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A NEXUS AMONG AIR POLLUTION, ENERGY CONSUMPTION AND AGRICULTURAL PRODUCTIVITY IN BANGLADESH: AN ARDL MODEL WITH STRUCTURAL BREAK

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ABSTRACT

As an agro-based nation, Bangladesh is rising by a double burden, as the population is increasing with added food demand and unprecedented consumption of fossil fertilizers. This study examined the relationship between air pollution, agricultural output, fertilizer consumption and the contribution of agriculture to the domestic economy. For a longer period of time from 1972 to 2019, this study followed the Autoregressive Distributed Lag Model (ARDL) with rejecting the null hypothesis of cointegration in the long-run relationship of air pollution to others. Under Short run with ECM in a 1% level of significance suggested significant adjustment towards long-run equilibrium. Also, diagnostic tests and stability tests are employed for valuing our model in a statistical sense. In order to meet food demand, further steps *need to be taken by the government to stop or reduce fossil use, improve soil fertility and adequate crop production, and build some constant challenges to crop quality.*

Key words: Air Pollution, Energy Consumption, Agricultural Productivity, Development of Bangladesh, ARDL

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1. INTRODUCTION

Bangladesh, a Least Developed Countries (LDC) with a population of 161 million, has been taping incredible ratios of monetary expansion over the previous two decades. With strong economic growth and large population size, over the year following the expansion of the economy and population demand, the use of energy is growing. Consequently, emissions of GHG are also rising as the larger of GHG emission is the outcome of higher the energy consumption. As a result, Bangladesh has been known as the most polluted country in the world for PM2.5 exposure, whereas Dhaka became the second most polluted city in the 2019 World Air Quality Report. According to the Country Environmental Analysis (CEA), the World Bank's analytical tool (World Bank, 2006), Bangladesh's developing economy is losing 1% of its GDP every year as a result of air pollution. Enhancing global temperature is a crucial warning to the atmosphere. On the other hand, battle of fostering as well as assuring economic development, high-energy consumption has triggered environmental deterioration from unit to multiple. The researchers worked on this sector to bridging gap of research and knowledge and to answer the question "whether air pollutions are the outcome of economic development and energy consumption, or simply it is a standalone environmental dilemma". Empirical outcomes are inconclusive (Soytas and Sari, 2009; Ozturk and Acaravci, 2013) mostly due to the character of countries, the adoption of various analytical approaches and the use of several data durations for the study. The main policy problem is, for the sake of environmental integrity, a country should immediately achieve a reduction in carbon emissions, irrespective of the level of economic growth, or whether it should remain away from the vigorous operation of a reduction in emissions that will hinder economic growth and development capacity. However, a heavy society, enlarging urbanization, and a fast-growing industrial root have boosted the spirit of a looming environmental catastrophe.

The agricultural industry has a significant role to play in donating stocks to communities in both progressive and expanding nations. While agribusiness participates directly or indirectly in these arenas through several paths, such as building interest spaces, furnishing job alternatives, promoting other relevant initiatives, etc., it is also very important in times of environmental breakdown due to the increased consumption of stability, land use, and influencing air pollution. Environmental economics is an increasing area for scientists as well as economists alike. The trend issues in this area are environmental changes, increased temperature, and global warming due to boosted greenhouse gases (GHGs). Agribusiness is responsible for 15–35 per cent of global GHG emissions depending on whether or not it causes deforestation (World Bank, 2012). The agricultural area and its progress are very important to developed and developing countries alike. Energy consumption is growing due to the growth of the economic activity and population size resulting in higher worldwide GHG emissions. According to BBS, the GDP growth rate 8.15 percent in FY2018-19. But Bangladesh has maintained a Gross Domestic Product (GDP) growth rate of between 6% and

7% over the last six years, in a proposition to construct a sustainable economic order through which the country reach its aimed goal of becoming a developed economy by 2041 (The Financial Express, June 08, 2019). Bangladesh's energy consumption has therefore increased by more than 8% per year. In particular, electricity consumption increased even faster at 10% per year as it is used in most economic activities. According to the report of the Hydrocarbon Unit, Bangladesh, the estimated final energy consumption is around 47 MTOE in 2019. The average increase in energy consumption is around 6% per year. The average energy consumption per capita in Bangladesh is 293 kgoe (Kilogram Oil Equivalent) and the electricity generation per capita is 464 kWh with 90 per cent access to electricity, which is lower than in the neighboring countries of South Asia. Reconnoitering the link between economic growth, environmental pollution and energy consumption is a imperative part of any country's environmental energy policies. So, to mitigate the modern argument about sustainable development and environmental degradation, country-specific empirical research on the linkage between these three variables is still very important. Agricultural output and its contribution on economy is pivot that holds more than 50 percent on GDP just two decades before. Now, its hold less than 20 percent but still crop intensity is stagnant. Due to modern machineries advancement and HYV type production, crops production is decreasing in tortoise steps. Sustainability in food and food security is a crucial issue though its not accomplished in word. Lack of fertilizer consumption, loss of arable land per year, inefficient water management, climatic hazard in randomness and above all population increasing are challenges towards agricultural growth. As population is booming with lapse of time, resources and arable lands are decreasing and hence, difficult to meet the demand of food for growing population. To increase agricultural output, modern technologies and fertilizer use is in excessive manner. Both of these not only consume high level of energy but also pollute environment. To admit these issues, this paper explore nexus between air pollution, energy consumption and agricultural output in Bangladesh to finding out causal relation in long run & short run. This is the first study to examine air pollution, energy use and agricultural productivity nexus in one single analysis in Bangladesh. So far, there exists very little study but not considered all these issues into one frame. Study by Mozumder and Marathe (2007) who explored the causal relationship between Bangladesh's electricity consumption and economic growth using the Johansen vector error correction model. Alam et al., on the other hand, studied the potential nature of dynamic causality in Bangladesh between energy consumption, electricity use, carbon emissions and economic growth in 2012. Following the paper Koondhar et al. 2018, this paper used various comprehensive indexes for environmental degradation and air pollution representation which differ from previous studies.

2. LITERATURE REVIEW

Academic researchers and practitioners have been intensively exploring the link between energy consumption, environmental pollution and economic growth over the last few decades. There is plenty of literature on the casual relationship between electricity consumption and economic growth in developing economies around the world. But theoretical analysis in the area of environmental economics happens to have remained less than sufficient. The environmental decay is evaluated in the writings numerous times by researchers and policymakers, particularly after the 1990s. Regardless, the connection between air pollution and energy consumption regarding certain sectors of the economy did not get sufficient awareness, as can be seen in the agricultural division (Acheampong, 2018; Soytas et al., 2007; Muhammad, 2019; Saidi and Hammami, 2015; Wang et al., 2011; Wang et al., 2018, Kahouli, 2017; Shahbaz and Lean, 2012; Kasman and Duman, 2015; Acaravci and Ozturk, 2012). In addition, researchers and/or policy makers, engineers, executives and economists have a strong interest in the potential environmental impact of agriculture. Accordingly, this research would improve the literature on agriculture and the environment.

Onder et al. (2011) describe the environmental impact of agricultural activities under two major headings: adverse effects from pesticide usage, chemical fertilizer usage, irrigation, soil tillage, system of plant hormones, stubble burning, and animal junks. An additional research by Stolze et al. (2000) shows the positive impact of organic farming on air pollution with (I) lower usage of high-energy feed stuffs (II) shorter input of mineral fertilizers (III) elimination of pesticides (p. 56). The researcher also spoke of that there is no research available, which analyzed the net equilibrium of air pollutions in agriculture.

The main courage of the study is to fixate air pollution, energy consumption, and agricultural productivity which played a significant role in the present conversation on sustainable development and environmental subsidy. Some studies have shown a direct positive link between energy consumption and environmental degradation (Boutabba, 2014; Destek, Balli, & Manga, 2016). On the other hand, Uddin's (2020) analysis using data from 115 countries over the 1990-2016 period found the long-run dynamic relationship between agricultural and manufacturing GDP, energy consumption, urbanization, trade openness, transportation, and the pollutants.

Human viscosity and environmental degradations are also occurring at a similar rate due to this unsystematic development of the manufacturing sector. Though, a heavy society, widening urbanization and a fast-growing industrial root have boosted the spirit of a looming environmental catastrophe. Bangladesh has little capacity to pay attention to environmental development matters as it remains in the development stage and is one of the highly populated and one of the fastest population growth rates countries in the world. That's why, despite this ominous environmental tragedy, the country's policymakers have been ignoring the issue for a long time. Although a few studies on Bangladesh’s environment are available without conclusive results, environmental economics remains a relatively under-studied area in Bangladesh (Islam and Shahbaz, 2012). Similarly, the chosen variable for growth (GDP) as a determinant of Air pollution in earlier studies is not appropriate for Bangladesh.

3. DATA AND METHODOLOGICAL FRAMEWORK

3.1. Data Collection

This study assembles time series data from Economic Review report of Bangladesh and World Bank data of 1972 to 2019. Missing data are estimated under interpolation. The ARDL model is confirmed under Eviews version 10.0 and OLS first is not estimated. The multivariate blueprint of this study assembles six variables (Table 01). Only data of food grain and fertilizer use are collected from Economic Review report of several years, and missing are estimated. To avoid heteroscedasticity, the study transforms each variable in natural logarithm.

Table 1 Explanation of variables with data source

Variables	Description	Source
AGRI	Agriculture, forestry, and fishing, value added (% of GDP)	WDI
EN	Energy use (kg of oil equivalent per capita)	WDI
AGL	Agricultural land (% of land area)	WDI
AOP	Agricultural methane & CO2 emissions (% of total)	WDI
FER	fertilizer use in thousand metric ton	Economic review report
FG	Total food grain production in lakh metric ton	Economic review report

Source: Estimated.

3.2. Specification of Model

This study carried out an ARDL model to estimate air pollution resulted in energy consumed for boosting agricultural as well as food grain production in Bangladesh. To postulate EKC model by Ang (2007) and similarly estimated by other researchers (Sugiawan and Managi 2016; Shahbaz and Sinha 2019), the model is written as:

$$AOP_{it} = \alpha_i + \beta_1 AGRI_{it} + \beta_2 AGRI_{it}^2 + \beta_3 AGL_{it} + \beta_4 FER_{it} + \beta_5 FG_{it} + \beta_6 EN_{it} + \varepsilon_{it} \quad (1)$$

After logarithmic transformation, the equation of (1) xan be written as:

$$LnAOP_{it} = \alpha_i + \beta_1 LnAGRI_{it} + \beta_2 LnAGRI_{it}^2 + \beta_3 LnAGL_{it} + \beta_4 LnFER_{it} + \beta_5 LnFG_{it} + \beta_6 LnEN_{it} + \varepsilon_{it} \quad (2)$$

Where AGRI and $(AGRI)^2$ represents agricultural contribution on GDP, AGL means agricultural land use, FER fertilizer use on agricultural sector, FG total food grain production and EN represents energy use. EKC gives us suggestion that β1 is desirable but .β2 .β3 .β4 ,β5 and β6 is not expected. If EKC doesn't hold, then no coefficient of AGL, EC, FER or FG is easy to determine. So, to determine the coefficients of these variables and maintaining the rationale of EKC, researchers added a square term $(AGRI)^2$. If EKC hypothesis of AGRI is undesirable that means cointegration reveals byzantine correlation, then $(AGRI)^2$ will not be desirable variable.

Pesaran and Shin (1998) introduced the ARDL model for exhibiting analysis of long- and short-run correlations. Narayan (2004) similarly used this model to check the long-run and short-run nexus between selected variables. The integration order was distributed among the variables at I(0) or I(1) separately from the incidence of I(2). This study followed the same analytical technique in order to estimate the short-run and long-run causality among selected variables for Bangladesh. The ARDL model is shown in Eq. 3.

$$\Delta LnAOP_t = \alpha_0 + \sum_{i=1}^{z} \beta_{1i} \Delta LnAOP_{t-i} + \sum_{i=1}^{z} \gamma_{2i} \Delta LnAGRI_{t-i} + \sum_{i=1}^{z} \varepsilon_{3i} ([\![\Delta LnAGRI)2]\!]_{t-i} + \sum_{i=1}^{z} \rho_{4i} \Delta LnAGL_{t-i} + \sum_{i=1}^{z} \omega_{5i} \Delta LnFER_{t-i} + \sum_{i=1}^{z} \sigma_{6i} \Delta LnFG_{t-i} + \sum_{i=1}^{z} \tau_{7i} \Delta LnEN_{t-i} + \vartheta_1 LnAGRI_{t-1} + \vartheta_2 LnAGRI_{t-1}^2 + \vartheta_3 LnAGL_{t-1} + \vartheta_4 LnFER_{t-1} + \vartheta_5 LnFG_{t-1} + \vartheta_6 LnEN_{t-1} + \varepsilon_t \quad (3)$$

Where $\alpha_0$is intercept of the constant, Δ is difference operator, Z is lag order, β,γ,ε,ρ,ω and σ are short run coefficients and ε_t is the sign of error term. The null hypothesis of no long run-relationship Ho: $\vartheta_1 = \vartheta_2 = \vartheta_3 = \vartheta_3 = \vartheta_4 = \vartheta_5 = \vartheta_6 = 0$ against Ho : $\vartheta_1 \neq \vartheta_2 \neq \vartheta_3 \neq \vartheta_3 \neq \vartheta_4 \neq \vartheta_5 \neq \vartheta_6 \neq 0$. Rejecting null hypothesis under certain level of significance, this study go for further short run estimation. After accomplishing ARDL model with F-statistic values proposed by Pesaran & Narayan bound limits, the error correction mechanism model (ECM) with two exogenous regressors equation (4) is as follows:

$$\Delta LnAOP_t = \delta_0 + \sum_{i=1}^{z} \delta_{1i} \Delta LnAOP_{t-i} + \sum_{i=1}^{z} \delta_{2i} \Delta LnAGRI_{t-i} + \sum_{i=1}^{z} \delta_{3i} ([\![\Delta LnAGRI)2]\!]_{t-i} + \sum_{i=1}^{z} \delta_{4i} \Delta LnAGL_{t-i} + \sum_{i=1}^{z} \delta_{5i} \Delta LnFER_{t-i} + \sum_{i=1}^{z} \delta_{6i} \Delta LnFG_{t-i} + \sum_{i=1}^{z} \delta_{7i} \Delta LnEN_{t-i} \, \theta ECT_{t-1} + \pi_1 D_{1t} + \pi_2 D_{2t} + \varepsilon_t \quad (4)$$

Here, error correction term (ECT) describes about speed of adjustment, and depicts how the variables run towards the equilibrium through short-run. Its value must be negative with significant statistical value. Further stability test (CUSUM & CUSUSQ) and diagnostic tests are applied to promote ARDL model and fulfil its assumption,

4. EMPIRICAL RESULTS

4.1. Descriptive Statistics

This study assess six variables from 1972 to 2019 of which AOP is dependent variable (carbon & methane emission from liquid fuel consumption (percentage of total). Agriculture is our prime basis of economy and this study employs four variables- AGRI, AGL, FER & FG. AGRI represents includes Agriculture, forestry, and fishing, value added (% of GDP) which suddenly abrupt after 1979 of 52 percent to 1980 of 39 percent. As time goes, the contribution of agriculture on GDP is decreasing. AGL displays agricultural land use under land area, its pick on 79% at 1991 but within one year its doom in 73%. After 1992, its downward trend. Others variable have no drastic change. In case of test of normality, Except AGRI, FER and EN, others resemble normal distribution. In case of test of normality, Except AGRI, FER and EN, others resemble normal distribution.

Table 2 Basic statistics of six variables (before natural logarithm)

Basic statistics	AOP	AGRI	$(AGRI)^2$	AGL	FER	FG	EN
Mean	79.506	28.589	10.765	73.930	7523.747	230.741	157.090
Median	78.261	24.996	10.349	72.355	4848.995	186.402	137.003
Maximum	98.575	61.954	17.027	80.226	27950.120	415.740	362.044
Minimum	55.363	12.735	6.474	69.901	2217.800	96.710	88.147
SD	11.022	13.772	2.992	3.194	7248.779	95.762	67.789
Skewness	-0.133	1.047	0.577	0.425	1.778	0.524	1.525
Kurtosis	2.540	3.080	2.393	1.725	4.556	1.999	4.701
Jarque-Bera	0.564	8.788	3.400	4.701	30.134	4.202	24.400
Probability	0.754	0.012	0.183	0.095	0.000	0.122	0.000
Sum	3816.28	1372.26	516.74	3548.62	361139.80	11075.550	7540.314
Sum Sq. Dev.	5709.813	8914.570	420.796	479.427	2470000000	431002.9	215981.9
Observations	48	48	48	48	48	48	48

Source: Estimated.

4.2. Unit Root Tests Analysis

Before applying ARDL approach, it is necessary to determine the order of integration of the variables using unit root test. The ARDL is applicable only for the variable that is stationary either at level or at first difference [I(0) or I(1)]. Since ARDL is only restricted with I(0) or I(1) series, we apply unit root testy with two types; without structural break or conventional unit root and with single structural break test. For traditional unit root test, this study uses Augmented Dickey-Fuller (Dickey& Fuller, 1979) and Philips-Perron (Phillips & Perron, 1988) test. On both cases, study variables- AOP, AGRI, AGRI2, AGL, FER and EN are stationary at first difference. This study applies the Zivot–Andrews structural break unit root test, which allows having information about an unknown structural break point in the time series (Zivot and Andrews, 1992).

Table 3 Unit root test of variables

	ADF test		PP test	
Variables	Intercept	Intercept with trend	Intercept	Intercept with trend
AOP	1.14	-0.83	1.54	-0.74
	(-1.00)	(0.95)	(1)	(0.96)
AGRI	-1.19	-3.90	-1.05	-3.16
	(-0.67)	(0.02)	(0.73)	(0.11)
(AGRI)2	-1.64	-2.95	-1.61	-2.94
	(-0.45)	(0.16)	(0.47)	(0.16)
AGL	-1.30	-2.98	-1.21	-2.31

	(-0.62)	(0.15)	(0.66)	(0.42)
FER	-2.30	-1.28	-2.37	-1.08
	(-0.17)	(0.88)	(0.15)	(0.92)
FG	-0.77	-2.96	-0.70	-2.87
	(-0.82)	(0.15)	(0.84)	(0.18)
EN	3.62	4.03	5.02	2.87
	(-1)	(1)	(1)	(1)
D(AOP)	-0.81	-1.17	-8.41	-8.70
	(-0.81)	(0.90)	(0)	(0)
D(AGRI)	-3.68	-3.71	-7.48	-7.64
	(-0.01)	(0.03)	(0)	0.00
D($AGRI^2$)	-3.51	-3.65	-7.41	-7.95
	(-0.01)	(0.04)	(0)	(0)
D(AGL)	-5.36	-5.30	-5.35	-5.29
	(0)	(0)	(0)	(0)
D(FER)	-2.61	-4.13	-6.23	-9.47
	(-0.10)	(0.01)	(0)	(0)
D(FG)	-7.22	-7.14	-7.42	-7.32
	(0)	(0)	(0)	(0)
D(EN)	2.99	-6.46	-5.14	-6.48
	(-1)	(0)	(0)	(0)

Source: Estimated.

Table 4 Zivot-Andrews test of variables

	At level		**At first difference**	
Variables	**T statistic**	**Time break**	**T statistic**	**Time break**
AOP	-3.078	2012	-10.354**	2000
AGRI	-6.914**	1980	-10.781**	1983
(AGRI)2	-8.389**	1980	-11.566**	1983
AGL	-9.465**	1992	-6.337**	1990
FER	-4.351	1980	-7.977**	1983
FG	-3.367	1984	-9.767**	1983
EN	-2.668	2007	-7.104**	1996

Source: Estimated (** for 1% level of significance).

Results in Table 03 indicate the existence of unit roots with a structural break in both intercept and trend. Some are stationary at level but all variables are found to be stationary after first differences. After first difference most variables exhibit break at 1983 and at level AGRI, AGL exhibit break on 1991, so we take two dummies for our model as exogenous regressors. These results serve as grounds to implement the ARDL bounds testing approach to cointegration, examining the long run relationship between AOP, AGRI, AGL, EN, FER and FG from 1972 to 2019.

4.3. Analysis of Cointegration

Table 5 Result of auto-regressive distributions lag model (ARDL (1,1,2,2,2,0,1) model)

Variables	**F-statistic**	**P-value**
H(AOP(AGRI/AGRI2, AGL,FER,FG,EN)	5.974	0.0001
Critical bound value	I(0)	I(1)
10%	2.271	3.670
5%	2.729	4.318
1%	3.826	5.860

Source: Estimated.

In ARDL, we choose optimal lag criteria through Akaike's Information criteria (AIC). We carry out ARDL model and then UECM in equation (4). In case of ARDL model, the result of table () exhibits F-statistic as 5 .974, that surpasses the I(0) and I(1) bound at 1% level of significance. So, we can conclude that there is a cointegration of air pollution and agricultural output, agricultural land, fertilizer use, total food grain production and energy use. So, UECM can be estimated as short run and long run estimates.

4.4. Long-Run and Short-Run Estimation for the Period 1972-2019

In case of short run estimates, the response of agricultural contribution on GDP (AGRI) is negative but its square is positive with 5% level of significance. Therefore, our EKC postulation is positive with total air pollution emission. Fertilizer use (FER) responses positively and statistically significance at 1% with air pollution. Our structural breaks (D01 and D02) are negatively associated air pollution emission and regarded as exogenous regressors. In case of error correction mechanism, the error correction term explain 67.5% disequilibrium of air pollution emission from agriculture (AOP) to others variable. It's also explained at 1% level of significance ensures the speed of adjustment at 67.5% towards long run.

Table 6 Short run and long run coefficient analyzed by ARDL (1,1,2,2,2,0,1) model

Variable	Coefficient	S.E.	t-statistic	p-value
Long run results				
AGRI*	-3.655	1.411	-2.590	0.015
(AGRI)2*	0.574	0.212	2.707	0.011
AGL	0.665	0.437	1.523	0.139
FER*	-0.209	0.081	-2.566	0.016
FG*	0.245	0.097	2.523	0.018
EN**	-0.635	0.127	-5.000	0.000
Short run results				
Constant	7.385	1.038	7.114	0.000
D(AGRI)	-0.943	0.608	-1.550	0.132
D(AGRI)2	0.150	0.084	1.784	0.085
D(AGRI)2(-1))**	-0.028	0.009	-3.266	0.003
D(AGL)	-0.313	0.218	-1.434	0.163
D(AGL(-1))	-0.515	0.258	-1.996	0.056
D(FER)	-0.016	0.026	-0.643	0.525
D(FER(-1))**	0.080	0.024	3.383	0.002
D(EN)	-0.131	0.091	-1.438	0.162
D01**	-0.055	0.011	-4.961	0.000
D02**	-0.039	0.011	-3.430	0.002
ECT(-1)**	-0.675	0.095	-7.126	0.000
Test	Test statistic	p-values		
Normality	0.757	0.685		
Heteroscedasticity	1.089	0.409		
Serial correlation	0.595	0.559		
Test	Support			
CUSUM	Stable			
CUSUMSQ	Stable			

Source: Estimated.

On long run estimates, fertilizer use (FER) and energy use (EN) associated with negatively at 5% and 1% level of significance respectively. In addition, agricultural contribution on GDP (AGRI) expresses negatively but its square (AGRI) 2 responses positively response. Also, food grain (FG) is positively associated with the air pollution emission from agriculture (AOP). For diagnostic tests, further tests like serial correlation, heteroscedasticity and normality tests are rejected and strongly support our model. For stability testing, we also employ CUSUM & CUSUMSQ test and both are stable.

5. CONCLUSION AND POLICY IMPLICATIONS

This study attempt to exhibit relationship between agricultural output, air pollution and some control variables of agro-based issues. Data collected from World Bank website and economic review of long-time span on this context. Unit root tests reject null hypothesis at first difference of all variables. Regarding the issue of structural break and under taking consideration of natural disaster at 1991 or agricultural degradation on 1983, we apply Zivot-Andrews single break test. An empirical analysis of ARDL with AIC criteria, it fulfills all assumption with free from heterogeneity, over-specification and serial correlation.

Results of ARDL model using F statistic strongly suggest long run relationship and reject null hypothesis of no cointegration between air pollution, energy consumption and agricultural output in Bangladesh at 1% level of significance. Having yearly data, to loose less degrees of freedom & reduce more parameter in the model, under minimum AIC criteria, parsimonious lag order of this ARDL model is (1,1,2,2,2,0,1). For short run estimates, speed of adjustment describes about the equilibrium of the model is corrected by 67.5% for this model. Under EKC hypothesis, the sign of agricultural output on GDP (AGRI) is corrected through adding square term. As in short run and long run, it reveals negative but square term is positive resulting in its impact is positively attributed to air pollution. Also, fertilizer consumption is increased of 0.08 unit if single unit change increase for air pollution at 1% level of significance. For long run estimates, as air pollution increase for one-unit change, energy use consumption will decrease 0.64 unit under 1% level of significance. Agricultural output, food grain production and energy use is positively significance with 1% level of significance of air pollution. Hence, EKC is visited under ARDL model with agricultural contribution on GDP with square term and energy use with alternative sign on short run & long run. For meeting the demand of food use of fertilizer is increasing day by day. This running drift booming air pollution and reducing contribution of agriculture on GDP as time goes. Digging out this knowledge, this study assesses ARDL model using two dummies as fixed regressors, which confirm stability test (CUSUM and CUSUMSQ). Each curve depicts a smooth line under 95% confidence interval. Hence, in short run, long run, diagnostic test or stability stated that there is a strong association of air pollution and agricultural output, energy consumption, land use covered by agriculture, fertilizer use on agriculture and crop production.

Policies for this manuscript is measured from the basis of results. Before polices, some open secret but challenges are still burning question. Lessening arable lands, shifting agricultural lands to household or industries, water scarcity and climatic hazard, nature dependency farming and lower crop intensity are still prevailing obstacles towards agricultural boom (Tahidur, 2017). Steps and policies are too many taken from government side to curb the speed of carbon emission. Being a delta region, we need more ascertain and ecological safeguard-based planning and strictly maintenance. Shifting habits of utilizing fertilizer with fossil consumption, pesticides or machines with large volume and ingredient with hazardous amount to organic fertilizer and biological pest or eco-friendly fertilizers to maintain soil fertility, increase productivity and lessen harm. Replacing fossil fuel by renewable energy and promoting its availability through governmental scheme or plans, planning fertile or soil environment-based crops to meet the food demand and sustain healthy environment. As arable land is decreasing, so we need action to produce optimum level production through these steps discussed now (Tahidur 2017). Agricultural contribution is switching in place with RMG or another sector. However, to feed our population, advancement in modern equipment and studies on agricultural research will assist more for generating new High-yielding variety (HYV) of cereal or other crops. This study has some limitations. As it used dummy for performing structural break which comes from climatic hazard or political unrest, these issues to be included. Regarding multicollinearity issue, these two variables are not in account. In addition, regime shifts is neglected as our concern is solely utilize the direct effect of study variables. There is no theories available for combining these relations on environment aspect. For this, EKC under ARDL with ECM model is utilized. Above all, we have more to do to establish quality agricultural production, to reduce fossil consumption and, finally, to create an agricultural revolution.

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