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The Effect of Bioenergy and Pollution on Economy of Pakistan

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Abstract: This paper investigates the Effect of Bioenergy and pollution on economy of Pakistan. Unit root and integration tests have been used to check unit root properties and long-run relationship for the times of 2001Q1 to 2015Q2. The relevant result shows there is a long run relationship exists between the pollution and bioenergy. In short run, there is no effect or low effect of bioenergy on economic growth of Pakistan which have to possess no contributions for economic development. The study further investigates to show that biomass as the basic source of renewable energy, cooperate Pakistan to gain durable improvement aim in the long run as well as in short run. On other hand, government needs to take a serious step to control the pollution level in Pakistan.
Keywords: Bioenergy, pollution, GDP, Pakistan

INTRODUCTION

It is now widely recognized that sustainable development depends on secure and safe availability of food, water, and energy. At the same time industrial raw materials are increasingly based on renewable resources. Such an increase in consumption consequences together with the increased hazards of pollution and the safety problems associated with a large bioenergy waste. This puts biomass and bioenergy and hence the bio-economy at the center of sustainable economic development. Bioenergy potentials to contribute to sustainable development need to be assessed in the context of the broader energy system, the food, and agriculture system, and the water use systems in Pakistan. To identifies the major impacts of bioenergy development on the national energy sectors and households and communities in Pakistan and presents a conceptual framework that can guide further research on bioenergy for development. Accept recently advised the Administrator that the nation has the capacity to create a biofuel system that can help meet energy needs over the generations ahead without degrading the natural resources of soil and water, but they caution that this outcome will not be automatic easy or inexpensive for economy of Pakistan.

Demand for energy and its resources is increasing continuously due to the rapid outgrowth of population and urbanization. Present sources of energy in Pakistan are not sufficient to overcome the increasing needs. Since 1973 the energy resources have been doubled in developed countries, but the demand is still higher. World energy demand is expected to increase approximately 50% above 2002 level and will increase approximately two and half times the present level. The major energy demand is fulfilled from the conventional energy resources like coal, petroleum and natural gas. It was estimated that the oil sources might be depleted till 2050. The process of obtaining energy from these sources causes atmospheric pollution resulting in problems like global warming, acid rain, etc. Viewing the increase in the energy demands and keeping given the pollution a shift over to non-conventional sources like wind, sunlight, water, biomass, etc., is inevitable. Biomass is being used from the ancient times as a combustion fuel for cooking keeping warmth in houses etc. Biomass is available in abundance and is cheap, and its better utilization is to convert it into energy-rich products using suitable process.

Bioenergy materials are the most promising feedstock as natural and renewable resource essential to the functioning of modern industrial societies. A considerable amount of such materials as waste by products is being generated through agricultural practices mainly from various agro based industries which are the source of pollution for Pakistan economy. Sadly much of the lignocellulose biomass is often disposed of by burning which is not restricted to develop Pakistan. Recently lignocellulose biomasses have gained increasing research interests and special importance because of their renewable nature. Therefore the huge amounts of lignocellulose biomass can potentially be converted into different high value products including bio-fuels, value added fine chemicals, and cheap energy sources for microbial fermentation and enzyme production.

In Pakistan agriculture continues to be an important economic sector as it makes a significant contribution to national incomes and economic growth because it plays an important role in the economic transformation particularly in Pakistan. Biofuels are a relatively newly applied alternative fuel. In the past few years interest in biofuels has greatly increased and this can be attributed to environmental, economic, and geopolitical factors. Harmful emissions, high crude oil prices, and the growing dependency on foreign oil supplies have provided incentives for pursuing alternative fuel sources such as ethanol and biodiesel are being a source for pollution to economy. Rising global demand for oil and concerns about the costs and consequences of global warming are contributing fresh momentum to viewing agriculture as a way to diversify our sources of energy for a more secure and renewable energy future.

Pakistan is currently facing the energy crisis, and if Pakistan develops the biofuels industry, it can overcome that crisis in more effective way. According to World Bank (2005) to transforming agricultural waste and manure into biogas will improve the living standard of poor rural people by providing energy for cooking and lighting increase jobs and substitute the time spent collecting firewood with economic activities and decrease the release of greenhouse gases mainly in rural areas and this all can be applied to the rural areas of Pakistan also. The UN reported that as biofuels absorb crop surpluses in developing countries, so the commodity prices will rise, increasing income for farmers in developing countries. This will lead to more economically sustainable agriculture and prices in most developing countries. Presumed environmental benefits are important drivers for greater use of biofuels particularly the benefits of reduced GHG emissions. No fuel system is free of environmental concerns.

The study investigates the effect of bioenergy and pollution on economy of Pakistan. The bioenergy sources to be used to test the relationship 0f wood, fossils of sugarcane etc. with pollution. The study is designed to show the effect of bioenergy and pollution in the economic performance of Pakistan, which will be a significant and important contribution to the literature in general and for the case of Pakistan in particular. The range of waste treatment technologies that are tailored to produce bioenergy is growing. There are a number of key areas of bioenergy from wastes including biogas, biofuels and bioheat. When considering using bioenergy, it is important to take into account the overall emission of carbon in the process of electricity production. Energy use is one of several essential components for every country: The overall situation and the implications of increased energy use in the future. The problem of the provision of power in rural areas, including the consideration of energy resources and energy conversion. The main objective of this paper is to investigate the impact of bioenergy and pollution for Pakistan economy.

LITERATURE REVIEW

A large number of studies have been undertaken to examine the effect of bioenergy and pollution on economic growth of Pakistan particularly in the last two decades. The issue of bioenergy has received great attention of the academic researchers, international organizations and institutions. The majority of the researchers found a significant relationship between bioenergy and pollution on economic growth.

Butt *et al*., [1] says that the use of biomass plays a Vitol role in developing countries like Pakistan for full filling energy demand. Pakistan is an agricultural country, so the household uses agricultural waste like biogasses rice husk, cotton stalks, etc. for their energy requirements. The productivity can be increased by transferring the traditional way of utilizing to the modern way. It can overcome the shortage of Energy in Pakistan.

Uddin *et al*., [2] argues that Pakistan is facing of energy shortage since last decade. Every year Pakistan spending more than 14.5 billion US dollars to import crude oil in order to fulfill the energy gap. Energy demand increasing rapidly but exploration and use of renewable energy is not meeting the needs of requirements. The potential of biogas is reviewed to meet the energy requirement of Pakistan.

According to Kagan [3] bioenergy produced and used everywhere where biomass can be produced. Moreover, bioenergy technologies are developing rapidly. Whereas the first and second generation of bioenergy types such as ethanol and biodiesel were produced from food-based crops such as sugar beet, wheat, maize, soy, rapeseed and vegetable oil, etc. the third and fourth generation of biofuels make use of algal biomass, artificial photosynthesis or are developed using advanced biochemical processes and do not directly compete with food production

Bhutto *et al*., [4] indicates that in Pakistan, access to commercial energy is limited, the household uses wood, animal waste and crops waste in the traditional way for the energy sources, to fulfill the energy sources of household it is important to change the traditional method to conventional scientific technologies.it will be a great impact on economy of pakistan in term of Energy creation in abundant level. To develop new technologies to convert these traditional way to scientific way.

Tingting *et al*., [5] describe that bioenergy is the major domestic energy for rural households in developing countries due to its cheap or easy getting characteristics. Productive use of bioenergy is an

important strategy for rural households to improve not only their income but also their health.

Shabazz *et al*., [6] says that there is a long-run effect of bioenergy on economic growth. There exist a relationship of bioenergy consumption and economic growth. Consumption of biomass energy stimulates economic growth. Renewable energy can increase the economic growth. Biomass is a form of renewable energy, so it has an impact on economic growth in long run. Particularly rural areas economy can accelerate by bioenergy consumption.

Smith *et al*., [7] argues that solid fuels are difficult to burn in simple combustion devices such as household cooking and heating stoves without substantial emissions of pollutants, principally because of the difficulty of completely premixing the fuel and air during burning, which is done easily with liquid and gaseous fuels. Where biomass is usually used directly without undergoing any further processing. So it's called modern bioenergy comes from further processing of biomass into many new forms such as liquid transportation fuel.

Zhang *et al*., [8] says that in households that use sulfur-rich coals, for example, sulfur dioxide (SO2) pollution affects not only indoor air quality (IAQ) but also outdoor air quality at a local or regional scale because coal burns at a substantially higher temperature than biomass, higher emissions of NO2 were measured for coal combustion than for biomass combustion.

Karta [9] argues that producing more biomass could also contribute to a poorer environment by exhausting the soil from nutrients, worsening erosion, drawing on the water resources, and pushing habitats aside with deteriorating biodiversity as a consequence. There is a serious danger that biofuels are being produced at the cost of rainforests, which not only absorb carbon dioxide from the atmosphere but are also home to a unique range of biodiversity (Biofuels and developing countries, 2008)

Condor [10] indicates that increased interest in dedicated biomass crops requires attention: the environmental impacts, the increased price of agricultural products, and the sustainability of bioenergy crops, have become arguments capable of limiting the development of the bioenergy sector.

Lacorte *et al*., [11] indicates that renewable Energy Directive encourages the production and use of biofuels by establishing a binding minimum target for renewable energy sources of 10% of final energy use in the transport sector by 2020. The Directive issued this target to respect emission reduction regulations of the greenhouse gasses (GHG), to improve the energy security supply, and to increase the use of renewable energy sources thus reducing the dependence on oil imports. The Biofuel Directive recognizes that the increase in the use of biofuels should be accompanied by a detailed analysis of their environmental impacts, in order to avoid any potential negative effect as much as possible.

Schirnding *et al*., [7] describe that more than 2 billion of the world's population poorest people still rely on biomass and coal burning for household energy needs such as cooking and heating. A large using of biomass and bioenergy mostly in developing countries of the world which belong to particularly Asia and African countries. It causes various diseases because of burning on traditional way. Government policy to change the traditional method to modern way is very important in this context.

Demirbas [12] argues that current policies of biofuels energy address environmental issues including environmentally friendly technologies to increase the supply of energy, protect the environment from pollution and to create jobs in rural areas.it will be better for the economy particularly agricultural economies. The demand for agriculture products will be going up and hence bringing prosperity in economic level.

According to Solomon [13] that government's interest in liquid biofuels production and also use of biofuels increased worldwide because of the scarcity of petroleum production to help mitigate adverse global climate change. In developing and develop countries, efforts are included programs to shift toward the production and use of biofuels based on residues and waste materials from the agricultural and forestry sectors, and perennial grasses.

Domac *et al*., [14] point out that this is encouraging the trend in many countries for policymakers beginning to perceive the benefits of commercial biomass e.g. employment, earning, regional economic gain, contribution to the security of energy supply and others important economic benefits. Use of commercial biomass can bring socio, economic, and other benefits for the countries. Worldwide international community is keeping keen interest to moving society towards more widespread use of renewable energy resources.

Jahangir [15] describe that Bioenergy is produced from organic matter and when it convert in a scientific manner it becomes a renewable energy. It produces heat and power in more which can overcome the demand of energy in developing countries .it creates more jobs, developing infrastructures. Biofuels will meet the demand of transport oil .it is an important instrument for climatic change to overcome the Air pollution, water pollution and soil pollution in the developing countries as well as in developed countries.

Jacobson [16] says that use of biofuels expanded for many years because of biofuels replacing fossil fuels that reduce global warming and Air pollution problems .particularly Ethanol may help very much in reducing global warming and Air pollution problems both in developing and developed countries.

According to Erum *et al*., [17] that demand for energy increases with passage of time, alternate sources like biofuels can share important role to full fill the demand of energy in future.

Nasir *et al*., [18] argues that almost 70% Pakistan population living in rural areas ,ninety-four percent of household in rural areas and 58% in urban areas all of them depend on biomass fuels (wood, dung, and agricultural waste). The use of these fuels in the traditional way which is a big threat to the health of mass particularly for women and children .women during cooking affected by the smoking of the waste materials. The traditional way can be converted to scientific way to decrease this problem. The main objective of this effects of bioenergy and pollution on Pakistan economy.

RESEARCH METHODOLOGY

Models

In order to analyze the effect of bioenergy and pollution on economic performance of Pakistan, a linear regression model will used. The model is designed by taking real GDP as dependent variable, while Bioenergy and Pollution are taken as dependent variables.

GDP = f (BE, P)

Where:
BE = Bioenergy
GDP = Gross Domestic Production at Constant local currency
P = Pollution (taking Co2 as measure of pollution)

The study will use Time Series data for the period 2002Q1 to 2015Q4. .Using the time series data often include the possibility of obtaining spurious regression. However, firstly, to test if a time series is non–stationary this study will uses the Augmented Dickey-Fuller test, which examines the hypothesis that the variable in question has a unit root. If the series is found to have a unit root differencing the data is appropriate before performing the regression analysis, to avoid the problem of spurious regression arising from non-stationary in the time series. Secondly, this study will involve testing of Cointegration using the Johansen Maximum likelihood approach, to detect the existence of a long-run relationship among the variables included in this study. We all applied Ganger Causality test that mutual interaction between the variables; For the short run relationship, an error correction model (EMC); which based on the difference form of variables and also include one lagged value of error correction term in the model. The long estimation should be analyzed through ADF unit root test, Integration, Granger Causality while short run estimation will evaluate through ECM. Annual data for the sample period 2002-2015collected from Pakistan economic survey and later it converted into quarterly frequency hence our data span become 2002Q1 to 2015Q4.

RESULTS AND DISCUSSIONS

Results and discussion are based on the estimations of the model as mentioned in methodology; the analysis contains both short run and long run estimations. ADF, cointegration, and Granger Casualty test is used for the long run estimations while ECM will show the short linkages between the variables. Here table -1 estimates the ADF unit root test

ADF unit root test

Table-1: ADF unit root test

Variable	at level	at 2nd difference	Conclusion
GDP	0.761187 (-1.948313)	-2.921175 (-2.349842)	non-stationary at level & 1st difference stationary at 2nd difference
CO_2	0.389591 (-1.948313)	-2.140853 (-2.921175)	non-stationary at level & 1st difference stationary at 2nd difference
BE	-1.430163 (-3.568308)	-2.921175 (-2.473817)	non-stationary at level & 1st difference stationary at 2nd difference

ADF unit root test shows in the table -1 contains variable in the first column, ADF estimation in at level in the second column while it shows the ADF estimations on the 2nd difference in third column while the final column indicates the conclusion regarding the existence of stationary. The ADF estimations show that all variables are non-stationary at the level and first difference and become stationary at the 2nd difference. This fulfills the basic requirement of cointegration. The Table -2 shows the cointegration results.

Co integration

Table -2: Co integration

Sample (adjusted): 2003Q2 2015Q4				
Included observations: 51 after adjustments				
Trend assumption: Linear deterministic trend				
Series: CO2 BE GDP				
Lags interval (in first differences): 1 to 1				
Unrestricted Co integration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.759117	135.7624	29.79707	0.0001
At most 1 *	0.626329	63.16677	15.49471	0.0000
At most 2 *	0.224451	12.96342	3.841466	0.0003
Trace test indicates 3 co integrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Co integration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.759117	72.59561	21.13162	0.0000
At most 1 *	0.626329	50.20335	14.26460	0.0000
At most 2 *	0.224451	12.96342	3.841466	0.0003
Max-eigenvalue test indicates 3 co integrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

The above table shows cointegration estimations; it contains two sub-tables one trace statistics and other maximal Eigen-value statistics. Both of these statistics are estimated through maximal likelihood method; these statistics are tested against their relevant critical values; the cointegration results shows existence of three cointegrating vectors both in maximal Eigen values and trace statistics. This indicates that all variables have long run relationship and determine each other.

Granger Causality Tests

Table -3: Granger Causality Tests

Sample: 2002Q1 2015Q4			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
BE does not Granger Cause CO2	51	18.0763	2.E-06
CO2 does not Granger Cause BE		14.5456	1.E-05
GDP does not Granger Cause CO2	51	37.1672	2.E-10
CO2 does not Granger Cause GDP		10.0022	0.0002
GDP does not Granger Cause BE	51	13.3226	3.E-05
BE does not Granger Cause GDP		10.5288	0.0002

Granger causality results shows that bivariate causality between BE and CO_2 it imply BE causes CO_2 this that bioenergy causes air pollution in Pakistan; GDP also shows bivariate causality with CO_2 which indicates that CO_2 causes GDP means higher energy consumption resulted in higher production and high level of GDP; The production of GDP also need higher energy that causes the emission of CO2 and pollution. GDP and bioenergy (BE) also have bivariate causality with this indicates GDP causes BE means that higher GDP requires higher demand for energy and thus higher BE is generated, and on the other side a higher level of production of BE also generates and contributes in and producing higher GDP.

ECM results

Table–4: ECM results

Dependent Variable: DGDP				
Method: Least Squares				
Sample (adjusted): 2003Q1 2015Q4				
Included observations: 52 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007837	0.001088	7.201236	0.0000
DCO2	0.414509	0.101155	4.097766	0.0002
DBE	0.002876	0.003240	0.887743	0.3791
ECT(-1)	0.104520	0.034231	3.053347	0.0037
R-squared	0.465194	Mean dependent var		0.011550
Adjusted R-squared	0.431769	S.D. dependent var		0.005620
S.E. of regression	0.004236	Akaike info criterion		-8.016506
Sum squared resid	0.000861	Schwarz criterion		-7.866410
Log likelihood	212.4291	Hannan-Quinn criter.		-7.958963
F-statistic	13.91740	Durbin-Watson stat		0.169380
Prob(F-statistic)	0.000001			

The error correction model shows the short-run parameters of the model, all variables are taken in differenced form and lag value of error correction term is included in the model. DGDP is taken as dependent variable, while BE, DCO_2 and lag of error correction model are included as independent variables. The ECM results show that pollution is positive and significant effect on economy of Pakistan because the higher CO2 means higher economic activity and production which means that its common those in industrialized nations although Pakistan is not that much industrialized yet higher amount of CO2 is the part of higher production and economic growth. Bioenergy is appeared with positive but insignificant sing this implies that bioenergy may not contribute to GDP and economic activities in short run but as Cointegration results indicates that it hold a long run relationship thus it only contributes to GDP in long run. The lag value of error correction term (ECT(-1)) is used for the short run dynamics and its coefficient shows positive and significant sign which means that model is holding divergence property and will long time to converge and restore long-run equilibrium.

CONCLUSION

This paper shows the linkages between bioenergy, pollution for the economy of Pakistan. Since Pakistan is suffering from energy shortage, therefore, utilization of bioenergy from the different sources is highly desirable; bioenergy is one of the options with the government. Indeed Pollution is most popular issue of Pakistan economy, its effect on different sectors of the economy. Therefore this study is designed to estimate relationship bioenergy and pollution on the economy of Pakistan.

Pollution is increasing with the increase of production. Emission of various gasses affects economy since many years. Pakistan is one of the economy where the use of bioenergy in the long term is not so fast, it has a great impact on economic growth in the long run, but in the short run, there is no significant impact on economy of Pakistan.

This study uses both short and long run linkages between these variables. This study applied ADF unit root, cointegration, Granger Causality for long run estimations while and Error correction model are applied for the short run estimations. The empirical estimations of the model indicates that pollution and bioenergy has long run association with GDP; this show bioenergy and pollution both are increasing GDP; but in short run the only pollution is contributing to GDP and bioenergy role is insignificant and negligible; one of the reason might be low level of production of bioenergy that does not contribute to the economic growth in short run.

With the increased of industries, pollution increasing in a large scale, so the government has to take some serious actions to overcome the issue of pollution in the country. The government can keep check and balance on those industries which is sources of CO2 emissions. Another responsibility regards of this issue for the government have to make such legislation which protects the country from pollution on one side and develop the economic growth on another side. The International community can also cooperate Pakistan financially to decrease the relevant issue. Compare with other Asian countries Fund of climatic change for Pakistan is very few. Various International NGOs, communities, climatic change institutes which working for climatic change should have to help Pakistan financially and also have to increase the fund of climatic change for Pakistan. Since Pakistan is a growing economy converting their agricultural sectors to industrial sectors rapidly, so it's important for such of countries to moderate their technologies. New technologies have to introduce which can help to overcome pollution issue to a certain extent.

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