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CLIMATE CHANGE: A BEACON TO DOMESTIC FAMINE

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ABSTRACT

The drops from heaven calculate each food grain for the Keralities. Kerala the land blessed with nature is a casino for agriculture. The economy depending on agriculture is highly fluctuating with the climate change. It imprints the impact on state revenue, Productive yield, and cost of production and reduction of welfare of its native. The increased temperature adversely affects the status of natural resources and the environment. Studies shows 1% increase in temperature reduces the yield up to 3% to 7%. This is a reason for productivity fluctuations and a possible beacon for an upcoming famine that Kerala might face. The researchers aim to analyze the impact of temperature variations and rainfall trends on agricultural productivity in the state of Kerala. The role of man in climate change is criticized in grounds of reduced production, pollution and repeated flood events. The researchers gather statistic on climate change and crops manufactured (viz. rice, coconut, pepper, cashew, cardamom, coffee, tea, arecanut, ginger, turmeric and banana) over years and uses descriptive design to find out patterns. The analysis lights evidence on productivity fluctuations caused by climate variability at the surface level. The paper also points out the causes and the mitigation measures for reducing this predicted manmade disaster.

***Key words**: climate change, domestic famine, mitigation measures, productivity*

INTRODUCTION

India is in desperate need to answer calls of climatic conditions, which also is the rising buzz of the save planet earth protests worldwide. India's greenhouse gas emissions as an industrialist is at peak and and in a steady hike with respect to the cater needs of a growing population. Fatal climate situations such as sea level rise, changes in pattern of monsoon, increased events of floods and storms, and severe droughts have started affecting the way of life of Indians in a way it wasn't before. Nature is demanding an adjustment from man's disrespectful and destructive behavior and else the very celestial existence of us threatened. Recently in South Region climate variability affects, floods & cyclones, has resulted in destruction of crops, property, infrastructure, disease outbreaks and loss of lives. All these on the other hand pull behind general socio-

ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

economic growth of the state. The livelihood of Indians are largely nature bounded, (the contribution of the primary sector holds 17% of the GDP) (CIA, 2018), and this makes Indians more sensitive to extreme of climatic conditions. Scientists projects earth's surface temperature to rise from 1.1^0c to 6.4^0 c over the next 100 years (Ramachandran R. 2015).

RESEARCH HYPOTHESIS

H_{A1}: There is significant and negative impact of annual temperature variation and agricultural productivity in the state.

H_{A2}: There is significant and positive relationship between average annual production of crops and average rainfall marked in the state.

METHODOLOGY

The researchers resort a descriptive design for this study which helps them describe the status quo of the subject studied. To study the influence of temperature and rainfall on productivity, the researchers took eleven crop's yields data for thirty years as sample and constructed a time series pool incorporating temperature variations and rainfall marked in the state for this period.

LITERATURE REVIEW

Temperature

The regional changes in climate of state Kerala cannot be explained by the lone factor of monotonic increase in country's CO2 emission levels (Mukhopadhyay, Partha, &Revi, Aromar, 2015). The last 30 years has marked a pattern-less change in minimum and maximum temperature levels marked in the state (the IMD data of 1989 to 2018 signifies this observation). The state being inclusive for a variety of crops has suffered due to this temperature falls and hikes that resulted in productivity falls (Saran, Shyam 2015). As a result some farmers in the high-range are even forced to switch to farm crops which otherwise only found in low-ranges of the state. The surface air temperature is increasing in both urban and rural areas, and is disproportional (Pulver, Simone 2015). This is because of the storage of heat in concrete buildings and roads in urban areas. Increased phase of urbanization and industrialization as pushed by population growth is accounted reason towards it.

Rainfall

The state reaps maximum advantage out of the summer monsoon (June to October). The changes in the sea surface level could significantly affect the volume of rain the summer monsoon could fetch (Srivastava, Nidhi 2015). The rainfall data of the last thirty years

ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

are indifferent in the total variability, but is significant in the maximum rainfall occurrence received in a single day time (Krishnakumar, K. N., Rao, G. P., & Gopakumar, C. S. 2009). The repeated flood incidents the state suffered during last years' could be cited as evidence for this observation. These dissimilar patterns in the rainfall have caused crops failure and are visible in the crops productivity data collected by the researcher.

THE FAMINE PHENOMENON: CLIMATE INDUCED AGRICULTURAL OUTPUT VARIABILITY

This section of the paper examines the science behind crop failure induced by climate conditions i.e. temperature and rainfall variability. In HH Mann's work on rainfall and famine he presents rainfall as the better predictor for maximum quality harvest and he coins the variable 'effective rainfall' for agricultural prosperity. He conceptualised situations of rainfall outside the growing season, scattered showers, rainfall in excess of 2 inches per day etc which are useless for agriculture and may result in crop failure. All these factors together determined the 'goodness' of the season (Heston 1983).

There are conceptual flows in rainfall that lack support famine and crop failure, such as; seed choice of farmers, drought, pesticides and fertilisers used, varieties of crops used etc. (Damodaran, Vinita 2015). The researchers here in this paper bracket all these secondary influences to keep the high notch over climatic conditions. States like Kerala, Tamilnadu, Rajasthan, Gujarat and NorthEastern parts have marked a hike in average temperature by 1° C (Bhagat, R. B. (2017)

In the densely populated South Asian region climate variability do possesses greater significance as it potentially might lead to the risk of hunger and starvation (Lal, Rattan 2018). Agricultural land encroachment caused by rapid population hike is addressed by nations. Poor farmers cannot afford costly means of protection against crop failure such as insurance (Strachey, R. 2017). High cost of such actions further deepens the loss of suffered by farmers.

In continuation to the introduction to climate variability, rainfall changes, temperature rising and famine; the researchers further concentrates discussion on the climate variability and its impact upon agriculture productivity in state of Kerala specific.

Rooted from 1950s the state suffers steadily increasing climatic situations, like variability in extreme cold and hot temperatures, and unpredictability of rain cycle (IPCC 2014). Evidences of man's footprints are visible in all the causes that led to these drastic situations, researchers has mutual consent on the view that repeated food

ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

occurrences in Kerala are evidence to it. Annual monsoon fall in rates of the state is duly affected by the industrial emissions, deforestation and change in farming trends of the state.

DATA AND RESULTS

Kerala's eleven major crops (viz. rice, coconut, pepper, cashew, cardamom, coffee, tea, arecanut, ginger, turmeric and banana) annual production data in for the years -2018 constitute the sample for analysis. The researcher has has collected data on annual average temperature and annual rainfall data in the state during the same period. Further the researchers used statistical packages of STATA and SPSS to clean and process data.

The preliminary analysis showed the average annual production of selected crops and annual rainfall data adheres the assumption of normality (K-S test significant at .200 & .208 for average annual production, and for K-S test significant at 0.200 &0.438 for annual rainfall. For annual average temperature the K–S test for normality tends (significant at .000 and .001) to accept the null at the variable being not normal.

A Spearman product correlation coefficient was conducted to evaluate the Ho_1 that there is no significant relationship between average annual production of crops and average temperature marked in the state.

The null is rejected in favor of alternative that; as annual temperature rises the productivity of crops falls, that there exists a considerable negative correlation between the variables analyzed (spearman's rho -.370* significant at .041 <0.05 one tailed (spearman rho chosen as the KS test accepts Ho) N 30). The descriptive reports; mean annual production to be 190178.31 with 10666.52 SD and mean annual temperature to be 25.52° C with 0.556 SD.

(The following software outputs indicate the above mentioned

Table No 1: Descriptive statistics of average annual production and average temperature

Descriptive Statistics	Mean	Std. Deviation	N
av_anual_prdct	190178.3083	10666.51987	30
average temperature in year	25.5126	.55641	30

Source: www.data.gov.in, www.ras.org.in, www.ecostat.kerala.gov.in

Table No 2: Spearman product correlation of average annual production and average temperature

ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

Correlations			av_anual_prdct	avaerage temperature in year
Spearman's rho	av_anual_prdct	Correlation Coefficient	1.000	-.370*
		Sig. (1-tailed)	.	.041
	avaerage temperature in year	Correlation Coefficient	-.370*	1.000
		Sig. (1-tailed)	.041	.

*. Correlation is significant at the 0.05 level (1-tailed).) Source: www.data.gov.in, www.ras.org.in, www.ecostat.kerala.gov.in

Further a linear regression of the two variables was conducted to ascertain how annual average temperature signifies the annual crops produced, and results showed that the model to be insignificant at 0.111>0.10 of F 2.761, eventhough the temperature variation explained 12% variation in annual crops manufactured (R-squared at 0.116). (considering the significance level share border to ascertained value)

Table No 3: Causal relationship between average annual production and average temperature

Linear regression

lnav_ann_prdct	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
av_temp	-0.035	0.021	-1.66	0.111	-0.079	0.009	
Constant	13.054	0.542	24.11	0.000	11.928	14.180	***

Mean dependent var	12.154	SD dependent var	0.058
R-squared	0.116	Number of obs	30.000
F-test	2.761	Prob> F	0.111
Akaike crit. (AIC)	-65.923	Bayesian crit. (BIC)	-63.652

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: www.data.gov.in, www.ras.org.in, www.ecostat.kerala.gov.in

As annual rainfall data found met parametric assumptions; a Pearson correlation test was conducted to evaluate the Ho_2 that there is no significant relationship between average annual production of crops and average rainfall marked in the state. Here the null is accepted as; annual rainfall rises and productivity of crops hikes, that there exists a positive correlation between the variables (Pearson Correlation coefficient .328 being .064>0.05 one tailed, N 30). The descriptive reports mean annual rainfall to be 26226.43mm with 4393.7 SD.

(The following software outputs indicate the above mentioned

Table No 4: Descriptive statistics of average annual production and average rainfall.

ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

Descriptive Statistics	Mean	Std. Deviation	N
av_anual_prdct	190178.3083	10666.51987	30
Annual rainfall (in 10th of mm) 1996-2018	26226.43	4393.700	30

Source: www.data.gov.in, www.ras.org.in, www.ecostat.kerala.gov.in

Table No 5: Pearson product-moment correlation between average annual production and average rainfall.

Correlations		av_anual_prdct	Annual rainfall (in 10th of mm) 1989-2018
av_anual_prdct	Pearson Correlation	1	.328
	Sig. 1-tailed)		.064
Annual rainfall (in 10th of mm) 1996-2018	Pearson Correlation	.328	1
	Sig. (1-tailed)	.064	

Source: www.data.gov.in, www.ras.org.in, www.ecostat.kerala.gov.in

DISCUSSION & FINDINGS

For establishing a robust significance of climate impact on agricultural productivity in Kerala, on future endeavours, the researchers needs to include more variables such as minimum temperature, maximum temperature, seasonal rainfall changes etc. for a larger time frame or even on monthly wise, as the regressed model in the paper were not able to explain productivity variation (R squared at 0.175, F 2.125 insignificant at 0.146>0.10) composite by the variables average temperature and rainfall. Further a district wise analysis is expected to yield a high explanation hence geographical concentration of crops is found in the state.

The unexplained variation in the model are due to variables not included to the model such as seeds used, labours employed, govt assistance received, irrigation quality, seasonal variations, pesticides use and intervals etc. In Kerala these play a high impact, labour for instance; high cost and availability of domestic labour are common issues farmers face. These form opportunity for future researches to be based on.

The trends in the climatic change are establishing disaster patterns in the state like repeated floods. These unfavourable conditions will lead to a possible food crisis in the state and the state's burden on the imports will rise. In this regard; to meet this threat the state need to initiate some adaptation and mitigation measures following footsteps of nations who established environmental standards or developing own standards and norms, also made part of law making. In par with, the individual practices also need to

ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

be directed to be focused towards need for environmental protection as a cover against climate change.

MITIGATION MEASURES

Mitigation measures helps to develop the society and be more resilient to the threat of climate change. As European Union has adopted Green Direct Payment under CAP (Common Agricultural Policy), grants are provided for the practice which ensures environmental benefit on ecological focus area. India too has entered Green Box club with the launch of PM- KISAN scheme where there is a shift from price support to income support.

Popularity and implementation of Integrated Farming System (IFS): It reduces the cost and to promote greater cultivation. The farmer under such system will be able to earn income after few years. Civil society organizations and NGOs should initiate to promote IFS.

Mixed cropping, mulching, ridges and furrows, tillage and stop burning the residues are some of other measures to reduce the emission of nitrous oxide and carbon dioxide into the atmosphere.

Popularization of agro foresting also helps to reduce carbon dioxide in 3 levels: carbon sequestration, carbon conservation and carbon substitution.

The excessive use of chemical fertilizers for continued season is also a major constituent for climatic changes. This needs to be addressed by promoting organic farming and legalizing its provisions under state judiciary.

CONCLUSION

Recognizing economic growth is essential to poverty alleviation; researchers adapt the lens of toxic free/ cement free development patterns. Increased construction of buildings, induced by rapid industrialization and population growth, will cause hike in surface temperature, change in rainfall patterns and will ultimately result in agricultural yield in the state of Kerala. In par with the development objectives of NitiAyog the state government is liable to invest in construction of additional buildings and roads whch would require shaping toxics, burning fuels in transit and generation tonnes of non-degradable waste which would ultimately be dumped and will affect the fertility of soil and reduce the area of total cultivable land. The causes and hazards of pre-mentioned threat to society are already over discussed and literature and study reports are available in abundance. But apart from discussions actions are not found soon authorities need to

ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

face a threshold where these threats need to addressed in a nature friendly way. As step towards that government need to invest in startups fostering in eco friendly constructions (which already are available worldwide and needs R&D in commercializing) and innovative farming techniques adoptions including development of more immune seeds.

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ISSN: 2278-4632
Vol-10 Issue-5 No. 8 May 2020

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