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Pakistan's export of agricultural products and its relationship toindustrialization, energy use, and carbon emissions using an accelerated reaction time series analysis

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Abstract

This study aims to contribute new information to the existing body of knowledge by conducting an investigation into the causal relationships that may exist between Pakistan's agricultural exports, industrialization, urbanization, transportation, energy consumption, and carbon emissions. In order to investigate the short-run and long- run relationships that exist between certain variables over the course of four decades, the auto regressive distributed lag model (ARDL) has been used to evaluate time-series data. This has been done over the course of the past four decades. To determine which way the chain of events should be followed, the Granger causality test was performed. It is possible to draw the conclusion, based on the results of the unit root test, that all of the selected variables display stationary both at the level and after having undergone first difference. This is the case both before and after the initial differentiation. The proof that co integration exists among all variables was supplied by the bound test, which was carried out with a significance threshold of 1%. On the basis of projections made for the longer term, it is projected that a rise in the amount of energy consumed will result in a rise in the amount of agricultural goods exported. The increase in urbanization, improvements in transportation infrastructure, and rising levels of carbon dioxide emissions are all to blame for the drop in agricultural exports that Pakistan has seen in recent years. The escalation of industrialization, transportation, and energy consumption leads in a commensurate rise in the exportation of agricultural products in the near time frame. This growth is due to the fact that more agricultural products are being shipped out of the country. The simultaneous effects of increased urbanization and greenhouse gas emissions have a detrimental effect on the export of agricultural goods produced in Pakistan. On the basis of the findings of our study, we propose the implementation of environmentally responsible agricultural practised, the use of renewable energy sources, the development of technology that reduces carbon emissions, and the creation of a portfolio that focuses on the export of environmentally friendly agricultural products. All of these ideas are intended to reduce the negative impact that agriculture has on the environment.

Introduction

Several factors can be blamed for the agricultural sector's contribution to Pakistan's GDP falling from 22.04% in 2019 to 19.3% in 2020. This decrease will take place during the years 2019 and 2020. Conventional farming practised, limited use of agricultural technology, deterioration of agricultural land, weak agricultural policies, and the outbreak of locusts in Pakistan are among these. The outbreak of locusts in Pakistan is one of the most significant factors. The outbreak of locusts has caused significant damage to agriculture, in especially in the provinces of Balochistan, Punjab, and Sindh, which are three of the most important provinces for crop production. According to the initial assessment, the amount of damage extends across more than 115,000 hectares of various cereal crops, including wheat, oil seed crops, cotton, and gram, as well as fruit and vegetable crops. In addition to that, it has been noticed that losses have occurred in grazing pastures. The agriculture industry continues to have a major place as the primary sector andcontributor to Pakistan's overall economy, despite the fact that certain crop losses have been reported to have occurred in Khyber Pakhtunkhwa by the Government of Pakistan in the year 2020. This is essentially the result of its significant involvement in the provision of sustenance, both directly and indirectly, to a significant portion of the population, as well as its substantial contribution to labour participation, which now sits at 42.3%. The aforementioned sector attracts the greatest number of people to participate in the labour force and suppliesthe manufacturing sector with the greatest quantity of necessary resources. It is conceivable for this sector to increase the amount of money it contributes to the nation's gross domestic product by implementing the most recent agricultural technologies. This industry has the capacity to do so. This industry has the capability of producing goods for both domestic consumption and international trade; as a result, it can ensure that there is no threat to the nation's supply of food and contribute to income from international trade. This development has the ability to make a contribution to the alleviation of poverty and has the potential to enhance the socioeconomic environment for a sizeable portion of the world's population. According to the analysis that was commissioned by the GOP for the 2020 election cycle, the agricultural sector is currently facing a number of significant challenges, the most significant of which are pest infestations, urbanization, climate change, and water scarcity. The expansion of the agricultural business is dependent on the existence of climatic conditions that are suitable for its growth. According to Khan et al. 2020a, there is a significant connection between agriculture and climate, which encompasses a

number of factors including precipitation, temperature, and other meteorological elements that have consequential effects on economic indicators such as agricultural production, commodity pricing, and overall economic development. The climate of Pakistan is favourable for the growth of main cereal crops like maize, wheat, rice, cotton, and sugarcane, and these may all be cultivated successfully there. Wheat beats all other grain commodities on the local market in terms of production, consumption, and demand. Wheat dominates all three categories. On the other hand, rice is one of the agricultural goods that is exported the most. According to Rehmanet al. (2015), the global export of Basmati rice accounts for around 25 percent of the total export of rice. The farmers of Pakistan have established a habitual reliance on the excessive use of chemical fertilizers and pesticides in their agricultural practised. This practise not only contributes to an increase in the amount of carbon that is emitted into the atmosphere, but it also reduces crop production and the overall value-added contribution that is made by the agricultural sector(Koondhar et al., 2021b). Both the agricultural and the non-agricultural sectors of Pakistan's economy are vital to the country's overall success. For the manufacturing of value-added commodities, non-agricultural industries are reliant on the agricultural industry as a key supply of raw materials because of the industry's central role in the provision of food. Despite this, the agricultural sector is confronted with difficulties as a consequence of the rising levels of carbon emissions and the effects of industrialization in non-agricultural sectors. These difficulties are made worse by the pressures of urbanization. At first, the process of developing non-agricultural industrialization leads to the transformation of arable land into land that is not suitable for agricultural production. In addition, the process of industrialization results in the recruitment and retention of significant numbers of workers, which leads to a scarcity of people willing to work in agricultural settings. In addition, the Quraishi et al., 1994 study found that the demand for agricultural raw materials from industries that are not related to agriculture had a significant impact on the cropping patterns in Pakistan.

Due to the ever-increasing rate of urbanization, which offers obstacles for the growth of the agricultural sector, the process of globalsocioeconomic change acts as a barrier to the progression of agricultural development (Malik and Ali, 2015). The persistent movement of people from rural areas into urban areas in Pakistan has caused the country's cities and towns to rapidly expand in order to make room for the country's

ever-increasing population. This phenomenon is known as urban sprawl. According to Peerzado et al.'s research from 2019, Pakistan does not have any laws that address this issue, which has led to the conversion of agricultural land into land that is used for residential and commercial purposes. The growth of the transportation industry is accompanied by an increase in the consumption of energy, which in turn causes a deterioration of the natural environment and a corresponding increase in the amount of carbon emissions. In addition, environmental changes, such as shifts in temperature and precipitation patterns as well as instances of drought, are having an impact on agricultural production.The increase in environmental pollution has led to a decrease in soil fertility and a rise in erratic weather patterns, such as unexpected precipitation, temperature variations, and temperature spikes. This is a direct outcome of the pollution's impact on the ecosystem. These occurrences have an indirect but direct impact on the standard andquantity of agricultural output. It should come as no surprise that a product with quality that is below average would not meet the criteria necessary for its adoption on worldwide markets. In a similar vein, evenif the quality of agricultural products is regarded adequate for international trade but the quantity is insufficient, the export of such products will be hampered by many obstacles.

At the moment, the COVID-19 pandemic is presenting problems on a worldwide scale that have never been seen before. Pakistan is still considered to be a poor nation, so it is not immune to the consequences of the COVID-19 epidemic, which has had a severe influence on all aspects of the country's economy. (GOP, 2020) The present COVID-19 epidemic has increased the level of anxiety regarding food security in relation to the maintenance of the nation's population. During the COVID-19 epidemic, it became obvious that logistical obstacles were occurring, which led to difficulty in ensuring that an appropriate food supply was maintained throughout the nation. In addition, the exports of agricultural products to countries outside of the United States saw a significant decrease, and in some cases, it came to a complete standstill for a specific period of time. According to Yamano et al.'s (2020) findings, the result causes enormous economic losses not only for the economy of the nation but also for its producers.

Utilizing annual time-series data spanning the previous four decades, thepurpose of this study is to conduct an analysis of the impact that Pakistan's agricultural product exports have had on the country's process of industrialization, urbanization, transportation, energy consumption, and carbon emissions. The agricultural production and industrial

production of the country are the primary contributors to the economy of the nation. Our research is primarily concentrated on formulating and enacting all-encompassing policies with the end goal of increasing the amount of agricultural goods produced by the country as a whole, and this is the fundamental emphasis of our investigation. By presenting the following, it is our hope to make a meaningful contribution to the pool of previously accumulated information. To this day, there has been a shortage of scholarly investigations studying the association between Pakistan's agricultural exports and a number of indirect factors over an extended period of time. These factors include industrialization, urbanization, transportation, energy consumption, and carbon emissions. In addition, we utilized the auto regressive distributed lag (ARDL) methodology, which is renowned for its increased efficiency and capability to yield robust conclusions while having a small sample size (Pesaran et al., 2001). This allowed us to analyse the data in a more accurate manner. In addition, it is anticipated that the findings of this study will contribute to the existing body of knowledge and further expand our awareness of the interrelationships among the factors that are the subject of the examination. In the end, these discoveries will be useful for guiding policy making in areas such as the transformation of industries, urban planning, the control of urban sprawl, the effective utilization of energy, the optimization of transportation infrastructure, and the reduction of carbon emissions.

Methods And Collection

The data for the most recent years in the time series were used to compile the sample, and they cover the span of 1976 to 2017. The length of four decades was determined by using a calculation that was based on the availability of data for all of the factors that were taken into consideration. For the aim of this study, secondary sources such as the Food and Agriculture Organisation (FAO), the World Bank's World Development Indicators (WDI), the International Energy Agency (IEA), and Electronic Data Gathering, Analysis, and Retrieval (EDGAR) were investigated. The annual time-series data of the model are presented in Table 1, and the "Availability of Data" section gives information regarding the data's original source. Figure 2 depicts the patterns that may be observed across all of the variables that have been taken into account. In this study, we investigate Pakistan's Agricultural Products Export (APE), Industrialization (IND), Urbanisation (UP), Transportation (TP), Energy Consumption (EC), and Carbon Emission (CO2) trends and patterns from 1976 all the way up to 2017. Since 2007, there has been a discernible decline in the amount of agricultural products that are shipped out of the country. This reduction is happening at the same time when urbanisation and carbon emissions are both trending in the upward direction. Figure 2 demonstrates that there has also been a decline in the amount of transportation and industry that has taken place. In light of the fact that the industrialization and transportation sectors are both highly dependent on nonrenewable energy sources, it should come as no surprise that there is an urgent requirement for a reduction in carbon emissions.

Model Description

The autoregressive distributed lag (ARDL) model that was proposed by Rehman et al. (2020a) in Equation 1 is used in order to investigate the correlation between the dependent variable of agricultural products export (APE) and the independent variables of industrialization (IND), urbanisation (URB), transportation (TP), energy consumption (EC), and carbon emission (CO2). Pesaran et al. (2001) developed the autoregressive distributed lag limits test method in order to check the presence of cointegration and evaluate the short- and long-run equilibrium within the selected time-series data. This was done in order to determine whether or not the data exhibits cointegration. The adjustable stationary properties of the variables give the ARDL model an edge over more traditional methods of cointegration. This benefit is due to the fact that the ARDL model can be used. According to Pesaran and Shin (1998), it is able to perform data analysis on multiple levels, including the level, the initial difference, and data that is mutually cointegrated.

Results And Discussion

Table 3 displays the empirical findings obtained from the Augmented Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root tests. Dickey and Fuller (1979) and Phillips and Peron (1988) are credited as being the first researchers to recognise the tests that study the stationary properties ofvariables. It is possible to deduce, on the basis of the results of the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, that certain variables under examination display stationary at level I(0), while others indicate stationary at the first difference I(1). This is the case because some of the variables exhibit stationary at level I(0), while others demonstrate stationary at level I(1). This provides another justification for the application of the ARDL model.

Gr-anger Causality Test

The Granger causality test provides estimations that analyse the direction of causal relationships among the variables that are being investigated to determine whether or not there is a correlation between them. Table 6 contains the results of the Granger causality test, which demonstrate that there is a causal relationship between industrialization and transportation, but that this relationship is only in one direction. This suggests that there is a strong relationship between industrialization and transportation, namely that the logarithm of industrialization (LnIND) has a causal influence on the logarithm of transportation (LnTP), whereas the logarithm of

transportation (LnTP) does not have any effect on the LnIND. In addition, the results of this research reveal that there is a one-way causal relationship, often referred to as unidirectional Granger causality, between energy consumption (LnEC) and agricultural products export (LnAPE), industrialization (LnIND), and transportation (LnTP). This is indicated by the fact that there is a correlation between the three variables that increases with increasing levels of energy consumption. That is to say, LnEC has a cause-and-effect relationship with LnAPE, LnIND, and LnTP, whereas none of the other variables in the study have a similar relationship with LnEC.

Summary:

The empirical data that were discussed before were utilised in order to evaluate the policy repercussions. Instead of increasing urbanisation by infringing upon additional agricultural land, which would result in a decline of arable land, the government of Pakistan should focus on adopting land reforms and developing high-rise buildings instead of expanding urbanisation by intruding upon further agricultural land. In addition, it is suggested that the government of Pakistan give some thought to the possibility of instituting subsidy programmes for businesses that are involved in the manufacture of agricultural goods with added value. This move would not only make it easier for such sectors to expand, but it would also make it more likely that they would have access to viable marketing channels. In addition, the utilisation of renewable energy sources ought to be given top priority as a means of mitigating carbon emissions and the damaging impact that they have on the surrounding ecosystem. It is necessary for the government of Pakistan to strategically organise exhibitions and promote the entry of Pakistani agricultural products into international markets that have not yet been explored in order to increase the country's overall level of exports. It is projected that an increase in Pakistan's exports of agricultural products will result in considerable benefits for the overall economic development of the country. Additionally, as a result of this expansion, a number of countries that are not traditionally agriculturally based will be able to purchase agricultural products from Pakistan, which will fulfil their need for food. Additionally, as a result of this, agricultural products that originate in Pakistan will gain in both value and recognition on a worldwide scale, allowing them to be exported to agreater number of countries.

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