IMPACT OF CLIMATE CHANGE ON THE PRODUCTION AND MARKETING OF MINOR CROPS IN PAKISTAN

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ABSTRACT: *Climate change impacts on minor crops of Pakistan during the last 10 years from 2005 to 2014. Thus, the secondary data were used, which were collected by Pakistan Economic Survey and Agrometeorological department of Pakistan. The different parameters were estimated, like: Perception, temperature, and their influence on production of minor crops (Gram, Mustard, Barley, Jowar and Bajra) grown in the country. Results revealed that if one ^0C above maximum average temperature increases, can increase about 88.759 thousand tons of gram, while increase by one ^0C minimum average temperature can bring declined about 86.3801 thousand tons; where if 1 mm maximum average rainfall may increase, will cause 30.429 thousand ton to dwindle in its production, while 1 mm minimum average rainfall may increase 67.277 thousand tons. Mustard is a rabi minor crop, results show that one ^0C temperature increase can decline the production of 0.232 thousand ton, while increase by one ^0C minimum average temperature can bring declined about 8.729 thousand tons; where if 1 mm maximum average rainfall may increase, will cause 5.246 thousand ton to increase in its production, while 1 mm minimum average rainfall may increase 1.690 thousand tons. The Barley in Pakistan is cultivated in Rabi season, results show that if one ^0C maximum temperature increases, which will reduce the production by 4.056 thousand tons; while one ^0C minimum average temperature can dwindle production by 9.795 thousand tons; on the other hands, one 1 mm maximum average rainfall will reduce 1.221 thousand ton increase, moreover 1 mm minimum average rainfall increase, which will 1.452 thousand tons decline. Results of Jowar crop shown that if one ^0C maximum average temperature increases, which will increase the production of 7.785 thousand tons; while one ^0C minimum average temperature may increases, which will decrease 24.153 thousand tons; while one 1 mm maximum average rainfall can increase 1.708 thousand tons, moreover one mm minimum average rainfall will be dwindle 2.978 thousand tons produce. In case of Bajra crop, if one ^0C maximum average temperature can reduce production by 18.724 thousand tons; while one ^0C minimum average temperature will increase production by 30.328 thousand tons, on the other hands, one 1 mm maximum average rainfall can reduce 4.232 thousand tons. Moreover, it reveals that one mm minimum average rainfall can increase 3.761 thousand tons of Bajra. While checking the reliability of the variables, it was found that R-square for gram, mustard, barley, jowar and bajra was about 0.687425, 0.754345, 0.736386, 0.749857 and 0.674584 respectively. Statistically, if the value of R^2 is greater than 0.5, the variables can be considered as good fit to the model.*

Key words: Climate change, Minor crops, Kharif Crops, Rabi Crops.

INTRODUCTION

Agriculture contributes more than 21 percent towards the GDP of Pakistan, produces creative occupation openings aimed at 45 percent of the labour force. In addition, 60 percent of the population, directly or indirectly, depends on this sector. Pakistan is unique of the furthermost overcrowded areas on the globe, while its food production/agriculture is fluctuating at greater scale [1]. Reasons for fluctuation have been deluged in the state through 2010 and dense rainfall in Pakistan for the duration of 2011 due to the climate change impediments. The country, these days' faces a series of threatening climate change effects: varying rainy season forms, melting of ice glaciers, periodic overflowing, increasing marine water heights, desertification, increasing water lack and earthquake. In 2010, Pakistan was recorded as per the figure single state in the worldwide affected by the environment connected adversities. Countryside laborers are changed their profession apart from agricultural work, tightening the worker in the bazaar related to agriculture in addition putting stress on farm earnings. Yet, necessity on farming remains unmoved among the countryside independent people, their average agriculture land size carry on to dwindled with the populace growing [2]. The preliminary studies carried out indicated that Pakistan's region and 49.6 percentage populace is at hazard due to the effect of climate variation 22.8 percentage.[3]. Pakistan is single of the furthermore at risk states to natural threats of the globe [4], and is visible to more than a few vulnerabilities for example deluges, volcanic activity, landslides and dearth, but deluges has been furthermost common matter causing immense injuries to lives and assets [5]. .

In Pakistan the performance of the agricultural sector (specially the minor's crops) is important in determining socio-economic outcomes for a large section of the population, the climate change impact on agriculture production, warming temperature decrease crop yield. The normal (1961-90) rain fall in monsoon period is 125 mm and is extremely flexible (85 mm) especially in te southern province (Sindh) of the country. The rainfall over Pakistan is a result of monsoon despairs forming in the "Bay of Bengal" and rarely moving westward into lower Sindh. Sometimes upper air vortex or trough strengthens over "North Arabian Sea" and moves inland, giving heavy shower and storm surge. Such climate situations become disastrous and cause heavy loss of lives and properties.[6] Minor crops, for example Gram, Mustard, Barley, Jowar and Bajra version for 25.6 percent of the worth additional in general in farming and 5.4 percent to GDP. The other crops version for 11.6 percent of the price extra in farming, While Livestock is minor parts of agriculture it contributes 55.9 percent to agrarian worth

added greatly additional than the joint involvement of minor and other crops (37.2) percent [7]. Thus, it is hypothesized that climate changes influence the agricultural produce in the country. Therefore, this research study has been designed to carry out the climate change impacts on production minor crops in Pakistan. Therefore, below objectives were studied in this research first: To study climate change (temperature and rainfall) situation in the country since last 10 years. Second: To appraise climate change impacts on minor crops in Pakistan since last 10 years, and last: To recommend policy prospects for the development of agriculture sector and its dependents (population and industry) in Pakistan [8] and [9]

The main focus of this study is to develop an econometric model to identify climate change impacts on production, of minor crops and following objectives were studied: To appraise the growth rate of minor crop production of Pakistan since last 10 years. To appraise climate change impacts on minor crops (Gram, Mustard, Barley, Jowar and Bajra) in Pakistan since last 10 years.

So this study is very beneficial for the climate change trends in Pakistan.

Methodology

The methodology is proposed to estimate a pooled data based on past 10 year from Pakistan. For the present study, secondary data were collected from various public and private sources, e.g. Pakistan Economic Survey, Pakistan Bureau of Statistics, Agrometeorological department of Sindh Pakistan and Social Science research Institute Tandojam.

Model specification:

The parameters from this estimation have been used along with data on projected rain fall, temperature and other natural vulnerability to calculate projected changes in gross cropped area, yield and production for minor crops. Thus, the growth performance was analyzed by using following model:

Growth rate model

$$g = \left(\frac{x_T}{x_t}\right)^{\frac{1}{T}} - 1$$

Where:

g = Average growth rate

X_t = Initial value of variable X

X_T = Final value of variable X

t = Base year

T = Final year

In order to investigate what changes occurred due to changes in weather, the regression results was used to interplead the impacts as follows:

Regression:

$$\mathbf{P = \beta_0 + \beta_1 Tm + \beta_2 Tn + \beta_3 Rm + \beta_4 Rn + \varepsilon}$$

Where: *Dependent variable*

P = Productivity of minor crops in the country.

Independent variable(s)

Tm. = Maximum mean average temperature

Tn. = Minimum mean average temperature

Rm. = Maximum mean average rainfall

Rn. = Minimum mean average rainfall

ε = error term, including other inputs.

$\beta_0, \beta 1, \beta 2, \beta 3, \& \beta_4$ re the parameters of the model.

The regression model will show that productivity level of minor crops to be a function of maximum average temperature, minimum average temperature, maximum average rainfall, minimum average rainfall and other parameters etc

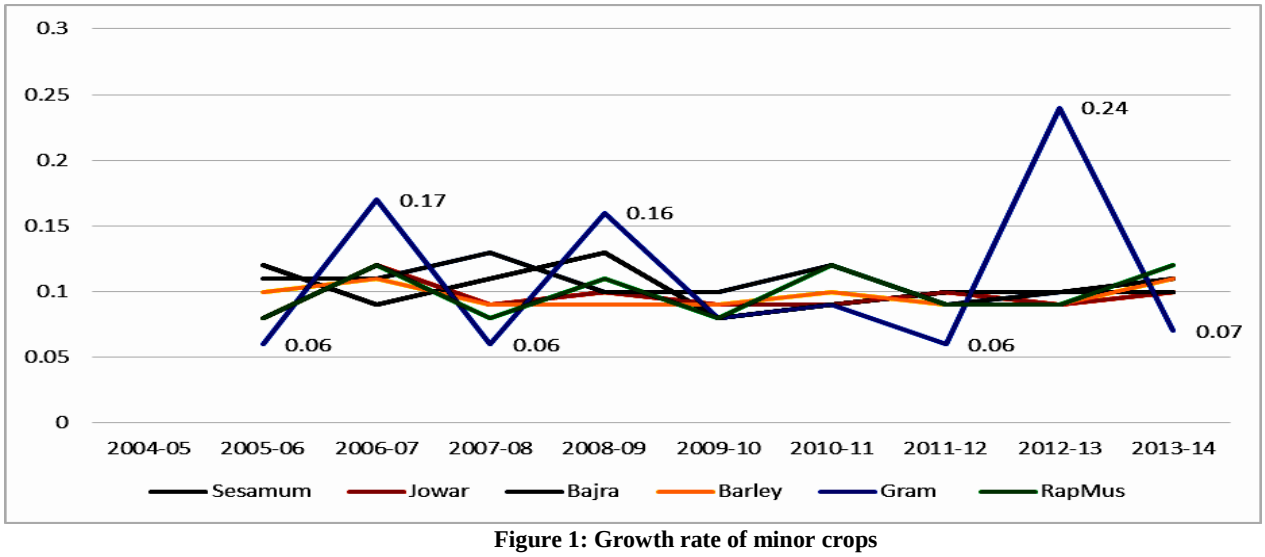

Figure 1: Growth rate of minor crops

Source: Author's calculation based on the data from Pakistan Economic Survey 2014.

Above figure shows the growth rate of minor crops from 2005-14, where it reveals that in 2006-14 all the crops have a positive growth rate (Sesamum, Jowar, Bajra, Gram, and Rap mustard), except the gram, where it reveals that only gram had high fluctuation. The gram growth rate grew from 0.06 to 0.17 during 2007, it also indicates that the growth rate was again declined, where again has been increased 0.16 during 2008-09. In the whole period of time from 2004-05 to 2013-14, the graph shows that the high fluctuation occurred during 2012-13.

Table 1: Multiple regression result with maximum and minimum mean averages of temperature and rainfall

Cropping season	Rabi			Kharif	
Crops	Gram (000) tons	Mustard (000) tons	Barley (000) tons	Jowar (000) tons	Bajra (000) tons
Intercept	-414.149	300.689	69.469	223.804	498.832
β_1 (max. temperature ^oC)	88.759	-0.232	4.056	7.785	-18.724
β_2 (min. temperature ^oC)	-86.3801	-8.729	-9.795	-24.153	30.328
β_3 (max. rainfall mm)	-30.429	5.246	1.221	1.708	-4.232
β_4(min. rainfall mm)	67.277	1.690	-1.452	-2.978	3.761
R-square	0.687425	0.754345	0.736386	0.749857	0.674584

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Suggestions

I. Climate knowledge should be shared at farm level i.e. about the change in rainfall and temperature patterns, shift in the tilling and harvesting timings.

II. Crop specific incentives to the farmer should be introduced i.e. by subsidizing heat resistant seeds, insecticides and pesticides.

III. Research and development in the fields of new crop varieties which are resistant to high temperature and high land moisture should be encouraged.

IV. Water management skills should be development in cases of flash floods or droughts

V. Disaster management strategies i.e. copping with extreme environmental conditions at farm level should be upgraded and improved.

VI. Importance of crop insurance policy, to safe guard farmer's future against climate risks, should be emphasized and implemented

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