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Economic perspectives of major field crops of Pakistan: An empirical study

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ABSTRACT

Agriculture is considered the backbone of Pakistan's economy, which relies heavily on its major crops. There are vast gaps between the acquired and actual output of produce, which suffers due to a lack of appropriate technology, use of inputs at improper times, unavailability of water and land use and inadequate education about insect pest control, which not only negatively affects the produce but also significantly reduces the amount of produce. Farmers mainly use synthetic chemicals for the control of insect pests, but these are used unwisely. To emphasize the major shortfalls and actual performance of major field crops, this study investigated the relationship between agricultural GDP and the output of major crops, including wheat, rice, sugarcane, maize and cotton, in Pakistan over a period of 65 years from 1950 to 2015. Time series data were collected from the Economic Survey of Pakistan (various publications). Crop data were analysed using the ordinary least square method and the Augmented Dickey Fuller (ADF) test, and the results were interpreted using Johansen's co-integration test. Our study finds that the output of wheat, rice and cotton has a positive and significant relationship with the agricultural GDP of Pakistan, while the output of sugarcane has a negative and non-significant relationship with the agricultural GDP of Pakistan. Therefore, this study recommends that the government of Pakistan should launch new funding programmes for the development of the agricultural sector.

1. Introduction

Agriculture is an important sector of Pakistan's economy. This sector directly supports the country's population and accounts for 26 percent of gross domestic product (GDP). The major agricultural crops include cotton, wheat, rice, sugarcane, fruits and vegetables. The irrigation system of Pakistan belongs to one of the world's largest systems to support agricultural production. There are two main seasons in Pakistan for production of crops: crops such as cotton, rice and sugarcane start in May and are harvested in November, whereas the wheat crop extends from November to April. A key urgent need to improve agricultural production is to use resources, mainly land and water, more efficiently. However, the change is mainly dependent on large landowners, who own 40 percent of arable land and control most of the irrigation systems, making it difficult to pass wide-ranging reforms. Pakistan is a net importer of agricultural products, with total annual imports of approximately 2 billion USD, including wheat, edible oils, pulses and food additives.

In the wheat production system, Punjab, which is Pakistan's irrigated province, has had a historical focus on a green revolution in wheat. During the 1960s, the Green Revolution in Pakistan also involved public investment in irrigation canals and market development (Renkow, 2000). The rural society and wheat production were transformed; the anticipation of starvation retreated (Hazell,

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2010). Despite this applauded improvement, the sustainable production of wheat remained the primary focus of Pakistan's population. The government of Pakistan still needed improvements for the production of wheat in different varieties. Previous research on the wheat crop has shown a slow growth rate of crop variety replacement by farmers in promoting new varieties of wheat in Pakistan (Heisey, 1990; Iqbal et al., 2002). In 1997, an estimated area of one million ha was used for wheat production, which was 51 percent of the entire wheat area in Pakistan (Smale et al., 2002).

Pakistan plays a major role worldwide as a rice exporter, and it annually exports approximately 2 million tons, which is 10 percent of the world's trade. In Basmati rice, approximately 25 percent of exports is Pakistan's share. Rice exports are the second highest source of income in Pakistan. Rice grains fulfil approximately 60 percent of the population of Pakistan's food needs, and rice is a potential source of food worldwide for animals during the winter (Drake et al., 2002; Nguyen et al., 2008). Rice is an important food for Pakistan. The usage of pesticides increased after the 1950s, when 250 metric tons of pesticides were imported for greater improvement of production. Its usage increased by 2158.6 percent from 1952 to 2004 (Khan et al., 2010).

Cotton is another cash crop of Pakistan, and Pakistan is the world's largest producer of raw cotton. In 2011–2012, Pakistan ranked as the 4th largest cotton producer, with a 9.81 percent share in global cotton. In the same period, Pakistan's yarn exports contributed 26.1 percent and 14.3 percent to the global market. Cotton exports accounted for 46 percent of Pakistan's total exports and provided 35 percent employment to the labour force (FAO, 2012; GOP, 2012). According to current agricultural policy, the Pakistan Central Cotton Committee has aimed to increase the production of cotton from 40 percent to 60 percent (PCCC, 2008). However, some evidence has shown that insufficient irrigation water is one of major problems in agricultural production in Pakistan. Farmers commonly apply water to furrowed fields by flood irrigation, resulting in low agriculture water productivity (Kahlown et al., 2007).

Maize is another cash and food crop of Pakistan, serving as feed as well as silage, and it is a high yielding cereal crop globally. After wheat, rice and cotton, maize is the fourth chief cereal crop of Pakistan, it is mainly sown in two seasons: spring and autumn. In spring, it is planted from February to March, while for autumn, maize is grown from July to August. The maize life cycle depends upon the availability of water; the water discrepancy at any phonological stage, i.e., reproductive and maturity stages, has several retorts and can damage the grain yield, and previous research (Heisey and Edmeades, 1999) has shown that drought stress also causes grain yield damage when it occurs in the reproductive stage of the crop's life cycle.

Sugarcane is a high-value cash crop of Pakistan and is quite important for sugar-related production. It accounts for 3.4 percent of additional agricultural value and 0.7 percent of the gross domestic product (GDP). As a sugar crop, sugarcane is the chief biofuel crop worldwide (Robinson et al., 2011). The slow growth rate of sugarcane in the early stage provides space and resources for intercropping in the field. Many studies have shown that sugarcane intercropping with other crops, such as peas, watermelon and onions, could decrease the yield of sugarcane and could increase economic income significantly (Al-Azad and Alam, 2004; Nazir et al., 2002).

2. Current scenario of major field crops of Pakistan

2.1. Wheat

Wheat is an important cereal crop for many countries, where it is consumed as a staple food. It is an admitted fact that nothing is more important than the needs of human beings. Sustainability and reliability in food production are very important for sustainable crop production. For wheat production, water supply and energy are important and will continue to constitute an important foundation to ensure the sustainability of agriculture and food production reliability. However, water and energy preservation are two key issues for researchers to decrease the costs of these two commodities in such a manner that production will not be hampered. In the 1980s, Pakistan experienced a golden era of water management in the construction of the canal irrigation system, which was developed at the same time; however, the results of different droughts reduced what the system could achieve. The country could only barely emerge from the eye-opening shock of water scarcity that persisted for almost three years from 1999 to 2002. Water scarcity caused over-use of ground water by pumping out this water, consuming an enormous amount of available energy, while the country was already facing a problem with this commodity (Pakistan, 2008–09).

Moreover, it has been reported that the availability of water for agriculture is expected to decrease from 72 percent to 62 percent in the period from 1995 to 2020, and globally, a decrease from 87 percent to 73 percent in developing countries was also estimated (Khan et al., 2006). Because Pakistan is an agricultural country, water scarcity in agriculture will have disadvantageous impacts on its economics because agriculture directly subsidizes its GDP, and more than 40 percent of labour is directly or indirectly engaged in this sector (Pakistan, 2008–09). In Pakistan, traditional crops, such as wheat, are planted on a flat basin that is directly flooded with water for irrigation. There are enormous water losses with this type of irrigation. Evaporation and deep percolation losses also cause a severe shortages to crops related to overexploitation of groundwater, encouraging a search for alternative methods of water application to crops, for example, raised bed (RB) technology, to meet water demands.

There is a serious challenge for agriculturists to meet the feeding requirements of nine billion people by the middle of the 21st century (FAO, 2009). To produce more food from less water in arid and semi-arid areas is a challenge for today's agriculture (Shideed, 2011). Water shortage and scarcity cause degradation of land due to rain-fed agriculture (Suleimenov et al., 2011) and lower food production, particularly in the agricultural and semi-agricultural zones of Africa (Fraiture et al., 2010). Approximately 80 percent of the world's agriculture comprises rain-fed land, which produces 80 percent of the food globally (Falkenmark et al., 2001; Valipour, 2013).

In North Africa and West Asia, 95 percent of land is rain-fed, and approximately 40 percent of the land in Uzbekistan has been used due to water shortages, causing despoiled fields (Shaumarov and Birner, 2013; Zakaria et al., 2013). Wheat is an important crop in Pakistan due to its widespread use as food (Iqtidar et al., 2006). In Pakistan, 6.35 million hectares of land are irrigated with canal water, 12.53 million hectares are cultivated through tube wells, and for the remaining 3.59 million hectares, no water is available, for a total 22.45 of million hectares (GOP, 2012). Limited water results in susceptibility to water scarcity conditions, causing wheat biomass to reduce wheat crops (Oweis and Hachum, 2004; Tavakkoli and Oweis, 2004; Xie et al., 2005). Poor and sparsely distributed rainfall in arid regions of Pakistan further aggravates this situation. Losses ranging from very low yields or even complete loss under severe water stress in wheat crops have been well documented (Oweis, 1997). Harvesting and utilization of rain water have been successfully used in many arid regions, using runoff water from the catchment area and delivering it to the collection acreage (Qiang et al., 2006; Short and Lantzke, 2006). Rain water efficiency can be improved with appropriate water harvesting techniques, such as micro-watersheds (Rogelio et al., 2006; Zakaria et al., 2012). Using

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