

Original Research Article

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## Effect of Climate Change on Cropping Pattern of Vegetables in Madhya Pradesh, India

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### ABSTRACT

#### Keywords

Socio-economic status, Climate change, Cropping pattern, Vegetable cultivation

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The study was carried out in seoni district of Madhya Pradesh to assess the effect of Climate change on cropping pattern of vegetables. Six villages of Seoni block were selected on the basis maximum area under vegetable crops. Total 120 vegetable growers were selected by simple random sampling method. The study reveals that more than half of the vegetable growers had medium socio-economic status and half of the vegetable growers had low level of knowledge towards climate change. Near to two third of the growers shifted their cropping pattern from potato- Cabbage - cucumber to Maize - Pea - Musk melon due to climate change. The results of correlation analysis shows that occupation and knowledge level of the vegetable growers had positive and significant correlation with effect of climate change on cropping pattern of vegetables. The vegetable growers faced economic, market related, technical, situational, extension and institutional related problems in vegetable cultivation. Planners and development workers should formulate policies to improve the knowledge towards the climate and design a procedure to overcome these problems.

### Introduction

Vegetables play a vital role in the maintenance of human health and cheapest sources of natural protective food, contributing carbohydrates, vitamins and minerals in human diet (Choudhury, 2006). A balanced diet is essential to sustain good health. For a well-balanced diet, about 300 gram vegetables are required containing root vegetable, green vegetables and others vegetables, but only 130 grams per capita is

available. Most of the leafy vegetables and root crops are rich in minerals like Ca, Fe, and phosphorous some leafy vegetables are rich in microelements like copper, manganese zinc and vitamin A, B, C. In the vegetable production climate plays a major role and now a day's climate change is rapidly affecting the vegetable production.

Climate change is a statistical variation in properties of the climate system that include in global temperature, rainfall, sunlight,

precipitation etc. due to human and natural drivers activity. Agriculture production depends on environmental, varietal and management factors. Climate plays a major role as its positive and negative impact immediately influences crop productivity. Awareness among the farmers about the climate change is very necessary for crop output in terms of production.

For proper growth and development, all vegetable requires an optimum temperature which varies from crop to crop and also limits the range and production of many crops and high temperature with low precipitation will reduced the availability of irrigation water and at the same time increased evapotranspiration leads to severe water stress resulting low yield and quality of vegetable crops (Devi, 2017). A little change in the climatic parameters will bring drastic changes in the quality and nutritional value of vegetables and also affect the post harvest quality and basis for severe losses and affect food safety during storage. (Cotty and Jaime-Garcia, 2007). Besides these losses also affects insect pest and disease incidence and weed infestation in vegetable crops (Vermeulen *et al.*, 2010). In this view climate factors affects the vegetable production. Farmer's knowledge about the climate is more important to mitigate the ill effect of weather or climate to some extent. In the recent years extreme weather events like excessive and deficit rainfall, flood, severe frost, temperature and drought are occurring more commonly affecting agricultural production and productivity which leads to decrease farmer's income (Bhan *et al.*, 2014).

A lower agricultural production and productivity due to climate change has implication for food prices, which in turn affect the livelihood and food security status of household in a country. Under this circumstances improved and sustainable

agriculture technology according to forecast based, agro advisories and full information about factor effecting of climate change are more useful to reduce vulnerability and improve adaptability of agriculture to climate change. In Seoni district of Madhya Pradesh major vegetable crops grown are Tomato, Onion, Brinjal, Chili, Cucurbits. In a vegetable growing area of a Seoni many factor are available which directly connected with climate change and like average temperature increase, change in rainfall amount and pattern, change in climatic variability and extreme events, weed, pest and pathogen. Keeping in view of the above points, the present study was carried out with following objectives:

To know the personal, socio-economic and psychological profile of vegetable growers.

To study effect of climate change on cropping pattern of vegetable crops.

To identify the various problems faced by vegetable growers.

## **Materials and Methods**

The present study was conducted in Seoni district of Madhya Pradesh. The Seoni district is located in the southern part of Madhya Pradesh. The district lies between latitude 21° 36' to 22° 57' North and longitude 79° 19' to 80° 17' East. Out of the 8 blocks, only Seoni block was selected purposively because it has the second position of the vegetable production and area. The block comprises of 289 villages. A list of vegetable crops growing in the villages were prepared on the basis of their production, out of which 6 villages Mungwani khurd, Mungwani kala, Simariya, Khairy, Singhodi and Jamuniya were selected randomly on the basis of availability of vegetable growers and adopted by KVK Seoni. A list of vegetable growers from selected villages was prepared with the help of RAEs. To make sample of 120

respondents for the present study the 20.00 per cent vegetable growers from the total farmer in selected villages of Seoni block through proportionate random sampling method. A well structured and pre tested schedule was used to collect information from the vegetable growers.

## **Results and Discussion**

### **Personal and Socio economic status of the vegetable growers**

The perusal of data presented in table 1 indicates that out of the total vegetable growers, majority (65.00%) of growers belonged to middle age group. The result is consonance with the findings of Pyasi, 2009 and Natya, 2011. A sizable group of the farmers (44.16%) were educated up to higher secondary level and 20.00 per cent were educated up to high school level, while 18.34 per cent were illiterate and only 17.50 per cent educated up to college level. It was also noted that majority of growers (72.50%) were engaged in vegetable cultivation. A sizable group of vegetable growers (46.67%) had marginal size of land holding followed by 36.67 per cent small size of land holding, 15.83 per cent had medium size land holding and very few (0.83 %) had large size of land holding.

Majority of the growers (60.83%) were found in low income category followed by medium income group (28.33%) and high income group (10.84%). Similar trend was observed in the study of Neerja *et al.*, (2016). Majority of the vegetable growers (62.50%) had medium farm power followed by 20.83 per cent had low farm power and 16.67 per cent had high farm power. The percentage of area under vegetable crops shows the area under vegetable cultivation in their total land holding. Majority of the growers (63.34%) had 1-25 percent area under vegetable crops.

Near to one fourth vegetable growers (23.33%) had 26-50 per cent area and 13.33 per cent had 51-75 percent area under vegetable crops.

It can be also furnished from that majority of the vegetable growers (63.33%) had 6-10 tonne production, while 20 per cent had 1-5 tonne production and 16.67 per cent had above 10 tonne production of vegetable annually. Near to three fourth growers (74.17%) had medium farming experience, while 18.33 per cent had high farming experience and few farmers (7.50%) had low farming experience.

Out of the total vegetable growers, 52.50 per cent had medium socio-economic status while 37.50 per cent had low socio-economic status, whereas 10.00 per cent had high socio-economic status.

### **Psychological variables**

The data presented in table 2 revealed that out of the total vegetable growers, more than half of the growers (57.50%) were belonged to medium level of scientific orientation followed by 27.50 per cent had high scientific orientation and 15.00 per cent had low scientific orientation towards vegetable cultivation. Majority of the growers (66.67%) had medium risk bearing ability, 18.33 per cent had high risk bearing ability and 15.00 per cent had low risk bearing ability towards the vegetable cultivation. Out of the total vegetable growers, 63.33 per cent had medium economic motivation, 26.67 per cent had high economic motivation and 10.00 per cent had low economic motivation towards vegetable cultivation.

### **Knowledge level towards climate change**

Knowledge plays a vital role in adoption of technology. Knowledge towards climate change will help the farmers in managing

vegetable cultivation practices in phase of disruptive climatic events. Half of the farmers (50.00%) had low level of knowledge towards change in rainfall pattern and rainfall distribution, while 40.00 per cent had medium and only 10.00 per cent vegetable growers had high level of knowledge towards change in rainfall pattern and rainfall distribution on vegetable cultivation. Similarly higher percentage of the vegetable growers (56.67%) had low level of knowledge followed by 23.33 per cent had medium and 20.00 per cent had high level of knowledge towards change in temperature (Table 3).

Out of total vegetable growers, 50.00 per cent had low knowledge level towards climate change in concern of vegetable production, whereas 44.17 per cent had medium knowledge level and very few vegetable growers (5.83%) had high knowledge level of knowledge related to climate change

### **Effect of climate change on cropping pattern of vegetable crops**

Out of the total vegetable growers, 62.50 per cent farmers shifted from old cropping pattern Potato - Cabbage - cucumber to new cropping pattern Maize - Pea - Musk Melon due to climate change followed by those vegetable growers (25.00%) who shifted from old cropping pattern Okra - Pea - Tomato to new cropping pattern Pulses - Tomato - cabbage. Rest of the vegetable growers (12.50%) shifted from Bitter gourd - Garlic - Pea to Maize - French bean - Colocasia due to climate change.

Zero order correlation coefficient between independent variables and the effect of climate change on cropping pattern of vegetable crops revealed that the effect of climate change on cropping pattern of vegetable crops had positive and significant relationship with occupation at 0.01 level of

probability and knowledge level at 0.05 level of probability (Table 6).

In case of age, farm power, annual production, and economic motivation of vegetable growers were found to have positive and non-significant correlation with effect of climate change on cropping pattern of vegetable crop whereas education, size of land holding, percentage area under vegetable crop, socio-economic status, annual income, farming experience, scientific orientation, risk bearing ability, showed negative and non-significant correlation with effect of climate change on cropping pattern of vegetable crop.

### **Problems faced by vegetable growers**

The problems reported by the growers in production of vegetable crops were lack of fund to purchase agriculture input (93.33%) is the first economic problem, the second and third problems were highest cost of fertilizer, seed, equipment and pesticide (81.67%) and high labour cost (77.50%). The fourth problem was lack of loan facility (68.33%). In case of the market related problem low price of vegetable in market (84.17%) received first rank followed by lack of knowledge of market price of vegetable (75.83%) with second rank, irregularity of market facility (77.50%) ranked third and timely unavailability of fertilizer, seed and insecticide etc. in market (75.00%) received fourth rank (Table 5).

It is also furnished that Lack of knowledge of high production variety (75.83%) was first technical problem, followed by training related problem (75.00%), lack of soil testing facility (74.17%), lack of knowledge about quantity and medicine for seed treatment (71.67%) and lack of knowledge of pest and disease were technical problems in vegetable cultivation. Similar study has been done by Sahu *et al.*, (2013).

**Table.1** Personal and socio-economic status of the vegetable growers

N=120

Categories	Frequency	Percentage
<b>Age</b>		
Young age group	26	21.66
Middle age group	78	65.00
Old age group	16	13.34
<b>Education</b>		
Illiterate	22	18.34
Up to high school	24	20.00
Up to higher secondary	53	44.16
Up to College	21	17.50
<b>Occupation</b>		
Vegetable Cultivation	87	72.50
Vegetable Cultivation + labour	15	12.50
Vegetable Cultivation + business	10	8.33
Vegetable Cultivation + service	8	6.67
<b>Size of Land Holding</b>		
Marginal farmer	56	46.67
Small farmer	44	36.67
Medium farmer	19	15.83
Large farmer	01	0.83
<b>Annual income</b>		
Low	73	60.83
Medium	34	28.33
High	13	10.84
<b>Farm power</b>		
Low	25	20.83
Medium	75	62.50
High	20	16.67
<b>Percentage of area under vegetable crops</b>		
(1-25 %) area	76	63.34
(26-50%) area	28	23.33
(51-75 %) area	16	13.33
<b>Annual production of vegetable crops</b>		
1-5 tonne	24	20.00
6-10 tonne	76	63.33
Above 10 tonne	20	16.67
<b>Farming experience</b>		
Low	09	07.50
Medium	89	74.17
High	22	18.33
<b>Socio economic status</b>		
Low	45	37.50
Medium	63	52.50
High	12	10.00

**Table.2** Psychological variables of vegetable growers

N= 120

Categories	Frequency	Percentage
<b>Scientific orientation</b>		
Low	18	15.00
Medium	69	57.50
High	33	27.50
<b>Risk bearing ability</b>		
Low	18	15.00
Medium	80	66.67
High	22	18.33
<b>Economic motivation</b>		
Low	12	10.00
Medium	76	63.33
High	32	26.67

**Table.3** Knowledge level towards the impact of climate change on vegetable crops

N= 120

<b>Knowledge level towards change in rainfall pattern and rainfall distribution</b>		
Categories	Frequency	Percentage
Low	60	50.00
Medium	48	40.00
High	12	10.00
<b>Knowledge level towards change in temperature</b>		
Low	68	56.67
Medium	28	23.33
High	24	20.00
<b>Knowledge level towards climate change</b>		
Low	60	50.00
Medium	53	44.17
High	7	5.83

**Table.4** Effect of climate change on cropping pattern of vegetable crops

Old cropping pattern	New cropping pattern	Frequency	Percentage
Potato - Cabbage - cucumber	Maize - Pea - Musk melon	75	62.50
Okra - Pea – Tomato	Pulses - Tomato - cabbage	30	25.00
Bitter guard - Garlic – Pea	Maize - French bean – Colocasia	15	12.50
<b>Total</b>		<b>120</b>	<b>100.00</b>

**Table.5** Problems faced by vegetable growers in vegetable cultivation

S. No.	Problems	Frequency	Percentage	Rank
<b>Economic problem</b>				
1.	Lack of fund to purchase agriculture input	112	93.33	<b>I</b>
2.	High cost of fertilizer, seed, equipment and pesticide.	98	81.67	<b>II</b>
3.	High labour cost	93	77.50	<b>III</b>
4.	Lack of loan facility	82	68.33	<b>IV</b>
<b>Market related problem</b>				
1.	Lack of knowledge of Market price of vegetable.	91	75.83	<b>II</b>
2.	Irregularity of market facility	93	77.50	<b>III</b>
3.	Timely unavailability of fertilizer, seed and insecticide etc. in market	90	75.00	<b>IV</b>
4.	Low price of vegetable in market	101	84.17	<b>I</b>
<b>Technical problem</b>				
1	Lack of knowledge of high production variety	91	75.83	<b>I</b>
2.	Lack of knowledge about quantity and medicine for seed treatment	86	71.67	<b>IV</b>
3.	Training related problem	90	75.00	<b>II</b>
4.	Lack of knowledge of pest and disease	86	71.67	<b>IV</b>
5.	Lack of soil testing facility	89	74.17	<b>III</b>
<b>Situational problem</b>				
1.	Unavailability of agricultural inputs in village	88	73.33	<b>III</b>
2.	Distance between village and market	93	77.50	<b>I</b>
3.	Irregular supply of electricity	89	74.17	<b>II</b>
4.	Lack of transportation facility	88	73.33	<b>III</b>
<b>Extension related</b>				
1.	Information are not available in local language	80	66.67	<b>V</b>
2.	Irregular visit of RAEO's	88	73.33	<b>III</b>
3.	Demonstration related problem	90	75.00	<b>II</b>
4.	Unavailability of technical literature	85	70.83	<b>IV</b>
5.	RAEO's only contact with large farmer	97	80.83	<b>I</b>
<b>Institutional problem</b>				
1.	Lack of co-operative societies in the village	97	80.83	<b>II</b>
2.	Unavailability of agricultural input in society	90	75.00	<b>III</b>
3.	<b>Not provided timely information by gram panchayat</b>	<b>105</b>	<b>87.50</b>	<b>I</b>

**Table.6** Relationship between profile of vegetable growers and effect of climate change on cropping pattern of vegetable crops

S. No.	Independent Variables	Dependent variable (Y)
1.	Age	0.083
2.	Education	-0.012
3.	Occupation	0.258**
4.	Size of land holding	-0.032
5.	Annual income	-0.082
6.	Farm power	0.092
7.	percentage of area under vegetable crop	-0.070
8.	Annual production of vegetable crops	0.073
9.	Farming experience	-0.085
10.	Socio-economic status	-0.134
11.	Scientific orientation	-0.009
12.	Risk bearing ability	-0.033
13.	Economic motivation	0.091
14.	<b>Knowledge level</b>	<b>0.213*</b>

NS = Non- significant

\*Significant at 0.05 level of probability

\*\*Significant at 0.01 level of probability.

Distance between village and market (77.50%) received first rank in situational problems, irregular supply of electricity (74.17%) ranked second, unavailability of agricultural inputs in village and lack of transportation facility (73.33%) received third rank. In case of extension related problem, RAEO's only contacted with large farmer (80.83%) followed by demonstration related problem (75.00%), irregular visits of RAEO's, unavailability of technical literature (70.83%) and information was not available in local language (66.67%). While timely information was not provided by gram panchayat (87.50%), lack of co-operative societies in the village (80.83%) and unavailability of agricultural input in co-operative societies (75.00) were the institutional problems received by the vegetable growers. These problems should be removed in order to ensure sustainable vegetable cultivation.

It is concluded that 52.50 per cent vegetable growers had medium socio-economic status and about 50.00 per cent vegetable growers had low level of knowledge towards climate change and rest of the farmers had knowledge about the climate change.

To make vegetable growers more literate about climate change, climatic literacy programme should be organised in the villages on regular basis. Total 62.50 per cent growers were shifted their cropping pattern from potato- - Cabbage - Cucumber to Maize - Pea - Musk melon due to climate change. It is evident that vegetable growers were shifting their cropping pattern due to change in climatic events and also low productivity of vegetable crops. Government and development departments should design policies related to climate change to sustain socio economic condition of the vegetable growers and for their livelihood.

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