Impact of Subsector of agriculture and economic Growth on CO2 emission in Pakistan; An evidence from Environmental Kuznets Cure (EKC)

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Title page

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Abstract:

Modernization is not the only cause for producing Carbon dioxide Emission, to achieve a sustainable agriculture growth by introducing the concept of renewable energy into agriculture sector, through this process reduced the CO_2 emission in country. Secondly to measure the EKC in order to examine the association among variables in Pakistan. The main objective of this research is to check the EKC hypothesis with CO_2 emission and economic development, Renewable energy and agriculture sub-sector like, fisheries and crops Production in Pakistan. This study covers the time period 1984 to 2020. We have applied Autoregressive distribution lag (ARDL) bound test. The results indicate existence of long run association among all variable in the model. The result of co-integration in the short run shows negative relationship between CO_2 emission and Crops production in current time period and it shows a positive correlation with the first lag of CO_2 emission which means that current Crops production reduce the Corbin Dioxide emission by 32% during a year, while in lag period it will increased in the short run. In the long run one percent increase in Crops production will reduced the CO_2 emission by 86%. Renewable energy shows negative relation with CO_2 emission in short run, one percent increase in renewable energy will reduced the CO_2 by 0.017%. Our results supports the existence of EKC hypothesis for Pakistan.

Keywords : CO_2, Kuznets curve, Economic growth, Agriculture, ARDL

Introduction;

For economic growth, a healthy and safe environment is needed so it is necessary to emphasize the role of environmental deterioration. Lots of studies have been cleared that a sustainable environmental quality can be achieved by less use of carbon dioxide and energy. Economic activities and environmental deterioration go in a positive direction such as bulk use of energy, transportation, industrialization, and manufacturing, so on. Meanwhile, a rise in Greenhouse gases (GHG) especially CO2 putting down the quality of the environment. That day by day increasing economic activities deteriorate atmosphere but this is not a matter of a single country but it is also

a matter of fact of world's climate change. As per 2018 studies, world economic activities have increased the energy demand so far carbon emission has been escalated about 1.7% (International Energy Agency, 2019). Actually, this situation is a challenge and threat to the World. All developing and underdeveloped countries have been working to combat this occurrence. They pledge to reduce CO2 emissions but by not compromising economic growth and sustainable development. By keeping in mind two indicators that are Economic Growth and Environmental Deterioration, put forward the hypothesis of the Environmental Kuznets Curve. The researcher chose the EKC hypothesis just because there is a close association between environment and economic development. The Environmental Kuznets curve is used to create a compatibility between environmental conditions and increasing economic activities. (Madden at. El. 2019). According to that study, The EKC elaborates that the Environment worsened because of the increasing day-by-day economic progress and prosperity but it will bring about a solution to deterioration to the environment. (Kuznets, 1955). The theory of the Environmental Kuznets Curve guarantees the investigation in the area of connection between development and environment by using various econometric methodologies and methods, (Ahmed et, al 2017; Mulali et, al 2015). The Environmental Kuznets theory is basically applied to see the relationship between environmental quality and economic development. As per the Environment Kuznets Curve hypothesis, with extension in economic activities environment deteriorate at the first level, meanwhile, this deterioration decreases after a certain level of increase in income of the country. So the economic growth and development have their own solutions and measures of environmental deterioration (Kuznets 1955). Many studies and researches have been showing the warrants of investigations in authentications the relation between determinants of CO2 emissions and economic growth by applying various methods and methodologies of econometrics models (Ahmed et al., 2016; Apergis 2016). Measures of Determinants of CO2 emission is a critical and daunting deed but it is necessary for mitigation of environmental deterioration (Pata, 2018). However, the concord regarding Carbon dioxide emission is lacing, the EKC theory elaborates and highlights the exploration and modification of the EKC model. In a growth environment, the EKC hypothesis and model by cooperating with more determinants of CO2 try to find out the best fits. Lots of studies and researches have been used FDI, population, and financial development as factors of Carbon dioxide emission. However, recent studies have a target finding out the

relationship and existence of solutions for environmental protection nexus with economic development.

Agriculture and sub-sectors of agriculture such as, crops, and fisheries are the main determinants of Greenhouse gas emission. Basically, agriculture is a new contributor to Greenhouse gas emissions that Environmental Kuznets Curve needs to be improved and enhanced its policy measures (Gokmengolu and Taspinar 2018; Rafiq et al., 2015 and Jabeli and Yousef 2016 ;). The total estimated CO2 emissions caused because of agriculture is 11.8% and just particularly contribution of Pakistan's share is 6% in total emissions of the globe. According to recent studies if mitigation actions couldn't be fast the global GHG emissions caused by agriculture would increase to 58% by 2050 (World Resource Institute, 2019). The adverse and critical trend is seemed to further enhanced the Earth's environmental problems, thus decreasing Carbon dioxide emissions especially agricultural GHG, which has emerged as a worldwide serious issue that ought to be mitigated. Emissions caused because of agriculture sector is important to reduce because it causes many world's climate issues (World Bank, 2019). Consequently, mitigation measures significantly in the agriculture sector are relevant and timely with reducing climate issues, which can be done by incorporating with Environmental Kuznets Curves. Pakistan traditionally is an agricultural country as 18.5 percentage to be contributed in GDP of Pakistan. The Pakistan's agriculture sector comprised of three main subsectors as Fishing, Livestock and main is crops. Pakistan is a densely populated country and many people are related to the crops and fishing profession. In-between (1999-2011) from the agriculture sector livestock contributed about 14.5% of GHG emissions in the world's environment. Similarly, by crops production, about 14% of emissions are caused and fishing activities also cause environmental deteriorations about 174 million tonnes of Carbon dioxide emission according to World Bank report (Parker et al., 2019). As a matter of fact, the severe and noticeable culprit for the increase in CO2 emissions are fertilizers, irrigation methods, and pesticides which has been used in crops. Similarly, in livestock and fishing, CO2 is created and spread by farming and human activities (Watts, 2019).

Agriculture is an important sector for advanced and developing economies, so reducing agricultural cultivation and subsectors of agriculture is not a sustainable idea (Dogan, 2016). Contradictory, large agricultural production needs more carbon dioxide emissions (Zhang et al., 2019). In the case of Pakistan agriculture sector is very much important for the GDP (gross

domestic production) of Pakistan, it contributed 30% approximately to the GDP of Pakistan. Traditionally, Pakistan is an agricultural country half of the population is related to agriculture and for industries agricultural production is essential. That's all proves that the agriculture sector is a contributor toward environmental deterioration and an increase in CO2 emissions. Consequently, the economy-environment in nexus with the EKC hypothesis is timely and relevant to the crucial status of sustainable development of the world's environment.

In the case of Pakistan, we have a future of renewable energy solar energy, wind, and biomass energy. The energy mix of Pakistan is comprised of 64% of fossil fuels and 27% hydropower and similarly 9.65% comprised of other renewable energies (US government statistics, 2019). In addition to this, Pakistan is trying to make drastic and initiative steps to distance by their self.

The hypothesis Of Environmental Kuznets Curve (EKC) investigated the relationship among CO2 emissions, economic development, agriculture, and renewable energy. Using the EKC hypothesis to agriculture subsector is profitable interest (Qiao et al., 2019; Liuetal., 2017). However, limited research studies have been conducted related to EKC hypothesis in respect to the relationship of the agriculture sector, renewable energy. Therefore, considering the following scenario this research objectives are explained as follows: (1) to examine the impact of agricultural subsectors with renewable energy, and economic development on the CO2 emission and (2) to use the ARDL co-integration technique to explained the agriculture-economic development-renewable energy relationship in the framework of the EKC hypothesis for Pakistan by involving subsectors of agriculture, like crops, and fisheries for the period 1984–2020. The main purpose of this study is that to identify significance of economic and environmental justification from an examination of the relations among economic development, renewable energy, subsector of agriculture and CO2 emissions in the framework of EKC hypothesis for Pakistan.

Various Studies on EKC have shown mixed results of EKC (E.Beşe and S.Kalayci; 2021, Haseeb. A, et al, 2018) The main contribution of this study are: (1) this research is representing model of EKC by involving fisheries, Crops , Renewable energy and trend as the factor of contribution in terms of carbon dioxide Emission. (2) Time series data is used to estimate the hypothesis of EKC for Pakistan. Time series research is more suitable for estimating hypothesis of EKC for a country as compared to panel data analysis.

Literature Review;

There have been many studies find on environment, CO_2 emissions, economic growth and agriculture. Grossman and Krueger (1991) according to him EKC hypothesis illustrated the theory as economic development-Environmental degradation nexus (Kuznets, 1955). The development – environmental degradation nexus and with a strong relation has an upturn U-shaped curve, economic development escalated with an economy's environmental deteriorations. Subsequently, once an economy reach at threshold point the increasing income of nation can combat the environmental deteriorations, the environmental issues can be solve (Alam et al., 2016). To experimentally analyze and estimate the presence and stability of EKC theory, the carbon emissions has been taken as the proxy for degradations of environment, however it is taken in model as GDP function per capita or income per capita and square of GDP per capita as economic development (Qiao et al., 2019). For instance, with different country's samples, time spans and methodologies the EKC hypothesis generate different results. (Lacheheb aet al., 2015) according to him EKC in Algeria has not obtained the desire results in their economy. However, in Algeria the EKC theory has failed to achieve the inverted u-shaped curve and desired results and no evidence found for the EKC hypothesis. Economy grow in Algeria but environment degrade with time, it was estimated for long run in Algeria. In addition to that, in Azerbaijan's economy by applying Johansen co-integration method in between 1992-2013, the EKC hypothesis was also absent.

Javid. M and Sharif (2016) investigated the relationship among economic growth energy consumption to CO_2 and development in Pakistan from1972–2013. They used ARDL technique for the analsisy of regrssion, which targeted the trace of Environmental Kuznets curve (EKC) and determined that all input variables caused by extreme pollution. Kumar et al. (2017) analyzed the relationship between CO_2 emission and financial development in Pakistan from 1971 to 2011. They applied the ARDL technique for econometrics estimation. The findings of the study indicate that, CO_2 emission motivated by financial development, it is verified by the output of ARDL analysis in short and long-run. Rehman.M and Rashid.M (2017) observed the concept of energy use in environmental destruction by the multivariate model in SAARC countries, targeted the dangerous impact of energy consumption on the environment, and confirmed the EKC hypothesis.

A current research by Altintas and Kassouri in year 2020, indicates modifying results, where Environmental Kuznets hypothesis unwarranted and unfounded in the (EU) European Union,

where CO_2 emission applied as Environmental deteriorations indicator. To continue with uncertainty (Narayan et al., 2016) used panel studies for 181 countries, same in that case, obtained mix complex results which authenticates the accumulation bias (Baek, 2015a). The indecisive results of Environmental Kuznets Curve hypothesis authentication signify that dissimilar economic backgrounds, economic conditions and characteristics of different economies ceiled dissimilar relationship between environmental deteriorations and growth. Furthermore, some causes for inconclusive results are using incomplete method and methodologies, data, surveys and employment of different explanatory variables (Shahbaz and Sineha, 2019).

Earlier studies have shown that economic growth is more concerned with development goals like greener and sustainable goals for economy (Bekhet and Ottaman, 2018). In connection with this, Baek, (2015b) connect EKC hypothesis with energy usage for their research and proposals that economic development increase energy consumption and CO_2 emissions (Shabaz et al., 2015). By using Bayer-Hanck cointegration method in India for the year 1970-2014 by applying ARDL econometric methods development-environmental nexus proof the EKC hypothesis presence in India.

Renewable energy also called as greener energy is a main solution of CO_2 emissions and sustainable environmental issues. Greener energy is incorporated with EKC hypothesis as an explanatory variable (Al-Mulali and Ozturk, 2016). EKC hypothesis proved itself in many countries and preceding studies has proved that renewable energy is inversely related to CO_2 emissions. However, in many countries EKC hypothesis cannot proof itself. In fact, renewable energy found to reduce CO_2 emission, and the EKC hypothesis accepted and supported in many economies. As in case of agriculture and subsector of agriculture, the EKC hypothesis supported very limited (Zhang et al., 2019; Balezentis et al., 2019). For instance, in case of Pakistan Agriculture and EKC hypothesis for the year 1990-2020 proved and confirmed.

Data and Methodology

This research has consisted on annual time series data included time period of 1984 to 2020,this work has been done in Pakistan, CO_2E, LCrops, GDP, $LGDP^2$, LFesheris, and REN represent Corban dioxide emission, Log of Crops, gross domestic product and Log of Square gross domestic product, Log of Fisheries, and Renewable energy respectively presented in the long-run model in this research work.The data is collected from various sources such as CO_2E, GDP, REN has been taken from

WDI(World development Index)while LCrops, LFesheris has been taken from Pakistan handbook of statistics.

Model:

Pakistan economy is growing slowly, because of its significant contribution in the CO2 emissions in Asian countries, examined vitally to recognize the relation between development of economics and the emission of CO2 in the contest of EKC, which quadraticaly effect the CO2 emission in terms of income and GDP. The purpose of this research is to examine the effect of agricultural subsectors on CO2 emissions rather than examining agriculture as a whole (aggregate level) the main factors of agriculture e.g crops and fisheries illustrates the main components of the agriculture of Pakistan in terms of GDP. For this, we have adopted the model of (Lau et al.2017) and (Pata 2018a and 2018b.) with some changes which can be written as:

CO2E= f (Crops production, Fisheries, GDP, GDP2, REN,) **(1)**

Economic growth renewable energy also agriculture might affect the CO2 emission followed, the multivariate framework expresses as equation1.

Where CO2 represents the release of Carbon dioxide emission per unit, GDP depicts per capita GDP and GDP2 illustrates the square and REN shows the renewable energy.

According to research the contribution of crops is about USD16-19 billion in terms of gross output. While the other factor e.g fisheries added USD 3117 million, Fisheries as a sub-sector of agriculture show an important part in the Pakistan economy and provide the food safety to the country as it decrease the current burden on demand for, beef, mutton and chicken (Pak Economic survey 2019). The substantial addition of these subsectors to the agriculture in terms of GDP,it is assumed that each factor has some impact on CO2 emissions at national level. Crops and fisheries are considered substitutes for agriculture are illustrated by CROP and FISHERIES in eq2

CO2E= f(Crops , GDP,GDP2, FISHERIES,CROP, REN, Trend) **(2)**

The reduced form of the above model is illustrated below

$$\mathbf{CO2E= B_1 +B_2\ Crops +B_3\ GDP +B_4\ GDP^2 +B_5\ FISHERIES +B_6\ REN +B_7\ Trend +u} \quad \mathbf{(3)}$$

We have used the semi-log form of eq 3 to obtain a meaningful interpretation of parametrs. Therefore trhe equation 3 can be written as:

$$\mathbf{CO2E = B_1 + B_2\ Crops + B_3\ LGDP + B_4\ LGDP^2 + B_5\ LFISHERIES + B_6\ REN + B7\ Trend + u} \quad \mathbf{(4)}$$

Where B1 is intercept and u is the error term and the other parameters (B's) are the estimated coefficients. The value of B3and B4examines the multiple shape of EKC hypothesis for instance, if B3=B4=0 represents no relationship with CO2 emission. However, if B3>0 and B4=0, there is a positive relationship between income and co2 emission. Similarly, if B3<0 and B4>0. It depicts U shaped curve among them. Where B3>0 and B4<0 shows inverted U shaped curve according to EKC hypothesis (Dinda 2004,Sinha and shahbaz 2018.) B6 is anticipated to be negative the signs of the parameters B2 and B5 might show the sustainability and development in the country (liu et al,2017).

Econometric Methodology:

The procedure of estimation is used in this study followed by three important steps of econometrics. The unit root test is the first step which is performed to examine unit root. (Perron, 1990). Co-integration test is the second step to examine the co-integration with the help of ARDL Bound test (ARDL). Diagnostic and Stability test is the third step to check for heteroscedasticity with the help of the whit general test , Ramsey-regression equation specification error test (RESET Breusch-Godfrey test for serial correlation test, , and cumulative sum and CUSUM of squares. Philips and Hensen,(1990).

Unit root tests:

In order to check the Stationarity in a data, the well-known method unit root should be employed which avoid bogus results in terms of regression (Othoman and Bekhet 2018). This research is used unit root test to examine time effect of all variables in this model.

Co-integration test:

This research used the Auto Regressive Distributed Lags (ARDL) technique (Smith and Pesaran,1995) and Pesaran et.al(2001) to examine the amalgamation amid variables due to its numerous benefits in terms of different procedure of co-integration. This technique is performed

irrespective of the integration order of variables i.e. I(1), I(0) or both. Moreover, this procedure is best for small sample size .Shahbaz and Sinha,(2018), Shahbaz et.al(2016).

$$\Delta CO2Et = \boldsymbol{\alpha}_1 + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_2\, \Delta(LCrops)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_3\, \Delta(LGDP)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_4\, \Delta(LGDP)2_{t-2}$$

$$+ \sum_{i=2}^{t=n} \boldsymbol{\alpha}_5 \Delta(LFesheris)_{t-2} + \sum_{t=1}^{t=n} \alpha_6\, \Delta(REN)_{t-2} + \boldsymbol{\alpha}_7 CO2Et$$

$$+ \sum_{t=2}^{t=n} \boldsymbol{\alpha}_8\, (LCrops)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_9\, \Delta(LGDP)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_{10}\, (LGDP)2_{t-2}$$

$$+ \sum_{i=2}^{t=n} \boldsymbol{\alpha}_{11} (LFesheris)_{t-2} + \sum_{t=1}^{t=n} \alpha_{12}\, \Delta(REN)_{t-2} + \mu t \ldots (5)$$

Where $\boldsymbol{\alpha}_1 - \alpha_6$ are long term coefficients and $\alpha_6 - \alpha_{12}$are the coefficients for short-term. Co-integration test is employed by performing bound test for examining the joint significance. The null hypothesis (H_0) for the no-co-integration is versus the alternative hypothesis (H_1) there is existence of co-integration in the model.

$$(H0: \boldsymbol{\beta}_7 = \boldsymbol{\beta}_8 = \boldsymbol{\beta}_9 = \boldsymbol{\beta}_{10} = \boldsymbol{\beta}_{11} = \boldsymbol{\beta}_{12} = 0\ )$$

$$(H1: \boldsymbol{\beta}_7 \neq \boldsymbol{\beta}_8 \neq \boldsymbol{\beta}_9 \neq \boldsymbol{\beta}_{10} \neq \boldsymbol{\beta}_{11} \neq \boldsymbol{\beta}_{12} \neq 0)$$

ARDL technique has been implemented for the variable estimation from above given equations, which illustrates the procedure of Bound test. The F-statistic generated through ARDL bound and then compare it with the critical values of F-statistic (2005), Narayan because of their effectiveness for small samples. If the calculated F-statistic value is greater than the upper critical values then null hypothesis of no co-integration can be rejected. 2005(Narayan). After the co-integration of variables, long term estimation of model is represented below.

$$CO2Et = \boldsymbol{\beta}_1 + \sum_{t=2}^{t=n} \boldsymbol{\beta}_2\, (LCrops)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\beta}_3\, (GDP)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\beta}_4\, (LGDP)2_{t-2}$$

$$+ \sum_{i=2}^{t=n} \boldsymbol{\beta}_5 (LFesheris)_{t-2} + \sum_{t=1}^{t=n} \boldsymbol{\beta}_6\, (REN)_{t-2} + \mu t \ldots (6)$$

Whereas CO_2E, LCrops, GDP, $LGDP^2$, LFesheris and REN represent Corban dioxide emission, Log of Crops, gross domestic product and Log of Square gross domestic product, Log of Fisheries and Renewable energy are respectively presented in the long run model. In addition coefficient of short term are computed by performing ECM followed by ARDL technique.

$$\Delta CO2Et = \boldsymbol{\alpha}_1 + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_2\, \Delta(LCrops)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_3\, \Delta(GDP)_{t-2} + \sum_{t=2}^{t=n} \boldsymbol{\alpha}_4\, \Delta(LGDP)2_{t-2}$$

$$+ \sum_{i=2}^{t=n} \boldsymbol{\alpha}_5 \Delta(LFesheris)_{t-2} + \sum_{t=1}^{t=n} \alpha_6\, \Delta(REN)_{t-2} + \Upsilon(ECM)_{t-1}$$

$$+ \mu t \ldots (7)$$

Whereas CO_2E, LCrops, GDP, $LGDP^2$, LFesheris and REN represent Corban dioxide emission, Log of Crops, gross domestic product and Log of Square gross domestic product, Log of Fisheries and Renewable energy are respectively presented in the short term model. The u is the disturbance term and ϒ shows the coefficient of ECM which illustrated the speed of adjustment. However, ECT depicts the error correction term of lag time period. The coefficient of ECM is supposed to be significantly negative for operation of ECM Mechanism. The Error Correction Term depicts how much time is required for shock adjustment to their values of long term.

Diagnostic and stability test:

To avoid bias parameters in the model which leads to inappropriate hypothesis the estimated error term should have constant mean of zero value, normal distribution , no Autocorrelation, homoscedasticity and no Multcollinearity. Othoman and Bekhet(2018). Thus to confirm these problems, the Breusch-Godfrey tests have been employed. Moreover, Ramsey Reset test is performed to ensure that the model has accurate functional form (Pata 2018a and 2018b). This research has applied CUSUM and CUSUMQ estimation to predict model stability. When the plots of CUSUM and CUSUMQ tests are presented at the critical bounds at 5% significant level, the sable model is obtained, otherwise there can be a structural break in a period of estimation. Bekhet and Othoman(2018).

Empirical Results and interpretation of results:

This part of the research depict that the estimation of regression result from various approaches in the model are employed. This study followed by multiple pre and post estimation which are used to regress on data. At first use the unit root test to check the Stationarity of data and lag length of the model, than checked the co-integration among the all variable in the present model. At second the ARDL result has been depicted which are employed for the long run and short run association among the variables. Thirdly diagnostic test are presented.

Table: 2 Unit Root Test

	ADF				Phillips-Peron			
	Level		1st Difference		Level		1st Difference	
	t-stat	p-value	t-stat	p-value	t-stat	p-value	t-stat	p-value
$CO2E_{t-0}$	-4.02	0.0175	-4.661	0.0006	-2.019	0.071	-4.693	0.0006
$LCrops_{t-1}$	1.552	0.7917	5.622	0.0000	1.66	0.7453	-5.614	0.000
GDP_{t-1}	-3.015	0.1424	-3.234	0.0262	-2.027	0.5671	-3.173	0.030
$LGDP^2{}_{t-1}$	-3.067	0.1297	-3.578	0.0115	-2.564	0.2977	-3.512	0.053
$LFeshet_{-1}$	2.211	0.4691	-6.185	0.000	-2.634	0.0956	-6.185	0.000
REN_{t-1}	-2.461	0.1331	5.749	0.000	-2.437	0.1392	-5.747	0.000

This research performed Stationarity test by applying unit root test, which is suitable for examine the integration order of variables. Order zero or one i.e. I (0), I (1), or both but not I (2) is mandatory. Table 2 shows the result of unit root test. The result finds that every variable is stationary at first difference except CO2E which is stationary at level. This shows ARDL justification as a method of estimation. In this condition where no I(2) was confirmed among the variables to examine co-integration amid variables followed by Othoman and Bekhet (2018), Pata (2018a,2018b).

Table: 3 lag selection criteria

Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-223.097	NA	0.0287	13.47631	13.74567	13.56817
1	-19.9993	322.5675	1.60E-06	3.647015	5.532519	4.290026

2	12.61461	40.28772	2.41E-06*	3.8462*	7.34785*	5.040363
3	76.07799	55.99711*	8.93e-07	2.230706	7.348503	3.976022*

Table: 4 ARDL Bounds Test

ARDL Bounds Test			
Null Hypothesis: No long-run relationships exist			
Test Statistic		**Value**	**K**
F-statistic		8.096757	5
Critical Value Bounds			
Significance		**I0 Bound**	**I1 Bound**
10%		2.75	3.79
5%		3.12	4.25
2.50%		3.49	4.67
1%		3.93	5.23
R-Squared	0.993166	D.W	2.17
F- Statistic	145.3181	Prob(F-Statistic)	0.0000

Table 3, shows that lag selection criteria, the length of lag is 2 which is selected after examining the value of AIC and other criteria. This information leads that bound test will be conducted. The tabulated F-statistics is taken from table 4,the calculated F-statistics(5.23) is examined in regards of upper and lower bounds of(2005) Narayan and obvious a long term relationship among the emission of carbon dioxide Emission, crops, Renewable energy consumption, Fisheries are present because the computed F-statistics is higher than 1% upper bound critical value.

Table: 5 Long Run Coefficient of Carbon Dioxide Emission

Long Run Coefficient of Carbon Dioxide Emission Model				
Variable	**Coefficients**	**Std. Error**	**t-Statistic**	**Prob.**
LCROPS	-0.866538	0.077747	-11.1457	0.0000
GDP	0.000072	0.00001	6.941801	0.0000
LDGP2	-0.46989	0.245605	-1.91319	0.0727
LFESHERIES	2.337512	0.224749	10.40056	0.0000
REN	-0.002101	0.000381	-5.52097	0.0000
C	-3.37599	4.966024	-0.67982	0.5058
@TREND	-0.025746	0.00266	-9.68025	0.0000

Once evidence of co-integration was developed, the short term and long term coefficient were computed consist on equation 7 and equation 8 respectively. Table 5 shows that renewable

consumption declines environmental deterioration as it has inverse long term significant association with CO2E. An increase in 1% consumption of renewable energy declines CO2E by 0.002.Fisheries has a positive and significant association with CO2E but crops has a negative relationship with CO2E.Similarly GDP has lesser impact on CO2E,however the squared GDP shows the negative and significant association wit CO2E as 1% rise in GDP will decline CO2E by 46%.GDP2 coefficient is -0.4698 which shows that b4<0.This estimates show the hypothesis of EKC is valid in term of long run, as it depicts inverted U-shaped curve.

Table: 6 Short Run Coefficient of Carbon Dioxide Emission

Short Run Coefficient of Carbon Dioxide Emission Model				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LCROPS)	-0.327574	0.100818	-3.24916	0.0047
D(LCROPS(-1))	0.248634	0.072623	3.423622	0.0032
D(GDP)	-0.000085	0.000034	-2.45919	0.0249
D(GDP(-1))	-0.000171	0.000044	-3.87635	0.0012
D(LDGP2)	2.426844	0.837038	2.899324	0.0100
D(LDGP2(-1))	3.551795	0.968481	3.667387	0.0019
D(LFESHERIES)	0.618814	0.09813	6.306076	0.0000
D(LFESHERIES(-1))	-0.530907	0.145946	-3.63769	0.0020
D(REN)	-0.000172	0.000200	-0.86145	0.4010
D(REN(-1))	0.000718	0.000452	1.588262	0.1307
D(@TREND())	-0.022696	0.005618	-4.03971	0.0009
ECM_{t-1}	-0.881545	0.242161	-3.64033	0.0020

Table: 7 Diagnostic Tests

Model	**CO2**	
	Test-statics	**p-values**
Breusch-Godfrey Autocorrelation LM Test, F-statistic	0.533379	0.5973
Heteroskedasticity Test: White, F-statistic	0.924894	0.5630
Ramsey RESET Test, F-statistic	1.614959	0.2316

Notes: (1) Breusch-Godfrey Test H0: No serial correlation to 1 lags (2) Heteroskedasticity Test H0: NO Heteroskedasticity (3) RESETTestH0: Functional form is correct.

In table 6 the short run analysis has been estimated, the result of LCrops indicate the positive and statistically significance relationship with CO2E in current time period at 1% level which depicts 1% increase in variable LCrops leas to a reduction in CO2 emission by 32% but in the lag time period there is a positive association amid LCrops and CO2E means that 1% rise in LCrops tends to increase CO2E by 24%,while GDP estimates show negative and statistically significant association suggests that 1%rise in GDP leads a reduction in CO2E in current time period but in

lag time period there is negative and significant association.GDP2 has positive and significant amalgamation with CO2E in present period of time ,this association become stronger in la time period which illustrates 1% increase in GDP2 leads to 355 increase in CO2E. Moreover, Fisheries has positive and statistically significance association in current time period and vice versa whereas Renewable energy has inverse and statistically significance relationship in current time period and this amalgamation become positive and statistically significance in lag time period. Error correction term is negative and significant which is presented in table 6. The Error correction term illustrates the speed of adjustment where the equilibrium bears a shock. The ECT of -0.88 suggest that the conversion speed is 88% and the disturbance amid trend and the shock will be better during a year. The findings of table 7 illustrate the diagnostic estimation. The result of these tests depict that there is no heteroscedasticity, autocorrelation and non-normality are present in this research. Moreover, this Ramsey-Reset the statistical analyzation examines that a model exists in a proper functional form. CUSUM test and CUSUM of squares test has been performed in order to check the stability of the model.

Figure: 1

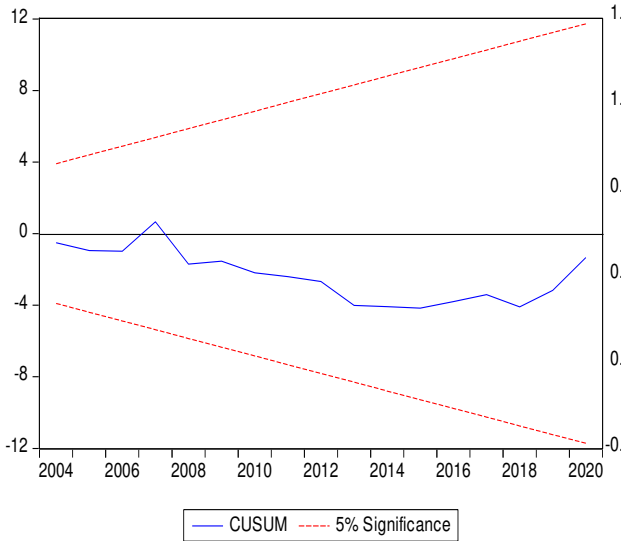

Figure: 2

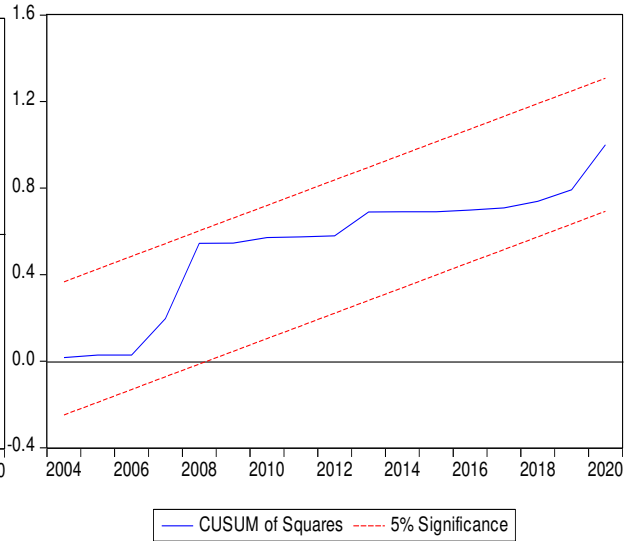

Figure 1 and 2 shows the result of CUSUM and CUSUM of squares test used on the CO_2 emission model of this study. This test are implemented to check the stability of parameter throughout the study period. This test provide the stability output of the coefficient in graphical form. The

graphical analysis of this test consist of two red line, which express the 5% level of significance and blue line in the middle. If the blue line cross the red line from upper or lower side of the boundary, than the estimated coefficients are said to be inconsistent or parameter are not stable with respect to time. Our finding of CUSUM and CUSUM of squares test indicated that all the coefficients are stable throughout the study period, because the blue didn't cross the red boundary line.

Conclusion and policies:

In this study used the ARDL bound technique for analysis of EKC hypothesis of income with CO_2 emission in Pakistan from 1984 to 2020 in the framework subsector of agriculture like, presented as Crops and fisheries. This research study incorporated the renewable energy as control variable, to investigate the effect of renewable energy on environment and to keep away our result from spurious regression. This study indicate the impact of different subsector of agriculture on the Corban dioxide emission and show an evidence of inverted U-shaped EKC hypothesis. The main findings according to this research that Carbon dioxide emission is increasing as the society become progressive, number of industries is increasing which leads to the higher GDP growth which is the good sign for the economy but environmental issues cannot be neglected, as in the research, It is found that GDP, fisheries, crops, renewable energy are somehow responsible for the environmental problems because there is the gap, many people use advance technologies and some people cannot access to modern ones, but in order to address these issues, efforts are required to shrink this gap which is necessary for the environment. The finding of this research depict that renewable consumption declines environmental deterioration as it has negative long term significant association with CO2E. An increase in 1% consumption of renewable energy declines CO2E by 0.002.Fisheries has a positive and significant association with CO2E but crops has a negative relationship with CO2E.Similarly GDP has lesser impact on CO2E, however the squared GDP shows the negative and significant association with CO2 emission as 1% rise in GDP will decline CO2 emission by 46%. GDP2 coefficient is -0.4698, this estimates show the hypothesis of EKC is valid in term of long run, as it depicts inverted U-shaped curve. Depend on (on the basis of) conclusion and result various policies can be recommended.

The government is supposed to impose such policies which facilitates the Renewable Energy in an efficient way .It is the need of time that the state should adopt some measures such as innovations in machineries which is related to yielding crops etc. which decrease the level of

CO2E.these measures can be done through subsidies which boosts the industries to import and purchase such as machineries. It is another measure that govt should facilitate and help to purchase Machineries which will helpful in farming. The government should motivate the studies which are related to crops, livestock's, fisheries that lead to stimulate new inventions. Public awareness and interest will play the key role to decrease the CO2 from the environment.

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