be affected by access to weather information (Hageback *et al.,* 2005; Deressa 2008 and Gbetibouo 2009).It is stressed regarding the importance of statistical models in the analysis of individuals' perceptions regarding climate change to help narrow the knowledge gap between policy makers and farmers (Shisanya and Khayesi, 2007). In addition to direct impact of climate change on apple productivity, it has also aggravated infestation of some diseases and pests resulting in more losses in yield (Sharma, 2012) (Gautam *et al*., 2013). Farmers are keen observers of such changes in the climate and their perceptions also corroborate a similar point of view (Gupta, 2009). Such observations warrant new approaches for production of apple in the hilly regions to combat climate change. Consequences of these climate changes are visible clearly in the shifting of apple cultivation from lower elevations to higher altitudes in Himachal Pradeshas apple yield mainly in lower altitudes has declined due to inadequate chilling as the temperature at lower altitudes is rising (Gautam *et al*., 2014). Hence, the present study aims to examine the farmers' perception on climate change in order to facilitate better understanding and combating the adverse effects of climate change with suitable policy making.

RESOURCES AND METHODS

Sampling frame :

To obtain data for the research survey, a sample is usually required. The multistage random sampling technique was applied for the selection of apple farming households in the selected block. The entire sampling plan consisted of several steps. At the first stage one apple producing district from the state of Himachal Pradesh was chosen purposively. Among all the districts in Himachal Pradesh, Shimla district was purposively selected due to its highest concentration of apple plantations. This district has been found to be on the cutting edge, as far as varying indicators of commercialization of agriculture through fruit farming are concerned. Further Narkanda block (Fig. A) was randomly selected for the final study.

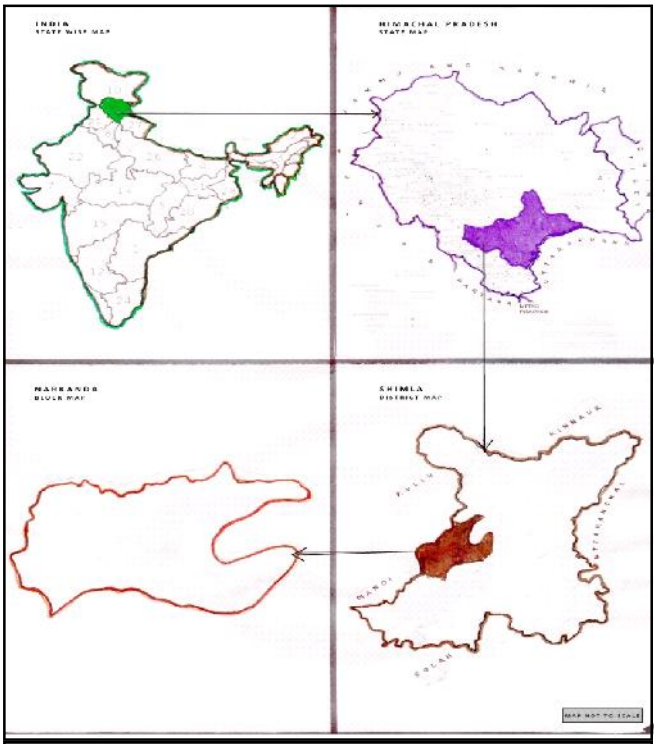


Fig. A: Selection of the study site (Narkanda Block)

Keeping this in view, this block provided suitable background to conduct the present investigation. At the second stage one block from the selected district was chosen randomly. In the third stage the block was divided into five altitudinal zones and were designated as E_1, E_2, E_3, E_4 and E_5 for $\leq$1500m, 1500-2000m, 2000-2500m, 2500- 3000m, $\geq$3000m above mean sea level (amsl), respectively. Selection of villages constitutes the fourth stage in the sampling frame. In the fourth stage, a list of villages falling under each altitudinal zone was prepared along with the area under apple and other crops. There

after 2 villages were selected randomly from each altitudinal zone. Thus, in all 10 villages *viz.*, Kirti, Namjha, Mangsu, Shamathla, Thanadar, Pamlai, Jarol, Tikkar, Saroga and Shilajan were ultimately selected for the present investigation.

A complete enumeration of all the 10 villages was done and the list of the households was prepared with the help of patwari of the village. From the list of commercial apple growers so prepared, 7 households from each village were selected based on equal allocation sampling method. Thus a sample of 70 apple growers from the block was drawn at random. However, the responses have been pooled against the given statements.

Seven households in each village were randomly sampled and information was gathered on various parameters, including perceptions of the farmers on the effects of temperature and precipitation on apple farming. Farmers were also interviewed on the trends in snowfall, extreme events, and changes in seasonality, cropping system.

Mean perception score (MPS):

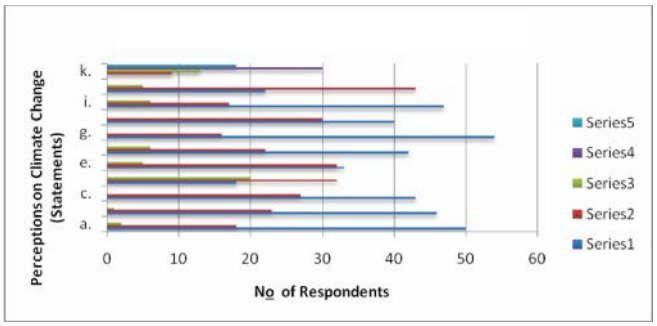
The perception of the respondents on the effects of climate change on apple production and productivity was measured with the help of the scale developed for the purpose. The scale consisted of 11statements/items which were framed by personally interacting with the respondents and then edited the responses as per the criteria given by Edwards and Kilpatrick (1948). The response of each respondent against each statement was obtained, on a five point continuum scale *viz.*, Strongly Agree, Agree, Undecided/don't know, Disagree and Strongly Disagree with respective score of 5, 4, 3, 2, and 1.

OBSERVATIONS AND ANALYSIS

The results obtained from the present study as well as discussions have been summarized under following heads:

Farmer perception regarding climate change in the study area :

It is evident from the information gathered that there is impact of climate change on the production and productivity of apple farming. For example, the apple belt in Solan, Sirmaur, Kangra and Mandi is showing decline in the apple area and production. The reliability of apple farming on climatic factors makes it more peculiar to its change as a whole. Farmers in areas like Kullu and lower belts of Shimla are opting for a change in crop industry or choosing suitable cultivars of apple for their geographical location.



Note: Series 5: Strongly agree Series 4: Agree
Series 3: Un - Decided Series 2: Disagree
Series 1: Strongly disagree

Fig. 1 : Farmers' perception on climate change

It has been viewed in the context of widespread perception of the farmers that climate change does occur and is exhibiting certain impact on all the aspects of apple farming. The perusal of the Table 1 states that, farmers believed in the existence of a drastic climate change scenario in the study area. As per the mean perception score (MPS) of 4.78, the most weighed perception among the farmers was that due to extreme change in temperature as a part of global warming that has caused a great obstacle in apple production. Only 68 per cent of the orchardists believed that climate change has not enhanced the concern of the Government (MPS: 2.19).

Similarly, the farmers have also expressed their concern due to climatic factors affecting their apple farming practices (MPS: 4.69) and farm management decisions. The next problem of focus was that the chilling requirements for apple production were been adversely affected by climate change (MPS: 4.65). It was followed by the issue of receiving less snowfall (MPS: 4.62) and winter precipitation (MPS: 3.34) in the recent past. Hence, they were not sure about their apple industries' future (MPS: 4.59). The farmers were also anxious because of unexpected occurrences of the hailstorms, which adversely affect their apple production (MPS: 4.58).All these factors have pulled the lower elevated region trailed by the shift of the traditional apple belt to the higher elevations (MPS: 4.52). The major issue was also for the reason that the climate change has unseemly affected rainfall (MPS: 4.40) and made it uncertain. Thereby its unexpected occurrence especially during

flowering and fruit development (MPS: 4.25) have adversely raised the trepidation among the farmer community in the study area.

Conclusion:

The study has attempted to address the impacts of changing conditions on the mountain agriculture as experienced by indigenous farmers of this region. The study based on the premise that any research findings on impact of changing climate on agriculture and farmers should take into account farmers 'knowledge of weather/ climate fluctuations *vis-à-vis* agriculture.The perspectives of climate change of indigenous farmers were compared with observed weather changes. The significance of study further compounded in fragile ecosystem of mountainous regions when such findings are used to devise the approach towards identifications, monitoring and adaptations strategies for climatic change. The study envisaged the scope of reorienting policy plan and calls for adaptations strategies for mountain agriculture.

The study showed that global climate change has impacted mountain people directly. Indigenous peoples' perceptions from different elevations zones ranging from ≤1500m amsl to ≥3000 m amsl, clearly revealed a change in climatic conditions.

Based on these conclusions, the following recommendations are made (Yufang *et al.*, 2013):

National and local policies should recognize and utilize their role to encourage practices of adaptation to climate change and raise awareness among vulnerable communities.

Trade-offs between short-term profit and longer-term investment will have to be considered in the context of climate change.

Research documenting the resilience of different tree crops under various climate-related stresses and their productivity under future climate conditions should be supported and communicated in order to increase the knowledge base to inform decisions on tree crop and species selection.

Farmers, local extension workers and scientists have a growing knowledge base on the response of tree crops to climate change and their vulnerability to climate risks.

Increasing access to knowledge about future possible climate change and its impacts on trees and tree crops and developing tools for the screening of tree crops and agroforestry systems for their potential to enhance resilience in the face of predicted climate change is vital

Table 1: Farmers' perception regarding the climate change

Sr. No.	Statement	Perception					MPS*	Rank
		SA	A	UD	DA	SDA		
		5	4	3	2	1		
1.	Farmers are concerned about the Climate change	50	18	2	0	0	4.69	2
2.	Chilling requirements for apple production has been adversely affected by climate change	46	23	1	0	0	4.65	3
3.	There is decline in the snowfall during past years due to climate change	43	27	0	0	0	4.62	4
4.	Climate change has adversely affected the winter precipitation in the study area	18	32	20	0	0	3.33	10
5.	Climate change has unseemly affected rainfall consequently the apple production	33	32	5	0	0	4.4	8
6.	Owing to climate change the farmers have to shift high chilling varieties to the higher elevations	42	22	6	0	0	4.52	7
7.	Due to drastic change in temperature as a part of global warming has caused a great obstacle in apple production	54	16	0	0	0	4.78	1
8.	Due to climate change , untimely occurrences of hail storms have increased affecting apple production in contrary	40	30	0	0	0	4.58	6
9.	Sustainability of apple production may be affected in the long run due to climate change	47	17	6	0	0	4.59	5
10.	Climate has resulted in untimely rainfall particularly at flowering and fruit development stage untowardly affecting apple production	22	43	5	0	0	4.25	9
11.	Climate change has enhanced the concern of the Government	0	9	13	30	18	2.19	11

and also include the consideration of changing water availability, labour shortages, and market prospects.

Growing concerns about the negative impacts of climate change can be addressed by increasing research on the prevalence of specific pests and disease, their agro-climatic associations, and existing methods for prevention and treatment and to prevent an increase in future risks and losses.

Existing prevention and treatment methods should also be screened for possible adverse environmental and human health effects and research on alternative techniques supported.

Awareness, urgency in response, and foresight in planning for climate change in agriculture could be improved across the study areas. Research findings and local experience must be communicated across the study region (Himachal Pradesh and similar ones) and translated into awareness of both the implications of climate change on agricultural systems and tools, including agricultural diversification, for adaptation.

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