International Journal of Agriculture and Environmental Research

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

IMPACT OF CARBON DIOXIDE EMISSIONS ON ECONOMIC GROWTH AMONG DIFFERENT REGIONS OF WORLD

[1]Sana Iftikhar, [2]Muhammad Abdul Quddus

[1]PhD Scholar, Department of Economics.,
National College of Business Administration & Economics, Lahore

[2]Head of Department, Department of Economics,
National College of Business Administration & Economics, Lahore

DOI: 10.46609/IJAER.2020.v06i01.006 **URL:** https://doi.org/10.46609/IJAER.2020.v06i01.006

ABSTRACT

Global climate change is a change in the long-term weather patterns that characterize the regions of the world. In the long run, the climatic change could affect agriculture in several ways such as quantity and quality of crops in terms of productivity and growth rate. This study investigates the impact of climate change, cereal production and economic growth in East Asia & Pacific, Latin America & Caribbean, Europe & Central Asia and Sub-Saharan Africa. The study employed the variables are carbon dioxide emissions, cereal production and GDP growth rate. The results show that climate change and economic growth is positively related East Asia & Pacific and Europe & Central Asia, while economic growth and climate change are negatively related in case of Latin America & Caribbean and Sub-Saharan Africa. There is need to overcome the problem of climate change in the form of carbon dioxide emissions both in Latin America & Caribbean and Sub-Saharan Africa.

Keywords: climate change, agricultural production, economic growth, East Asia & Pacific, Latin America & Caribbean, Europe & Central Asia, Sub-Saharan Africa

1. INTRODUCTION

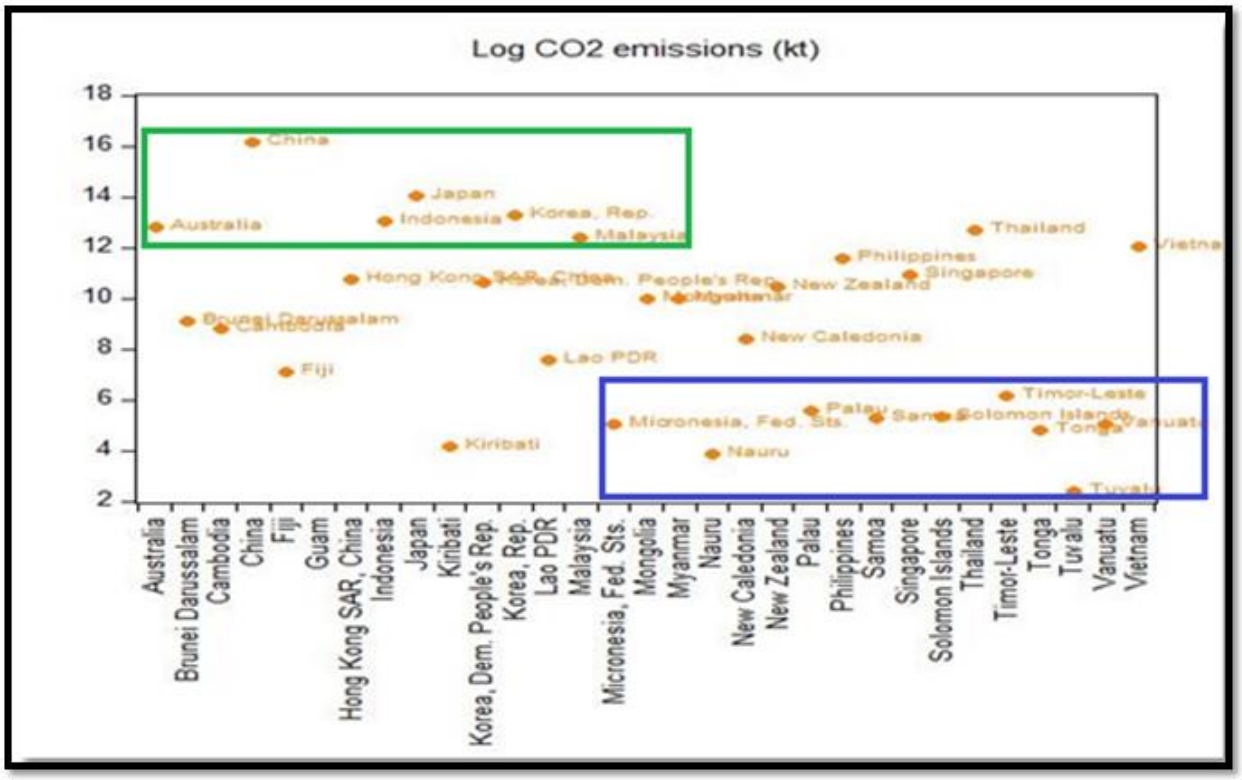
Today it is believed that the accumulation of carbon dioxide and other greenhouse gases will lead to global warming and other significant climatic changes over the next century and beyond. The last 100 years have shown an increase in global mean surface temperature of 0.4 to 0.8°C. Simulations for the coming 100 years show an increase in global mean surface temperature ranging from 1.4 to 5.8°C, while the atmospheric CO_2 concentration is more than twice the pre industrial level (IPCC, 2001). Global warming is widely seen as one of the most serious

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

environmental problem. It affects not only ecosystems by altering the composition of the vegetation as well as plant, animal diversity and human health, but also economies through a variety of channels, such as water resources, agriculture, energy and tourism. Tackling the problem of future climate change is one of the most challenging issues of this century and has major implications for policies of development and environmental management.

Figure 1: Situation of Carbon Dioxide Emission (kt) in East Asia and Pacific Region.



Source: Author's Estimation

Figure-1 shows the situation of carbon dioxide emission of East Asia and Pacific, China, Japan, Australia, Indonesia, Korea and Malaysia are found in the higher rank with highest values. Timor-Leste, Palay, Tonga, Nauru and Tuvalu are found in the lower rank with low values of carbon dioxide emissions. Figure-2 shows the situation of carbon dioxide emission of Latin America & Caribbean, Brazil, Mexico and Argentina are found in the higher rank with highest values. Bahamas, Barbados and Antigua & Barbudas are found in the lower rank with low values of carbon dioxide emissions.

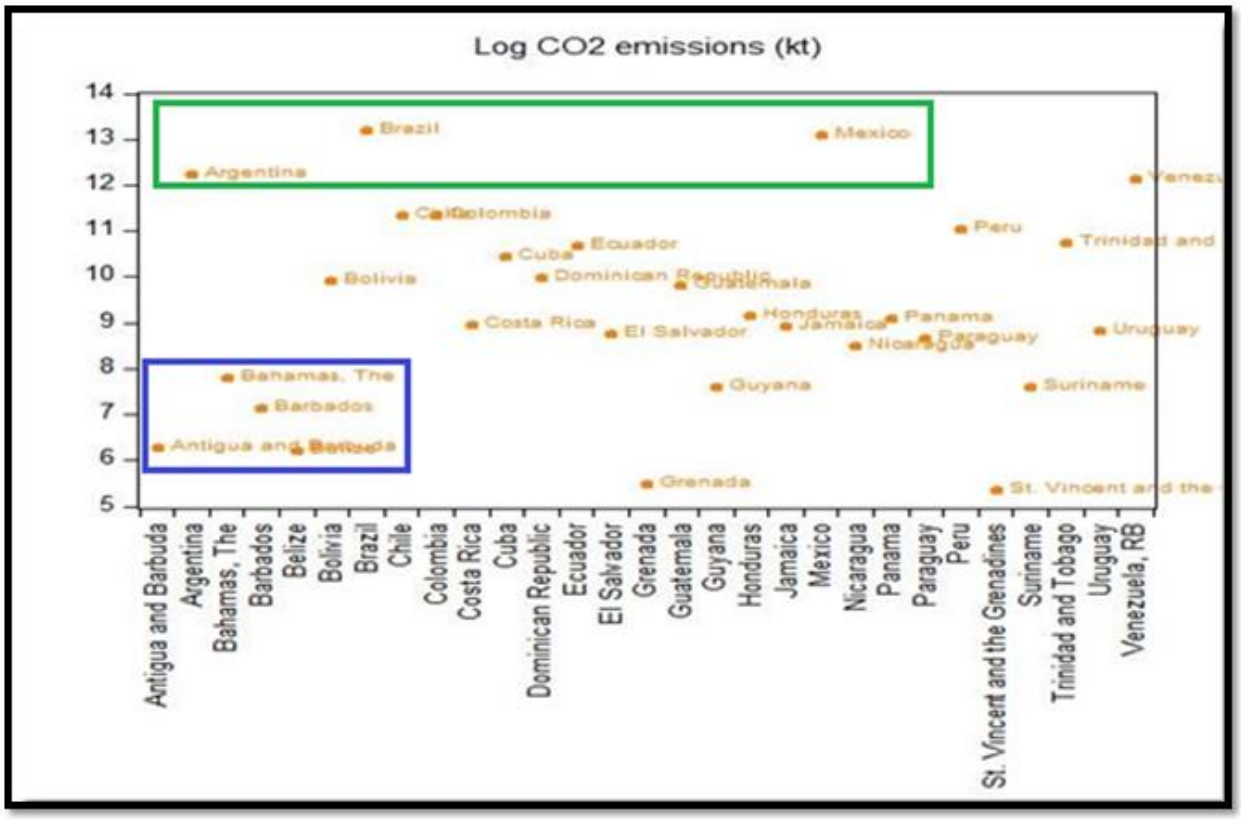
Figure-3 shows the situation of carbon dioxide emission of Europe and Central Asia, Russian Federation, Germany, France, Italy, Kazakhistan, Poland, Spain, Turky, United Kindom and

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Ukrain are found in the higher rank with highest values. Cyprus, Georgia, Lithuania, Stovenia, Moldova, Montenegro and Tajikistan are found in the lower rank with low values of carbon dioxide emissions. Figure-4 shows the situation of carbon dioxide emission of Europe and Central Asia, Russian Federation, Germany, France, Italy, Kazakhistan, Poland, Spain, Turky, United Kindom and Ukrain are found in the higher rank with highest values. Cyprus, Georgia, Lithuania, Stovenia, Moldova, Montenegro and Tajikistan are found in the lower rank with low values of carbon dioxide emissions.

Figure 2: Situation of Carbon Dioxide Emission (kt) in Latin America and Caribbean.

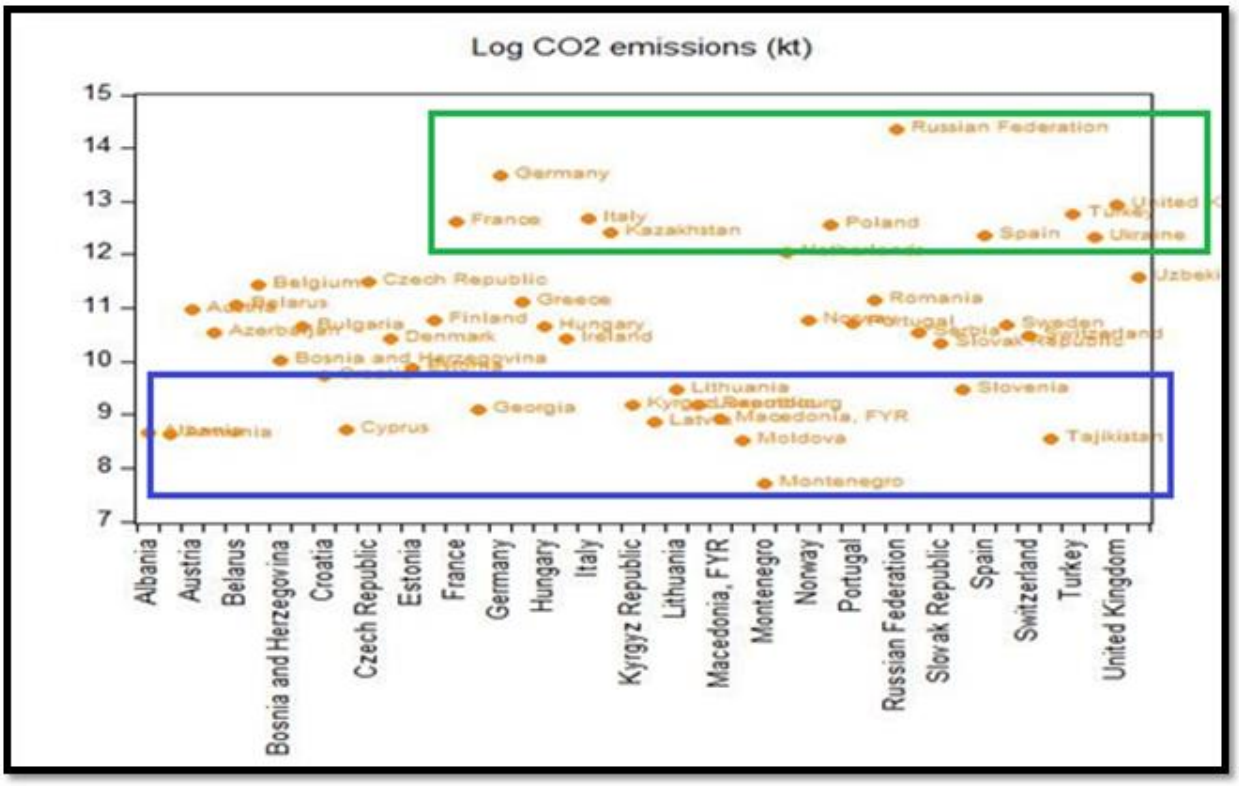


Source: Author's Estimation

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Figure 3: Situation of Carbon Dioxide Emission (kt) in Europe and Central Asia Region.



Source: Author's Estimation

Figure-4 shows the situation of carbon dioxide emission of Europe and Central Asia, Russian Federation, Germany, France, Italy, Kazakhistan, Poland, Spain, Turky, United Kindom and Ukrain are found in the higher rank with highest values. Cyprus, Georgia, Lithuania, Stovenia, Moldova, Montenegro and Tajikistan are found in the lower rank with low values of carbon dioxide emissions.

The main purpose of this study is to empirically investigate the relationship between CO_2 emissions, cereal production and economic growth of East Asia & Pacific, Latin America & Caribbean, Europe & Central Asia and Sub-Saharan Africa. World Bank has divided the world into these groups based upon the regions and climatic situations. Among them we select the four groups of countries. To the best of our knowledge, there has been no study that tried to estimate these variables for East Asia & Pacific, Latin America & Caribbean, Europe & Central Asia and

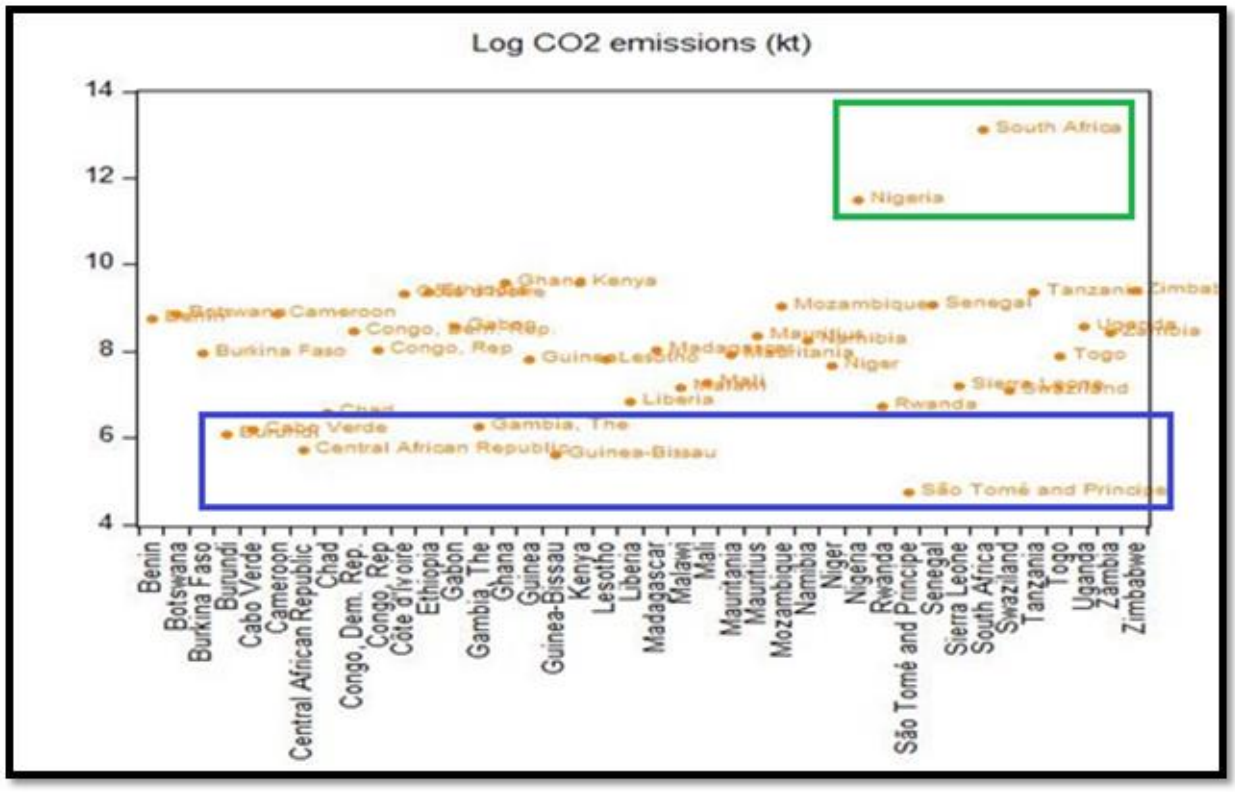
ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Sub-Saharan Africa through linear equation modeling for the year 2014. The paper is organized in the following manners;

- Section-2: Literature review containing predictions and findings.
- Section-3: Material and Methodology.
- Section-4: Econometric Analysis.
- Section-5: Conclusion along with Policy recommendations.

Figure 4: Situation of Carbon Dioxide Emission (kt) in Sub-Saharan Africa Region.



Source: Author's Estimation

Figure-4 shows the situation of carbon dioxide emission of Europe and Central Asia, Russian Federation, Germany, France, Italy, Kazakhistan, Poland, Spain, Turky, United Kindom and Ukrain are found in the higher rank with highest values. Cyprus, Georgia, Lithuania, Stovenia, Moldova, Montenegro and Tajikistan are found in the lower rank with low values of carbon dioxide emissions.

The main purpose of this study is to empirically investigate the relationship between CO_2 emissions, cereal production and economic growth of East Asia & Pacific, Latin America &

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Caribbean, Europe & Central Asia and Sub-Saharan Africa. World Bank has divided the world into these groups based upon the regions and climatic situations. Among them we select the four groups of countries. To the best of our knowledge, there has been no study that tried to estimate these variables for East Asia & Pacific, Latin America & Caribbean, Europe & Central Asia and Sub-Saharan Africa through linear equation modeling for the year 2014. The paper is organized in the following manners;

- Section-2: Literature review containing predictions and findings.
- Section-3: Material and Methodology.
- Section-4: Econometric Analysis.
- Section-5: Conclusion along with Policy recommendations.

1.1 Objectives

Following are the proposed objectives:

- To investigate the effect of climate change and agricultural production on economic growth in East Asia and Pacific.
- To investigate the effect of climate change and agricultural production on economic growth in Europe and Central Asia.
- To investigate the effect of climate change and agricultural production on economic growth in Latin America and Caribbean.
- To investigate the effect of climate change and agricultural production on economic growth in Sub-Saharan Africa.
- To provide policy implications.

2. LITERATURE REVIEW

Following are some research work which has done to see the issue of climate change and its affected dimensions. By examining the literature in perspective to the studied topic help to displaying the consequences of unsure climate shocks on agricultural efficiency.

Table 1: Predictions and findings in existing literature.

STUDY	PREDICTION AND FINDING
Dell, et al. (2008)	Increase in temperature leads to increase in economic growth in case of poor countries.
Janjua, et al. (2010)	Climate change has negative effect on wheat production.

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Shakoor, et al. (2011)	Temperature has negative impact on agriculture production.
Siddiqui, et al. 2012	Both in short and in long term the impact of climate change on wheat productivity is non-negative, while the impact of climate change is negative for Rice, Cotton and Sugarcane.
Akram, (2012)	Economic growth is negatively affected by changes in temperature, precipitation and population growth whereas urbanization and human development stimulates economic growth.
Tariq, et al. 2014	In the irrigated region, rising maximum temperature during January and November has negative effect, whereas variables such as wheat area, minimum temperature during November and March are positively related with wheat production.
Tebaldi and Beaudin (2015)	Real GDP growth rate decreased by 0.92% in the direct result of spring droughts in Northeast region
Jammazi & Aloui, (2015)	The results pointed out the existence of bilateral causal effects between EC and EG while only a unidirectional relationship was found from EC to CO2 emissions.
Afzal, Ahmed & Ahmed (2016)	Temperature effects the wheat production negatively at flowering stage while rainfall effects the wheat production negatively at every stage.
Qureshi, et al. (2016)	CO_2 emissions is positively and energy sources is negatively related wit agricultural value added. Greenhouse gas emission severely affected the agricultural production which includes cotton production, rice production and wheat production.
Arshad, et al. (2016)	Comparing variation in observed climatic parameters in the year of study to medium-term patterns, rice, and wheat yields were both negatively affected, indicative of production risk and of farmers' limited capacity for within-season adaptation (South Asia)
Bayramoglu and Yildirim (2017)	They concluded that energy saving policies such as technological progress and organizational rearrangements may have the booster effect for impact of the positive component of energy consumption.

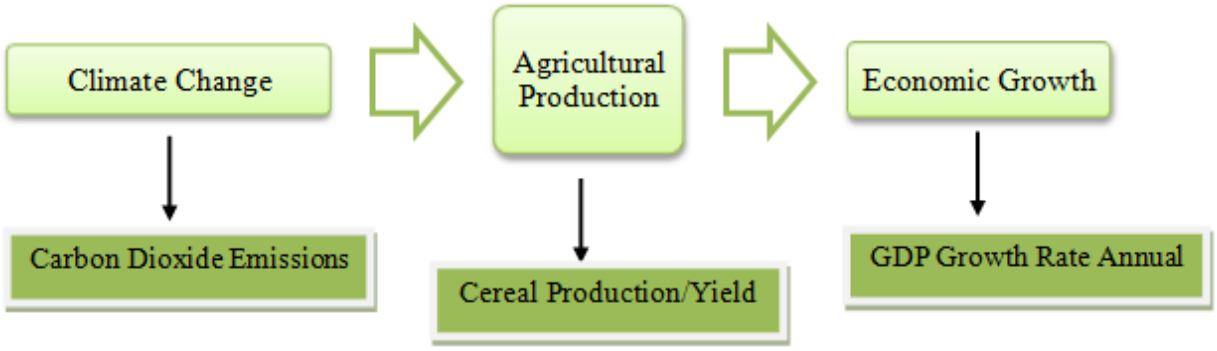
2.1. Conceptual Framework

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Conceptual model presented in below figure depicts the linkage between climate change, agricultural production and economic growth.

Figure 1: Conceptual framework showing the relationship between variables in the study.



3. METHODOLOGY

Methodology has a very important role in accomplishing the desired objectives of the study through using various tools & techniques. As the situation of climate change is worsen day by day all around the world. The selected target research areas in this study are East Asia & Pacific, Latin America & Caribbean, Europe & Central Asia and Sub-Saharan Africa.

3.1 Study area

World is mainly categorized into seven groups by region (World Bank, 2018)[1]. The groups are East Asia and Pacific, Europe and central Asia, Latin America and Caribbean, Middle East and North Africa, North America, South Asia and Sub-Saharan Africa consist of 38, 58, 42, 21, 3, 8 and 48 countries respectively. In this study we used four groups for analysis, whose countries are greater than 30 observations because our analysis is basically cross-sectional analysis. In cross-sectional analysis, required minimum number of observations should be 30.

The categories which are used in the analysis are given below in table with countries name.

East Asia and Pacific				
American Samoa	Hong Kong SAR, China	Marshall Islands	Palau	Papua New Guinea
Australia	Indonesia	Micronesia, Fed. Sts.	Philippines	Tonga

[1] https://data.worldbank.org/country

Brunei Darussalam	Japan	Mongolia	Samoa	Tuvalu
Cambodia	Kiribati	Myanmar	Singapore	Vanuatu
China	Korea, Rep.	**Nauru**	Solomon Islands	Vietnam
Fiji	Lao PDR	New Caledonia	Taiwan, China	
French Polynesia	Macao SAR, China	New Zealand	Thailand	
Guam	Malaysia	Northern Mariana Islands	Timor-Leste	
Europe and Central Asia				
Albania	Czech Republic	Iceland	Moldova	Slovenia
Andorra	Denmark	Ireland	Monaco	Spain
Armenia	Estonia	Isle of Man	Montenegro	Sweden
Austria	Faroe Islands	Italy	Netherlands	Switzerland
Azerbaijan	Finland	Kazakhstan	Norway	Tajikistan
Belarus	France	Kosovo	Poland	Turkey
Belgium	Georgia	Kyrgyz Republic	Portugal	Turkmenistan
Bosnia and Herzegovina	Germany	Latvia	Romania	Ukraine
Bulgaria	**Gibraltar**	Liechtenstein	Russian Federation	United Kingdom
Channel Islands	Greece	Lithuania	San Marino	Uzbekistan
Croatia	Greenland	Luxembourg	Serbia	
Cyprus	Hungary	Macedonia, FYR	Slovak Republic	
Latin America & the Caribbean				
Antigua and Barbuda	Cayman Islands	El Salvador	Panama	Suriname
Argentina	Chile	Grenada	Paraguay	Trinidad and Tobago
Aruba	Colombia	Guatemala	Peru	Turks and Caicos Islands
Bahamas, The	Costa Rica	Guyana	Puerto Rico	Uruguay

Barbados	Cuba	Haiti	Sint Maarten (Dutch part)	Venezuela, RB
Belize	Curacao	Honduras	St. Kitts and Nevis	Virgin Islands (U.S.)
Bolivia	Dominica	Jamaica	St. Lucia	
Brazil	Dominican Republic	Mexico	St. Martin (French part)	
British Virgin Islands	Ecuador	Nicaragua	St. Vincent and the Grenadines	
Sub-Saharan Africa				
Angola	Congo, Dem. Rep.	Guinea-Bissau	Namibia	South Sudan
Benin	Congo, Rep	Kenya	Niger	Sudan
Botswana	Côte d'Ivoire	Lesotho	Nigeria	Swaziland
Burkina Faso	Equatorial Guinea	Liberia	Rwanda	Tanzania
Burundi	Eritrea	Madagascar	São Tomé and Principe	Togo
Cabo Verde	Ethiopia	Malawi	Senegal	Uganda
Cameroon	Gabon	Mali	Seychelles	Zambia
Central African Republic	Gambia, The	Mauritania	Sierra Leone	Zimbabwe
Chad	Ghana	Mauritius	Somalia	
Comoros	Guinea	Mozambique	South Africa	

3.2 Data and Variables

In the study we used secondary data which is collected from World Development Indicators (WDI), 2014. Variables which are utilized to fulfill the desired objectives of the study are carbon dioxide emissions, agricultural land, cereal production, infant mortality rate and economic

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

growth. We use carbon dioxide emissions as a proxy variable for climate change because among total greenhouse gases, the concentration of carbon dioxide is higher as compared to other gases. Concentration of CO_2, out of overall GHG is greater as compared to other gases, concentration of CO_2 is 0.48% in Pakistan, 6.8% in India, 15% in USA and 30% in China.

4. ECONOMETRIC TECHNIQUES

4.1 Descriptive Analysis

Table 2: Descriptive Statistics of East Asia and Pacific.

	GDP Growth Annual (%)	Cereal Production (Metric tons)	CO_2 Emissions (kt)
Mean	4.72	36284787	466510.4
Median	3.40	3555033	14974.19
Maximum	36.52	5.57E+08	10291927
Minimum	-2.34	0.000000	11.00100
Std. Dev.	6.73	1.13E+08	1873284.
Skewness	3.715	4.322650	5.051813
Kurtosis	18.49	20.42103	27.00054
Probability	0.000	0.000000	0.000000
Sum	136.98	8.71E+08	13995311
Sum Sq. Dev.	1270.19	2.94E+17	1.02E+14

Table-2 shows the descriptive statistics of the main studied variables used for East Asia and Pacific's countries. In case of GDP growth rate, mean value is 4.72, median is 3.40, minimum value of GDP growth rate is -2.34 while the maximum value is 36.52 and Standard deviation of GDP growth rate is 6.73. It is shown in the table that means value cereal production in case of East Asia and Pacific countries is 36284787, median is 3555033 and standard deviation is 1.13E+08. Mean CO_2 emission is 466510.4 while median, maximum, minimum and standard deviation are 14974.19, 10291927, 11.001 and 1873284 respectively.

Table 3: Descriptive Statistics of Latin America and Caribbean.

	GDP Growth Annual (%)	Cereal Production (Metric tons)	CO_2 Emissions (kt)
Mean	2.56	7994532.	64801.71

Median	3.05	838643.0	8800.800
Maximum	7.60	1.01E+08	529808.2
Minimum	-3.89	74.00000	209.0190
Std. Dev.	2.766068	21557643	132307.9
Skewness	-0.304603	3.408223	2.711883
Kurtosis	2.730748	14.06245	9.339381
Probability	0.764888	0.000000	0.000000
Sum	74.26448	2.32E+08	1879249.
Sum Sq. Dev.	214.2316	1.30E+16	4.90E+11

Table-3 shows the descriptive statistics of the main studied variables used for Latin America and Caribbean countries. In case of GDP growth rate, mean value is 2.56, median is 3.05, minimum value of GDP growth rate is -3.89 while the maximum value is 7.60 and Standard deviation of GDP growth rate is 2.76. It is shown in the table that mean value cereal production in case of East Asia and Pacific countries is 7994532, median is 838643 and standard deviation is 21557643. Mean value of CO_2 emission is 64801.71 while median, maximum, minimum and standard deviation are 8800.80, 529808.2, 529808.2 and 209.01 respectively.

Table-4 shows the descriptive statistics of the main studied variables used for Europe and Central Asian countries. In case of GDP growth rate, mean value is 2.31, median is 8.32, minimum value of GDP growth rate is -6.55 while the maximum value is 8.32 and Standard deviation of GDP growth rate is 2.51. It is shown in the table that mean value cereal production in case of Europe and Central Asian countries is 12850125, median is 4197476 and standard deviation is 21245541. Mean value of CO_2 emission is 134025.1 while median, maximum, minimum and standard deviation are 42251.17, 1705346, 2211.201 and 276315.2 respectively.

Table 4: Descriptive Statistics of Europe and Central Asia

	GDP Growth Annual (%)	Cereal Production (Metric tons)	CO2 Emissions (kt)
Mean	2.319026	12850125	134025.1
Median	1.987559	4197476.	42251.17
Maximum	8.328387	1.03E+08	1705346.
Minimum	-6.552619	7362.000	2211.201
Std. Dev.	2.515469	21245541	276315.2
Skewness	-0.452273	2.621019	4.355030

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Kurtosis	5.541074	9.901719	24.27941
Probability	0.000938	0.000000	0.000000
Sum	106.6752	5.91E+08	6165155.
Sum Sq. Dev.	284.7413	2.03E+16	3.44E+12

Table 5: Descriptive Statistics of Sub-Saharan Africa

	GDP Growth Annual (%)	**Cereal Production (Metric tons)**	**CO_2 Emissions (kt)**
Mean	4.912276	3493771.	18937.03
Median	4.901067	1427435.	3085.781
Maximum	10.25749	24495794	489771.9
Minimum	0.611213	762.0000	113.6770
Std. Dev.	2.454265	5769444.	77828.56
Skewness	-0.043155	2.629374	5.767173
Kurtosis	2.443642	9.330749	35.25217
Probability	0.767856	0.000000	0.000000
Sum	196.4910	1.40E+08	757481.2
Sum Sq. Dev.	234.9132	1.30E+15	2.36E+11

Table-5 shows the descriptive statistics of the main studied variables used for Sub-Saharan Africa. In case of GDP growth rate, mean value is 4.91, median is 4.90, minimum value of GDP growth rate is 0.61 while the maximum value is 10.25 and Standard deviation of GDP growth rate is 2.45. It is shown in the table that mean value cereal production in case of Europe and Central Asian countries is 3493771, median is 1427435 and standard deviation is 5769444. Mean value of CO_2 emission is 18937.03 while median, maximum, minimum and standard deviation are 3085.78, 489771.9, 113.677 and 77828.56 respectively.

4.2 Regression Analysis

The relationship between carbon dioxide emissions, agricultural production and economic growth can be expressed in a linear relationship as shown:

$$(GDP)_i = \alpha_0 + \beta_1 (CO_2)_i + \beta_2 (CP)_i + \varepsilon \quad \ldots\ldots\ldots\ldots (1)$$

Here; GDP= GDP growth rate (%)

CO_2= Carbon Dioxide Emission (kt)

CP = Cereal Production (metric tons)

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Table 6: Impact of Carbon Dioxide Emissions on Cereal Production and Economic Growth in East Asia and Pacific.

Dependent Variable = GDP Growth Annual (%)				
Independent Variables	**Co-efficient**	**Standard Error**	**t-statistics**	**p-value**
Agriculture Land	0.077744	0.035460	2.192433	0.0445
Cereal Yield	0.000562	0.000316	1.778158	0.0956
CO2 emission	1.20E-07	2.90E-07	0.415779	0.6835
Infant Mortality Rate	0.124707	0.043584	2.861296	0.0119
Constant	-2.879425	2.042039	-1.410074	0.1789
R-square = 0.48				
F-statistics = 3.461				
Prob = 0.0341				

The regression model in Table 6 shows the relationship between carbon dioxide emissions, cereal yield and economic growth of East Asia and Pacific countries. The results show that carbon dioxide emissions and cereal yield have positive relationship with economic growth, with the increase in carbon dioxide emissions and cereal yield, economic growth tends to increase. Here in the model agricultural land and infant mortality rate act as a control variable. The coefficient values indicate that when there will be 1% increase in carbon dioxide emissions and cereal yield, economic growth will tend to increase by 0.0001% and 0.0007% respectively. As per values of F-statistics and concerning p-values, it is evident that the econometric model is fit. The value of R-square is 48%. Agricultural land, cereal yield and infant mortality rate are statistically significant while the CO_2 emission shows the insignificant result in case of East Asia and Pacific countries.

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Table 7: Impact of Carbon Dioxide Emissions on Cereal Production and Economic Growth in Latin America and Caribbean.

Dependent Variable = GDP Growth Annual (%)				
Independent Variables	**Co-efficient**	**Standard Error**	**t-statistics**	**p-value**
Agriculture Land	0.034687	0.022855	1.517743	0.1427
Cereal Production	7.69E-09	4.38E-08	0.175370	0.8623
CO2 emission	-9.37E-06	7.27E-06	-1.288859	0.2103
Crude Death Rate	-0.704586	0.313758	-2.245638	0.0346
Infant Mortality Rate	0.143313	0.071124	2.014961	0.0557
Constant	4.314324	2.558981	1.685954	0.1053
R-square = 0.38				
F-statistics = 2.8				
Prob = 0.036				

The regression model in Table 7 shows the relationship between carbon dioxide emissions, cereal production and economic growth of Latin America and Caribbean countries. The results show that carbon dioxide emissions have negative relationship with economic growth, with the decrease in carbon dioxide emissions, economic growth tends to reduce. Cereal production has positive relationship with economic growth, with the increase in cereal production economic growth will increase. Here in the model agricultural land, crude death rate and infant mortality rate act as a control variable. The coefficient values indicate that when there will be 1% increase in carbon dioxide emissions and cereal yield, economic growth will tend to decrease by 0.0006% and increase by 0.0009% respectively. As per values of F-statistics and concerning p-values, it is evident that the econometric model is fit. The value of R-square is 38%.

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

The regression model in Table 8 shows the relationship between carbon dioxide emissions, cereal production and economic growth of Europe and Central Asian countries. The results show that carbon dioxide emissions have positive relationship with economic growth, with the increase in carbon dioxide emissions, economic growth tends to enhance. Cereal production has negative relationship with economic growth. Here in the model agricultural land, crude death rates and infant mortality rate act as a control variable. The coefficient values indicate that when there will be 1% increase in carbon dioxide emissions and cereal yield, economic growth will tend to increase by 0.00004% and decrease by 0.0007% respectively. As per values of F-statistics and concerning p-values, it is evident that the econometric model is fit. The value of R-square is 40%. CO_2 emission, Agricultural land, cereal yield and crude death rate are statistically significant while infant mortality rate shows the insignificant result in case of Europe and Central Asian countries.

Table 8: Impact of Carbon Dioxide Emissions on Cereal Production and Economic Growth in Europe and Central Asia.

Dependent Variable = GDP Growth Annual (%)				
Independent Variables	**Co-efficient**	**Standard Error**	**t-statistics**	**p-value**
Agriculture Land	0.037261	0.018211	2.046032	0.0474
Cereal Production	-7.73E-08	2.99E-08	-2.588517	0.0134
CO2 emission	4.44E-06	2.24E-06	1.982981	0.05443
Crude Death Rate	-0.259368	0.131193	-1.976995	0.0550
Infant Mortality Rate	0.063026	0.044971	1.401469	0.1688
Constant	3.137977	1.629912	1.925243	0.0613
R-square = 0.40				
F-statistics = 5.268				
Prob = 0.0008				

ISSN: 2455-6939

Volume: 06, Issue: 01 "January-February 2020"

Table 9: Impact of Carbon Dioxide Emissions on Cereal Production and Economic Growth in Sub-Saharan Africa.

Dependent Variable = GDP Growth Annual (%)				
Independent Variables	**Co-efficient**	**Standard Error**	**t-statistics**	**p-value**
Agriculture Land	-0.002275	0.020386	-0.111598	0.9118
Cereal Production	2.19E-07	7.42E-08	2.948191	0.0057
CO2 emission	-1.22E-05	6.11E-06	-1.991851	0.0545
Crude Death Rate	-0.150000	0.368195	-0.407394	0.6863
Infant Mortality Rate	0.023368	0.047693	0.489974	0.6273
Constant	4.689068	1.773033	2.644659	0.0123
R-square = 0.25				
F-Statistics = 2.293				
Prob = 0.0671				

The regression model in Table 9 shows the relationship between carbon dioxide emissions, cereal production and economic growth of Sub-Saharan African countries. The results show that carbon dioxide emissions have negative relationship with economic growth, with the decrease in carbon dioxide emissions, economic growth tends to reduce. Cereal production has positive relationship with economic growth, with the increase in cereal production economic growth will increase. Here in the model agricultural land, crude death rates and infant mortality rate act as a control variable. The coefficient values indicate that when there will be 1% increase in carbon dioxide emissions and cereal yield, economic growth will tend to decrease by 0.0001% and increase by 0.0002% respectively. As per values of F-statistics and concerning p-values, it is evident that the econometric model is fit. The value of R-square is 25%. CO_2 emission,

Agricultural land, cereal yield and crude death rate are statistically significant while infant mortality rate shows the insignificant result in case of Sub-Saharan African countries.

5. CONCLUSION

The study attempts to investigate the interrelationship between carbon dioxide emissions, cereal production/yield and economic growth of different groups of countries worldwide. These groups are categorized on the bases of regions, developed by World Bank. Different regions of world have different situation of climatic change. According to results, climate change and economic growth is positively related East Asia & Pacific and Europe & Central Asia, while economic growth and climate change are negatively related in case of Latin America & Caribbean and Sub-Saharan Africa. The reason behind this scenario might be that East Asia & Pacific and Europe & Central Asia are the groups of those countries which control the carbon dioxide emissions, adopted those technology which are produce low carbon emissions. While the Latin America & Caribbean and Sub-Saharan Africa are the group who do not opt the latest technologies to reduce the carbon dioxide production. There is need to overcome the problem of climate change in the form of carbon dioxide emissions both in Latin America & Caribbean and Sub-Saharan Africa. Government of these economies should focus on controlling CO2 to improve the economic growth of particular economies.

REFERENCES

Afzal , M., Ahmed, T., & Ahmed , G. (2016). Empirical Assessment of Climate Change on Major Agricultural Crops of Pakistan. *Munich Personal RePEc Archive MPRA Paper No. 70958*.

Arellano, M., Bond, S., 1991. Some Tests of Specification for Panel Data: Monte Carlo Evidence and An Application to Employment Equations. Rev. Econ. Stud. 58, 277– 297.

Calzadilla, A., Zhu, T., Rehdanz, K., Tol, SJR., & Ringler, C. (2008). Economic-wide Impacts of Climate Change on Agriculture in Sub-Saharan Africa. University of Hamburge Working Paper FNU-170, Hamburg, Germany.

Dell, Melissa, Benjamin F. Jones, and Benjamin A. Olken. (2008). Climate Shocks and Economic Growth: Evidence from the Last Half Century, *NBER Working Paper 14132.*

Government of Pakistan (2016). Economic Survey of Pakistan, *Federal Bureau of Statistics, Statistics Division, Ministry of Economic Affairs and Statistics, Islamabad, Pakistan.*

IFAD (2015). Climate Change Impacts-South Asia.

IPCC (Intergovernmental Panel on Climate Change). (2007). IPCC Fourth assessment report: Climate change 2007. Synthesis report summary for policy makers. Geneva: IPCC.

Janjua, P. Z., Samad, G., & Khan, N. U. (2010). Impact of Climate Change on Wheat Production: A Case Study of Pakistan. *The Pakistan Development Review*, 799-822.

Qureshi, M. I., Awan, U., Arshad, Z., Rasli, A. M., Zaman, K., & Khan, F. (2016). Dynamic Linkages among Energy Consumption, Air Pollution, Greenhouse Gas Emissions and Agricultural Production in Pakistan: Sustainable Agriculture Key to Policy success. *Natural Hazards*, 367-381.

Shakoor, U., Saboor, A., Ali, I., & Mohsin, A. Q. (2011). Impact of Climate Change on Agriculture: Empirical Evidence from Arid Region. *Pak. J. Agri. Sci*, 327-333.

Tebaldi, Edinaldo, and Laura Beaudin. 2016. Climate Change and Economic Growth in Brazil. *Applied Economics Letters* 23 (4–6): 377–81

Yang, D. T., & Zhu, X. (2013). Modernization of Agriculture and Long-Term Growth. *Journal of Monetary Economics*, 367-382.

Ziervogel, G., Bharwani, S., Downing, T.E. (2006). Adapting to Climate Variability: Pumpkins, People and Policy. *Natural Resources Forum* 30:294–305.

