Impact of Climate Change on Growth and Variability in Area, Production and Productivity of Major Vegetables in India

Premlata kumari[1], Basavaraja H[2] and Nethravathi A Patil[3]
1. M.Sc (Ag Economics)Department of Agricultural Economics, UAS, Dharwad, India
2. Professor, Department of Agricultural Economics, UAS, Dharwad,India
3. P.hd Scholar, Department of Agribusiness Manangement, UAS, Dharwad,India

Abstract

Climate change necessarily brings about changes in the weather conditions. Climate change could affect agricultural productivity and causes increased health hazards and submergence of lands due to rise in the sea level to name a few. Climate change is the net result of many factors caused by continuous evolution of Planet Earth.Important vegetable crops grown in the country are tomato, onion, brinjal, cabbage, cauliflower, okra and peas. India contributes 13.38 per cent to the world vegetable production. The main objective of this paper isto know growth and variability in area, production and productivity of major vegetables, relationship between area, production and productivity of major vegetables with rainfall and temperature and replacement of area under these vegetables over the years and to predict values for area under selected vegetables for next five years. This study is mainly based on secondary data which was taken from NHM database 2013 and data was analyzed using Markov chain,correlation,CGR. The study revealed that CGR of Onion for area, production and productivity was highest in last 10 years.

Keywords

Coefficient of variation, compound growth rate, climate Change

I. INTRODUCTION

The Inter-Governmental Panel on Climate Change (IPCC) defines climate change as 'a change in the state of the climate that can be identified (e.g., using statistical tests) by changes in the mean and/or variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity' [1].Climate change is a phenomenon being experienced by the mankind since its origin on the earth. The Planet earth is going through this phenomenon ever since its birth. It is also a driving force of evolution that life on earth has undergone over the last millions of years. Climate change necessarily brings about changes in the weather conditions. There is reason tobelieve that climate change could affect agricultural productivity, and cause increased health hazards and submergence of lands due to rise in the sea level to name a few. Climate change is the net result of many factors caused by continuous evolution of Planet Earth through many geological eras. However, there is growingconcern about manmade developments causing, even if partially or insignificantly, the climate changeoutcomes. The importantfactors,which are responsible for climate change and are causally contributed by human civilization on earth, are:

1. Greenhouse Gases
2. Deforestation
3. Land-use Change
4. Energy Usage and
5. Vehicular Usage

Climate change has the potential to create a wide range of economic impacts. In all likelihood all sectors of the economy will be affected. The main impacts of climate change are temperature, rainfall (precipitation), mountain glaciers, sea level rise, health, agriculture, coastal erosion, biodiversity loss, storm/storm events, soil moisture availability, sea surface temperature and the likes.Some impacts will gradually affect economic processes, such as the effect of increasing temperature on energy demand, whereas others may come as extreme events, such as sudden floods or forest fires. Impacts may be either negative or positive. For example, agriculture may become more productive or tourism may flourish in areas experiencing higher or lower temperatures. However, in a global level, the negative impacts will generally outweigh the economic benefits. Beside industry specific impacts, the economy as a whole may be at risk in certain areas due to an increase in sea level and an increase in runoff by rivers [2].

India is a predominantly agriculture-oriented economy, as 52 per cent of the population directly depends on agriculture either as farmers or agricultural laborers, and their concentration is higher at 76 per cent in the villages. Variation in climate will have a direct impact on the majority of the livelihood of the people. Food production in India is sensitive to climate change like variations in temperature and monsoon rainfall. Every small change in temperature and rainfall has significant effect on the quality and quantity of fruits, vegetables, tea, coffee, basmati rice and aromatic and medicinal plants. It is predicted that a loss of 10 to 40 per cent in production may occur by 2100 due to climate change [3].

Horticulture is an important segment of agriculture, contributing about one-fifth share of the agriculture and allied sectors. Rapidly growing demand for horticultural commodities and products especially for processed fruits and vegetables market is an evidence of the phenomenon that is expected to accelerate horticultural growth. Consequently, horticulture is set to assume a greater role and importance within the agriculture sector.India's varied agro-climatic conditions allow it to produce a wide variety of horticultural crops such as fruits & vegetables, tuber crops, plantation crops, flowers, spices & condiments etc. India is the second largest producer of fruits as well as vegetables after China. Growing horticultural crops can provide gainful employment to a larger majority of the farmers and agricultural labour throughout the year.More than 40 kinds of vegetables belonging to different groups are grown in India in tropical, sub-tropical and temperate regions. Important vegetable crops grown in the country are tomato, onion, brinjal, cabbage, cauliflower, okra and peas. India contributes 13.38 per cent to the world vegetable production [4].The increasing awareness among the people regarding healthy diet and importance of vegetables has been responsible for augmentation of vegetable production in the country over the years. Variation in temperature and rainfall has affected area under different crops and their production and productivity. This study aims to overview growth and variability in area, production and productivity of major vegetables in India in the last ten years and to know relationship between area, production and productivity of major vegetables with rainfall and maximum and minimum temperature and it also explains replacement of area between different vegetable in the last ten years.

II. METHODOLOGY

Study is mainly based on secondary data.Data on average annual rainfall, minimum and maximumtemperature was obtained from Meteorological Department of India. Data related to area,production and productivity of Vegetables in India were obtained from Indian horticulture database2013, National Horticulture Board [4]. Ten years data from 2003-4 to 2012-13were used to study growth trend and variability in area,production and productivity of major vegetables and their correlation with rainfall and temperature over those years.For evaluating the trend in area, production and productivity under major vegetables in India the compound growth model of the type $Y_t = ab^t u_t$was employed[5]. Equation was converted into the logarithmic form in order to facilitate the use of linear regression.The linear regression of the above farm was fitted separately for area, production and productivity. Average annual compound growth rate was calculated as g = b-1. To obtain percentage compound growth rate the values of ‘g’ was multiplied by 100.To know the variation in area, production and productivity over the years coefficient of variation (CV) was worked out.Correlation between rainfall and area, production and productivity of major vegetables was estimated.Correlation ofminimum and maximum temperaturewith area,production and productivity was also calculated separately using formula for correlation co-efficient.Markov analysis was applied to know replacement of area between different vegetables in the last ten years.

III. RESULT AND DISCUSSION

A.Variability in area,production and productivity of major vegetables

Highest compound growth rate was observed in area under onion followed by tomato and cauliflower and area under potato has least compound growth rate over 10 years. With highest growth rate in area,variation production was highest for onion with productivity of 3.3547 per cent. Over the 10 years compound growth rate in brinjal production was least. Variation in productivity of peas was highest over last 10 years. Highest and lowest variation in productivity was recorded in peas and cauliflower respectively.

There was highest variation in area under tomato followed by onion and cauliflower and the least was in case of potato. Tomato experienced highest variation followed by onion and peas in case of production.Brinjal production was stable than other vegetables. Co-efficient of variation in productivity was highest and least in case of onion and cauliflower i.e.12.59 per cent and 2.10 per centrespectively.(Table I)

B. Correlation of area,production and productivity of major vegetables with rainfall and temperature

There is negative correlation between rainfall and area under different vegetables.

Among vegetables included under study peas and onion were affected most and least respectively by the rainfall.Production is affected most and least adversely in case of cauliflower and brinjal respectively.Productivity of cauliflower was affected adversely by rainfall to greatest extent as correlation coefficient is more than 0.5.productivity of okra is least affected by rainfall (Table II)

Minimum temperature affects negatively to area,production and productivity but impact is not significant as correlation co-efficient is very low except in case of cauliflower where correlation co-efficient is -0.523.Maximum temperature affects area, production and productivity of these vegetables positively but not significant as correlation co-efficient is low. (TableIII)

C.Replacement of area under different vegetable

Area under brinjal cultivation has been replaced by potato to the extent of 77.16 per cent followed by okra to the extent of 22.43 per cent. Brinjal has retained only 4 per cent of its area in last 10 years.Area under peas cultivation has been replaced by brinjal by 45.39 per cent followed by okra by 37.91 per cent of its area and it has retained 16.7 per cent of its total area over ten years.Brinjal has replaced okra by 44.75 per cent followed by tomato by 36.35 per cent and by onion by 18.91 per cent with respect to area. Area under tomato cultivation hasbeen replaced by onion to the extent of 24.21 per cent followed by brinjal to the extent of 5.per cent and it has retained 70.30 per cent of its area which is more stable than others. Brinjal has replaced potato by 12.23 per cent followed by onion by 9.41 per cent followed by peas by 6.62 per centand by okra by 2.82 per cent with respect to area and it has retained 68.93 per cent of its area in last ten years.Area under onion cultivation has been replaced by peas to the extent of 19.74 per cent followed by okra by 14.67 per cent followed by 10.7 per cent and by tomato by 3.8 per cent and it has retained 51.05 per cent of its area in the last ten years.So among the selected vegetables tomato has retained highest percent of its area and area under tomato cultivation is more stable. Okra has lost its area for its cultivation to greatest extent. (Table IV)

IV. CONCLUSION

Climate change has the potential to create a wide range of economic impacts. The main impacts of climate change are extreme temperature, variation in rainfall, melting of mountain glaciers, sea level rise, health hazards, and variation in agricultural production, coastal erosion, biodiversity loss, storm/storm events, variation in soil moisture availability and sea surface temperature and the likes. Variation in temperature and rainfall has affected area under different crops and their production and productivity. Food production in India is sensitive to climate change like variations in temperature and monsoon rainfall. Every small change in temperature and rainfall has significant effect on the quality and quantity of fruits and vegetables.There is negative correlation between rainfall and area under different vegetables.Productivity of cauliflower was affected adversely by rainfall to the greatest extent. Minimum temperature affects negatively to area, production and productivity of vegetables in Indian condition. Among the major vegetables tomato has retained its area in spite of variation in the climate.

V. TABLES

Table I: **Variability In Area, Production And Productivity Of Major Vegetables (2003-4 To 2012-13)**

Crops	CGR (%)			CV (%)		
	Area	Production	Productivity	Area	Production	Productivity
Brinjal	3.823	4.992	1.404	11.874	17.183	4.471
Onion	7.420	11.023	3.355	*22.781*	*30.443*	12.596
Peas	5.123	9.078	3.762	15.713	26.402	11.592
Cauliflower	5.529	5.887	0.340	16.466	17.617	2.108
Okra	4.925	7.236	2.202	14.847	22.513	7.559
Tomato	7.330	10.128	2.607	24.227	31.902	8.197
Potato	3.231	5.934	2.619	9.792	18.341	10.261

Table II: Correlation of area, production and productivity of major vegetables with rainfall

Crops	Area	Production	Productivity
Brinjal	-0.28784	-0.14123	-0.34483
Onion	-0.07576	-0.21825	-0.43063
Peas	-0.45821	-0.34435	-0.17104

Cauliflower	-0.32822	-0.39642	-0.69981
Okra	-0.32042	-0.26788	-0.1702
Tomato	-0.15691	-0.2366	-0.47885
Potato	-0.39357	-0.31288	-0.18563

Table III: Correlation Of Area, Production And Productivity Of Major Vegetables With Temperature

Crops	Temperature	Area	Production	Productivity
Brinjal	Min	0.0034	-0.0916	-0.2482
	Max	0.2482	0.1177	0.0928
Onion	Min	0.0034	-0.0916	-0.2482
	Max	0.1993	0.1843	0.1902
Peas	Min	-0.0895	-0.0165	0.1271
	Max	0.2575	0.2610	0.2839
Cauliflower	Min	-0.0138	-0.0852	-0.5235
	Max	0.2532	0.2209	-0.0954
Okra	Min	0.0003	-0.0264	-0.0377
	Max	0.2771	0.2362	0.1877
Tomato	Min	0.0628	-0.0105	-0.1611
	Max	0.2599	0.2383	0.2136
Potato	Min	0.0726	-0.0202	-0.0890
	Max	0.3549	0.2708	0.1569

Table IV:Replacement Of Area Under Different Vegetable

Crops	Brinjal	Peas	Okra	Tomato	Potato	Onion
Brinjal	0.0040	0.0000	0.2243	0.0000	0.7716	0.0000
Peas	0.4539	0.1670	0.3791	0.0000	0.0000	0.0000
Okra	0.4475	0.0000	0.0000	0.3635	0.0000	0.1891
Tomato	0.0550	0.0000	0.0000	0.7030	0.0000	0.2421
Potato	0.1223	0.0662	0.0282	0.0000	0.6893	0.0941
Onion	0.0000	0.1974	0.1467	0.0385	0.1070	0.5105

REFERENCES

[1] Anonymous,Statistics related to climate change –India, Ministry of Statistics and Programme Implementation,, 2013 Government of India, Central Statistical Office, Social Statistics Division, New Delhi.

[2] J .R . Arno,J. R Rosell,R.Balco, M. C . Ramos and J. AMartinez-Casanovas, Spatial Variability in Grape Yield and Quality Influenced by Soil and Crop Nutrition Characteristics. 13(3), 393-410 , 2012.

[3] Mahendra, singh and V.C.Mathur,Structural Changes in Horticultural Sector in India:Retrospect and Prospect for XIth Five year plan, Ind. Jn. of Agri. Econ., 63(3), 332-347,2008.

[4] Anonymous, 2013, Indian horticulture database, National Horticulture Board, Ministry of Agriculture, Government of India: 127-198.

[5] H. R. Keerthi, Production and marketing of pineapple in Shimoga district – an economic analysis. M.sc (Agri) Thesis,28-29, 2008, Univ. Agric. Sci., Dharwad (India).