

Impact of Climate Change on Agriculture and Indian Economy: A Quantitative Research Perspective from 1980 to 2016

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Abstract

This study examines effect of climatic change on Indian economy from 1980-2016 and made use of quantitative research design and secondary on climate change variables, GDP and population of India from 1980-2016. The data was gotten from World bank data base and data.gov.in. E-views 9.0 and SPSS 22.0 was used for data analysis and statistical methods such as Multiple Regression Analysis and Pearson Correlation was tested to examine the influence of climate variables on economic growth of India. The finding of the study shows that climatic change variables (rainfall and temperature) with population jointly influenced economic growth of India while independently, rainfall and population influenced economic growth of India and temperature was not significant. Also, a significant positive relationship within population and GDP was recorded and a negative correlation between temperature was also recorded. It was concluded in this study that climatic change has significant effect on economic growth of India, since substantial increase in temperature and rainfall could help in agricultural production which may in turn contribute to economic growth.

Keywords: Climate change; Economy; GDP; Climate; Temperature; Rainfall

Introduction

A vital aspect of current policy of the world has to do with combating the hazardous effect of climate change on ecosystem. Concerns for climate change have gained the interest of nations across the globe mainly due to the fact that it is a consequence of human activities [1,2]. The climate of Earth is ever evolving. Nevertheless, during the past century, the climate of Earth climate witnessed a drastic change. The earth's temperature has increased significantly with immediate negative impacts across board. Somewhat, the issues of climate change can be attributed to human activities particularly in the areas of industrialization and industry [3].

The Climate Change Framework of UN Convention (UNFCCC) (1992) that offers a plan to members in order to tackle factors responsible for such changes, states that "climate change which is ascribed directly or indirectly to activities of human beings which have negative effect on the structure of the universal atmosphere as well as inconsistency in natural climate and which is in addition to natural climate variability examined over a substantial period of time". Succinctly, climate change, also known as global warming refers to a surge of universal mean temperatures which will have significant negative impacts on global environment. The undue exploitation of natural resources and high rate of environmental pollution have prompted its hazardous effect on individuals' lives. Increase of global mean temperatures might likewise negatively influence the present circumstance of human health and safety [4,5].

Puthucherry [6] reported that South Asia is one of the main locations which will be affected by global warming severely within the next few years, especially India largely as a result of its different terrain. Global warming is expected to affect this region severely since the nation is swiftly depleting its mineral resources and as a result destroying its ecosystem mainly because of urbanization, numerous industrial activities and economic development. India is encountering socio-economic and climatic challenges in its plan to safeguard its rapid exhausting mineral resources [7]. Air as well as quality of water is deteriorating everyday as a result of rise in different forms of pollutants in the atmosphere. Also, the regions that will experience peak exposure to global warming are the nation's seaside eco-systems, agricultural

production as well as biodiversity. Unfortunately, these regions have already encountered natural disasters like Uttarakhand floods-landslides in 2013, Chennai flood in 2015, and drought in 2016. There are also reported cases of intense rainfall, heat waves and long-term dry spells.

Furthermore, the adverse effects of global warming are not equally experience globally. The impoverished nations and individuals primarily experience the negative effects of global warming and will feel the effects the most because of their vulnerability to the adverse effect of rise in sea level, water supplies, environments, food cultivation, fish farming and human wellbeing in general [8]. In a bid to enhance the growth of the economy as well as alleviate poverty, rising economy nations must diversify their economy and make life better for the people. As they engage in such activities, emissions of GHG will increase and ultimately lead to climatic change. Hence, this paper focuses on climate change and its effects on economy of India.

Statement of Problem

In a bid to make life better, human beings engage in some economic activities that deplete the ozone layer thereby exposing the world to global warming. Such activities include urbanization, industrialization, air pollution, inappropriate disposal of toxic waste, oil spillage, etc. Nevertheless, the adverse effect of global warming is inequitable across nations of the world. It is assumed that the industrialized nations that contributed immensely to emissions of GHG are less vulnerable to its adverse effects compared to the less industrialized nations who are mostly at the receiving end. This makes global warming a serious

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concern for economy of the world. This paper examines climate change and its effects on economy of India.

Objectives of the study

The objectives of this study are as follows:

1. To determine climatic change effect on economy of India.
2. To examine the trend in climatic condition of India.
3. To examine the effect of climatic change and Population on Indian economy.

Hypothesis: Climatic change will have no significant impact on economy of India

Literature Review

As a result climate change, some sectors of the economy might experience rapid growth when compared to the others and along with improving the dimension as well as constituents of various nations' GDP could become more diversified. Climatic changes also have negative effects on the lasting growth prospective of the country. Additionally, effects of climatic change are not the same across nations; Lucas, et al. [9] reported that agriculture sector, coastal areas and aged population suffer the most than others.

Based on the report of Stern, et al. [8], within subsequent fifty years, temperatures of the world are estimated to increase by 2°C to 3°C which could have adverse effect on growth of economy because it could affect quality of water, human wellbeing as well food production. It was also projected that almost 5 per cent of the world's GDP annually would be destroyed by these adverse impacts. Parry, et al. [10] estimated reduction in snow cover as well glaciers which could result into water scarcity. Peradventure global mean temperature rises by 1.5-2.5°C then almost 20-30 per cent of flora and fauna species might go into extinction [11].

According to Hitz and Smith [12] there exists a strong relationship between economic development and energy consumption. Consumption of energy leads to upsurge in greenhouse gas (GHG) emissions. Assessments show that about three-quarters of all CO₂ emissions are from industrialized nations. This finding shows that economic development is influenced by energy consumption that results in environmental degradation. In this present age, ever-increasing emissions of GHGs in developing nations, specifically in an emerging economy like as India have increased the attention given to the impact of climate change on economic development. Hope [13] opined that climate change might have some temporary positive impacts in some developed economies, but would become detrimental over a period of time.

Pindyck [14] reported that the adverse impact of temperature changes on GDP is determined by theoretical and empirical indicators. Mendelshon, et al. opined that most of the developing nations depend profoundly, for their economies, on agriculture. However, in view of the fact many of them are located within lower attitudes, therefore, they become vulnerable to climatic change in temperature. This accentuates the idea that low attitude regions experience excessive heat which is not appropriate for many of agricultural production; an increase in temperature could reduce agricultural productivity [15].

Gornall, et al. [16] reported that an increasing temperature can have substantial impact on agricultural production, farm earnings as well as security of food. Effect of climatic change varies across temperate

and humid regions. Within middle and high regions, agricultural production is expected to increase and spread out towards north; however, the contrary occurs in many nations of humid regions. The researchers reported an increase of 2°C in temperature within middle and high locations would boost cultivation of wheat with almost ten per cent whereas in lower regions, it would diminish [17].

Ebkom and Dahlberg [18] found that there are links among industrial development, ecosystems and climate change, and some difficulties associated with them. Concerning economic development, the ecosystems play two vital functions. Firstly, it makes raw materials available for manufacturing of goods as well as services. Also, it operates like basin for pollution agents that are manufactured from various production activities within the economy. In addition, ecosystems are likened to storage location for toxic and solid waste.

Mahfuz [19] discovered that due to hazardous climatic change in Southern part of Asia, effect of climatic change are affecting the economy, with the region having a tendency of diminishing their GDP to 8.8 per cent by year 2100. Likewise, he emphasized that nation within the location need to take appropriate steps in order to adjust to climatic changes so as to escape economic problems [20].

Methodology

This study made use of quantitative research design and secondary on climate change variables, GDP and population of India from 1980-2016. The data was gotten from World Bank data base and data.gov.in. E-views 9.0 and SPSS 22.0 was used for data analysis and statistical methods such as Multiple Regression Analysis and Pearson Correlation was tested to examine the influence of climate variables on economic growth of India. The dependent variable is GDP while independent variables are rainfall, temperature and population.

Data Analysis

Table 1 shows that GDP has the highest mean (2.724 ± 0.354) followed by Rainfall with (1.9367 ± 0.0361) and Temperature with (1.5530 ± 0.255) and population with (1.484 ± 1.5580). Graphs of variables are given in Figure 1.

Effect of Climatic Change Variables on Growth of Economy

Multiple regression of temperature, rainfall as well as population on GDP

Results of the analysis shows that temperature, rainfall and population significantly jointly influenced GDP [(R²=0.747; F

	LOGGDP	LOGPOPULATION	LOGRAINFALL	LOGTEMP
Mean	2.724054	1.484324	1.936757	1.552973
Median	2.620000	2.040000	1.930000	1.390000
Maximum	3.360000	3.120000	2.000000	2.000000
Minimum	2.260000	-0.160000	1.860000	1.380000
Std. Dev.	0.354216	1.558007	0.036137	0.255004
Skewness	0.506564	-0.003011	0.073202	0.910481
Kurtosis	1.850489	1.045889	2.246106	1.867098
Jarque-Bera	3.619530	5.886987	0.909260	7.090692
Probability	0.163693	0.052681	0.634683	0.028859
Sum	100.7900	54.92000	71.66000	57.46000
Sum Sq. Dev.	4.516892	87.38591	0.047011	2.340973
Observations	37	37	37	37

Table 1: Descriptive Statistics.

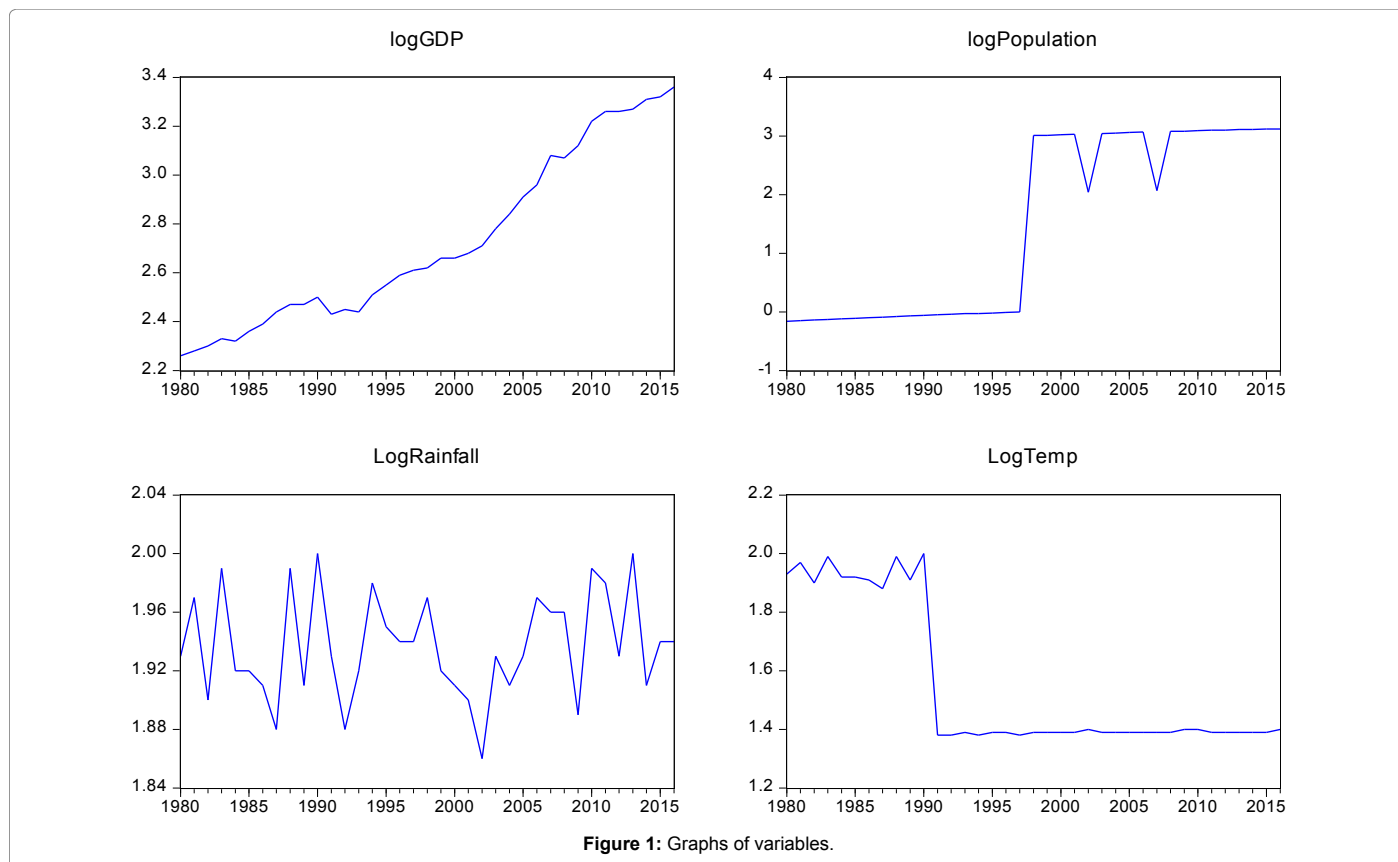


Figure 1: Graphs of variables.

Model	R	R ²	Adjusted R ²	Std. Error
1	0.864	0.747	0.724	0.18596

Predictors: logPopulation, logRainfall, logTemp.

Table 2: Model summary.

Model	SS	df	MS	F	Sig.
Regression	3.376	3	1.125	32.540	0.000
Residual	1.141	33	0.035		
Total	4.517	36			

Predictors: logPopulation, logRainfall, logTemp.

Dependent Variable: logGDP.

Table 3: ANOVA Result.

(3.36)=32.540; $p < 0.000$]. This infers that rainfall, temperature and population jointly accounted for about 74.7% of the variance observable in GDP. Further, the independent contribution of rainfall was significant ($\beta = 0.174$; $t = 1.964$; $p < 0.000$) and population was significant ($\beta = 0.718$; $t = 6.097$; $p < 0.000$) while temperature was not significant ($\beta = -0.177$; $t = -1.498$; $p > 0.000$). This implies that rainfall, temperature and population jointly contribute to economic growth of India while independently; rainfall and population significantly influenced economic growth while temperature did not influenced economic growth (Tables 2-5).

Correlation result shows a strong significant positive relationship within population and GDP ($r = 0.840$), and a negative relationship within temperature and GDP ($r = -0.639$) while there was no correlation between Rainfall and GDP. Also, Population was positively significant while Temperature was negatively significant [21,22].

Model		Unstandardized Coeff.		Standardized Coeff.	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-0.412	1.653		-0.249	0.805
	logTemp	-0.245	0.164	-0.177	-1.498	0.144
	logRainfall	1.691	0.861	0.174	1.964	0.058
	logPopulation	0.163	0.027	0.718	6.097	0.000

Dependent Variable: logGDP.

Table 4: Independent effect.

		logGDP	logTemp	logRainfall	logPopulation
logGDP	Pearson Correlation	1	-0.639	0.181	0.840
	Sig. (2-tailed)		0.000	0.283	0.000
	N	37	37	37	37
logTemp	Pearson Correlation	-0.639	1	0.080	-0.664
	Sig. (2-tailed)	0.000		0.640	0.000
	N	37	37	37	37
logRainfall	Pearson Correlation	0.181	0.080	1	0.030
	Sig. (2-tailed)	0.283	0.640		0.858
	N	37	37	37	37
logPopulation	Pearson Correlation	0.840	-0.664	0.030	1
	Sig. (2-tailed)	0.000	0.000	0.858	
	N	37	37	37	37

Table 5: Correlation matrix of variables.

Conclusion

This study examines effect of climatic change on Indian economy from 1980-2016. The result of the multiple regression analysis shows that climatic change variables (rainfall and temperature) with population jointly influenced economic growth of India while independently, rainfall and population n influenced economic growth of India and temperature was not significant. This finding supports Hope (2006) who opined that climate change might have some temporary positive impacts in some developed economies, but would become detrimental over a period of time. Also, Pindyck reported that the adverse impact of temperature changes on GDP is determined by theoretical and empirical indicators.

Also, the result of the correlation analysis shows a significant positive relationship within population and GDP, a negative correlation between temperature and while there was no correlation between Rainfall and GDP. This finding agrees with Gornall et al. who reported that an increasing temperature can have substantial impact on agricultural production, farm earnings as well as security of food. Therefore, it is concluded in this study that climatic change has significant effect on economic growth of India, since substantial increase in temperature and rainfall could help in agricultural production which may in turn contribute to economic growth.

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