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Exploring the relationship between climate change and sugar cane production as well as comparison of sugar cane production in Sindh Province: A case study of Hyderabad, Badin, Shaheed Benazirabad

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Abstract: *Climate change has meaningful effects on sugar cane production worldwide. The data were collected from Beuro Sindh Karachi. A coefficient of correlation and ANOVA were applied. The results of the coefficient of correlation indicated a positive relationship between climate and sugar cane production. of (0.63) conclude that there is a (Moderate positive correlation between the climate and sugar cane production of the Hyderabad district. The results of the model show that the coefficient of correlation of (0.310) concludes that there is a (Week positive correlation between the climate and sugar cane production in the Badin district. The results of the model show that the coefficient of correlation of (0.088) concludes that there is a (Highly weak positive correlation between the climate and sugar cane production of Shaheed Banazirabad district. The probability value is also less than the specified value of the level of significance (0.05). So, the production of sugar cane is not the same for all districts.*

Key Words: Climate Change, Sugar cane Production, Agriculture

Introduction

Climate variation results in sugar cane, sugar production in a significant number of countries explicitly in Pakistan, and future difficulties for sugar creation underneath varying moderation adverse consequences of environmental change. Sugar cane (Saccharum officinarum L.) is a crucial crop for the production of sugar and biofuels all over the world. The occurrence and harshness of severe weather proceedings have increased as a result of rising greenhouse gas emissions from homes and climate change. Environment substitute is anticipated to have crucial ramifications for sugar stick production on the planet, particularly in the developing global areas because of the reality of uncommonly low versatile limit, high weakness to normal perils, and horrible gauging frameworks and alleviating procedures. An increase in the frequency and intensity of severe

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environmental conditions has already had a significant negative impact on sugarcane production in the area and will continue to do so.. "Global climate change" may also have an effect on human prosperity through a variety of mechanisms. The most immediate and without a doubt most broad influence may moreover come by means of horticulture basically food creation (Kaufmann and Snell, 1997). sugar cane crops, but it's not clear whether a change in the local weather would increase or decrease sugar cane productivity (Srivastava & Rai, 2012). Sugar stick is one of the world's first food-delivering crops, presenting around 75% of sugar created on the planet for human utilization (de Figueiredo et al., 2010). Sugar stick is the cash yield of Pakistan and makes make a commitment of 0.6% in the entire Gross domestic product. During 2015-2016, the sugar stick crop developed on 1132 thousand hectares as analyzed 1141 thousand hectares going before year, with the creation of 65,475 thousand stacks (DE SOUZA et al., 2008). Environmental issues that have impacted agriculture in the past and will continue to do so are the result of a combination of anthropogenic and natural-caused long-lasting changes in global climate forms. Since the middle of the 18th century, there has been a 30% increase in atmospheric CO2 awareness ([CO2]) as a result of an increase in the burning of fossil fuels, manufacturing procedures, and disforestation (Houghton et al., 2001). Some crops, particularly C3 plants, can benefit greatly from increases in air temperature and atmospheric CO2 (Kimball, 1983, Tao et al., 2006). In many parts of the world, drought stress and high temperatures have been two major issues that have had an impact on agricultural production and the economy. The issues that the agriculture sector faces in response to scenarios of climate change are providing food security for a growing global population while preserving the environment and ecosystems (Rosenzweig et al., 2007). Fiji produced a record 516,529 tons of sugar in 1994 as a result of good weather, but due to drought circumstances, production fell by 47, 50, and 43 per cent in 1997, 1998, and 2003 (Gawander, 2007). The yield of sugar cane is very subject to local weather fluctuations since extreme weather events are occurring more frequently and with greater severity (Knox et al., 2010). The development of sugar cane is influenced by the severity of the drought caused by climate change, its duration, and the stage of the plant's growth. Due to low sucrose output under early and mid-boom dry conditions, cane yield typically declines. Late growth stage moderate dry spells might increase stalk sucrose concentration. Drought is the most significant stressor for sugar cane production in China, which is rated third in the world, as more than 80% of it grows under rain-fed conditions (Liand, & Yang, 2014)

Table 1

Top ten Sugar Cane Producers in 2013

Country	Production (Million Mg)
Brazil	739.27
India	341.20
China	126.14
Thailand	100.10
Pakistan	63.75
Mexico	61.18
Colombia	34.88
Indonesia	33.70

Country	Production (Million Mg)
Philippines	32.00
USA	27.91

(Source: FAO of the United Nations, FAOSTAT, and Fact fish) (FAO, 2014; Fact, 2015).

In 2013, The top 10 countries that produced sugar cane were Brazil, India, China, Thailand, Pakistan, Mexico, Colombia, Indonesia, Philippines, and the United States. As can be seen in Table 1, their cane production (million Mg of cane) represented 34.1, 15.8, 5.8, 4.6, 2.9, 2.8, 1.6, 1.6, 1.5, and 1.3% (a total of 72%) of the global cane production. These nations' cane yields (Mgha1) were placed 29th, 40th, 39th, 26th, 51st, 25th, 19th, 31st, 37th, and 27th out of the 103 countries that produce sugar cane, correspondingly (FAO, 2014; Fact, 2015). Changes in crop combinations and farming methods can also have an impact on nearby climate factors, either immediately or indirectly. Buildup consumption previously or after sugar cane gathering is a typical administration practice of sugar cane production in numerous nations. Green home fuel emanation in sugar cane production is the main issue. According to the most recent research (de Figueiredo et al., 2010), the sugar cane crop released approximately 2.4 tons of CO2 equivalentha-1 into the atmosphere. Burning residue (44%), using synthetic fertilizers (20%), and burning fossil fuels (18%) were the main sources of the CO2 that was released from sugar cane (de Figueiredo et al., 2010).

Literature Review

Bosello and Zhang (2005) learn about assessing the relationship between environmental variation and horticulture. the study recommends that the local weather trade is complicated and that production patterns will be affected by higher temperatures. In addition to Deressa 2005) used a Ricardian go-segment regression model and found that climate change significantly affects the yield of sugar cane. It has a detrimental effect on the production of sugar in South Africa, claim Deressa et al. 2005). Aces & Co. Local weather change has a substantial detrimental impact on agricultural productivity, which uses around 40% of the world's land, according to research published in 2010 (GOP, 2016). Academics, economists, and policymakers all over the world are most concerned about the negative effects of local weather exchange and its variability on agriculture. Consequently, a significant amount of empirical research has examined the relationship between crop yields and local weather trade using specific methodologies. According to Guiteras (2009), there are three primary ways to evaluate the effects of local weather change on a crop-growing region. (Bosello & Zhang, 2005) Sarker, Alam, and Gow, 2014. Temperature and precipitation changeability is expected to increase due to environmental factors in East Africa. According to projections made by Niang et al. (2014) (Guiteras, 2009), the temperature in Africa is expected to rise more quickly than the rest of the world, surpassing 2°C by the middle of the 20th century and 4°C by using the end of the 21st century. This study's main objective is to provide a concise review of the literature on climate interchange and its effects on crop productivity at the worldwide and national levels. Onyeji and Fischer (1993) discovered that local weather variations had decreased farming productivity, increased feast costs, and decreased consumer incomes. This study also shows that the impact of climate change has reduced Egypt's per capita food consumption (Barros et al., 2014). Hannah et al. (2005). Claims that, particularly in developing countries, trade in climate products is likely to have detrimental effects on food safety, agricultural production, and economic

growth. 2005) (Onyeji & Fischer, 1994). However, a hotter and possibly drier environment should bring about more intense dry spells for the duration of El Nio years, which will severely affect the sugar stick (World Bank 2004). During the next century, the local weather system may undergo significant changes that will have a big effect on agricultural yield. The acceleration of climate change is acknowledged as a global anomaly that, like more well-known extreme climate events, will undoubtedly have long-lasting effects (World Bank 2004). The poorest residents of the area will be most impacted by local weather trade due to limited resources, unfavourable geography, and a greater reliance on climate-sensitive income sources, according to the South Asia Climate Change Strategy of the World Bank. Flash floods in Pakistan and India in recent years are thought to have been caused directly by climate change, and they are likely to keep the region in a permanent state of poverty (Mendelsohn & Dinar, 1999). Starting around 2010, the agrarian quarter in Pakistan has stood up to three enormous floods that had overwhelming outcomes child the absolute economy and predoom in amply the farming area. Rainstorm floods caused significant destruction to agricultural outputs, domesticated animals, ranger services, and fisheries in 2010, 2011, and 2014. These floods also encouraged damage to important infrastructure, including animal covers, tube wells, composts, homes, water channels, people, seed stocks, and farming equipment. Before the main crops of wheat, rice, maize, sugar cane, and vegetables could be harvested, a devastating flood occurred. An estimated 13.3 million manufacturing lots were lost as a result of the yield loss of important crops. The 2010 flood killed 1.2 million farm animals, including chickens, and destroyed 2 million hectares of standing vegetation (Mendelsohn & Dinar, 1999). The application of the APSIM model in Southern China by (Ruan et al. 2018). The RCP 4.5 emissions scenario is expected to result in a sugar cane.

Methodology

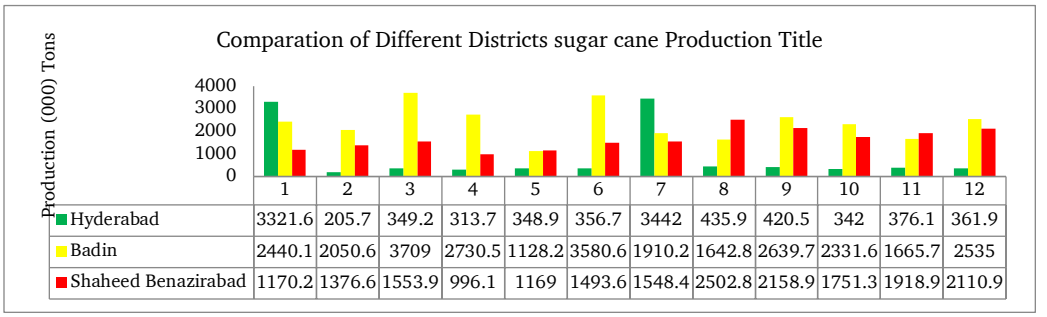
The data were received from the Sindh Bureau of Statistics Karachi. The data were presented in multiple bar charts. The coefficient of correlation was used to test the relationship between climate change and sugar cane production. ANOVA (Analysis of Variance) was applied for the comparison of the production of sugar cane.

Results and Discussion

The description of this study is shown multiple-bar diagram. In Figure 1.1, a Multiple bar diagram shows the twelve successive years of sugar cane production of the data of the three different districts of Sindh Hyderabad, Badin, Shaheed Banazira bad.

Figure 1

Sugar Cane Production

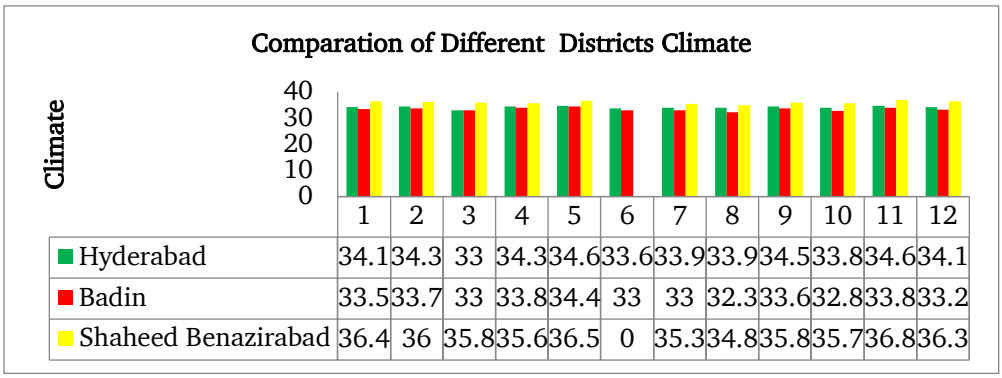


	1	2	3	4	5	6	7	8	9	10	11	12
Hyderabad	3321.6	205.7	349.2	313.7	348.9	356.7	3442	435.9	420.5	342	376.1	361.9
Badin	2440.1	2050.6	3709	2730.5	1128.2	3580.6	1910.2	1642.8	2639.7	2331.6	1665.7	2535
Shaheed Benazirabad	1170.2	1376.6	1553.9	996.1	1169	1493.6	1548.4	2502.8	2158.9	1751.3	1918.9	2110.9

from 2006 to 2017, the data in the graph shows that the year 2006 correspond to represents the number 1 observation, and 2007 corresponds to the number 2 observation, likewise, all twelve years of successive sugar cane production from (2006 to 2017) correspond to representing the number 1 to 12 observations. The twelve years of data on sugar cane production of three different districts of Sindh (Hyderabad, Badin, Shaheed Banazirabad) from (2006 to 2017) provide the actual shape of sugar cane production that shows how much production had been gotten.

Figure 2

Climate change of the districts In (Figure 2)



This multiple bar diagram shows the twelve years successive climate of the data of the three different districts of Sindh (Hyderabad, Badin, Shaheed Banazirabad) from **2006** to 2017, the data in the graph shows that the year 2006 correspond to represents number 1 observation, 2007 correspond to number 2 observation, likewise, all twelve years of successive production from 2006 to 2017 that are correspond to represents number 1 to 12 observations. The twelve years of data on the climate of three different districts of Sindh (Hyderabad, Badin, Shaheed Banazirabad) from 2006 to 2017 provide the actual shape of climate that shows how much climate had occurred.

Table 2

Model Summary of Correlation Analysis

	Model	R	R Square	Adjusted R Square	Std. Error of the mean
Hyderabad	1	0.63	0.004	-0.96	1236.56
Badin	2	0.310	0.96	0.05	759.17
Shaheed Benazir	3	0.088	0.008	-0.091	476.56

In (Table 02), The overall results of the coefficient of correlation show that the climate is positively affected by sugar cane production. The results of the model show that the coefficient of correlation of (0.63) concludes that there is a (Moderate positive correlation between the climate and sugar cane production of the Hyderabad district. The result of the coefficient of determination of (0.004) concludes that (99.99 %) of the variation in sugar cane production is explained by the variation in climate change. The results of the model show that the coefficient of correlation of (0.310) concludes that there is a (Week positive correlation between the climate and sugar

cane production in the Badin district. The coefficient of determination is (0.96) which concludes that (99.04%) of the variation in sugar cane production is explained by the variation in climate change. The results of the model show that the coefficient of correlation of (0.088) concludes that there is a (Highly weak positive correlation between the climate and sugar cane production of Shaheed Banazirabad district. The result of the coefficient of determination (0.008) concludes that (99.99 %) of the variation in sugar cane production is explained by the variation in climate change. Hence, in district Hyderabad the climate is moderately positively correlated with sugar cane production as compared to the district of Badin, Shaheed Banazirabad, we say that we should have to generate more crops of sugar cane by (varies) the climate.

Table 3

Analysis of Variance for Sugar Cane Production

	Sum of squares	df	Mean squares	F	Sig
Between groups	13645380.016	2	6822690.008		
Within groups	24015258.400	33	727735.103	9.375	0.001
Tota	37660638.416	35			

The F-ratio (9.375) for the combined effect of sugar cane production of different districts represents the statistic for testing whether the means of sugar cane production of different districts are not equal. The probability value (0.001) is less than the specified level of significance 0.05. Hence, we can say that the sugar cane production of mentioned districts is significantly different. In other words, the differences in the means of sugar cane production are significant.

Table 4

Analysis of Variance of Climate Change

	Sum of squares	df	Mean squares	F	Sig
Between groups	7.991	2	3.995		
Within groups	1191.175	33	36.096	0.111	0.896
Total	119.166	35			

The F-ratio (0.111) for the combined effect of the climate of different districts represents the statistic for testing whether the means of the climate of different districts are equal. If the probability value (0.896) is less than the specified level of significance 0.05, we can say that there is no significant difference in the climate of all districts. In other words, the differences in the means climate are (not) significant; the climate of the three districts is the same.

Conclusion

The effect of climate change was found on Agriculture sites by various researchers. In this particular research, we have found that climate changes affect sugar cane production in districts Hyderabad, Badin and Shaheed Banazirabad. The climate change effects are moderately positively correlated with sugar cane production in the district of Hyderabad furthermore statistical analysis provides that there is a weak positive correlation in the districts of Badin and Shaheed Banazirabad. It indicates that climate change affects sugar cane production but at a very low level. The effect of climate change also reduces the production of sugar cane. The sugar cane production for all districts was not the same, each district had different sugar production.

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