Agricultural Productivity in Balochistan Province of Pakistan: A Geographical Analysis

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Abstract: Agricultural sector plays a leading role in Pakistan’s economy. It contributed to nearly one fifth of the national GDP in 2010. Agricultural productivity is regionally dependent, demanding further investigation. This study examines the productivity index in districts of Balochistan province of Pakistan from 1981-82 to 2008-2009. Besides the thermal and water regime, pedological conditions play a favorable role in growing of valuable crops. The food crops, wheat, rice, bajra, barley, jowar and maize have been selected for the study. By contrast, very low level of agricultural productivity is confined to the districts falling in the drought prone areas characterized by irregular rainfall, rugged topography and poor irrigation facilities. Inadequacy of water is the main hurdle in agricultural productivity. For the present investigation, district wise secondary data have been collected from the agricultural census of Balochistan. The data collected have been processed and Yield Coefficient method has been employed to find out the level of agricultural productivity. The results are depicted by choropleth method on map. Hence, in the present paper an attempt has been made to assess the regional disparities in levels of agricultural productivity in districts of Balochistan province. Identification of causes of the disparity can prove helpful in solving the problem, thus enabling solution of food security.

Keywords: Yield Co-efficient, variation, sustainability, food crop, technological factors.

1. INTRODUCTION

Agriculture is the means of livelihood of rural population. About 68% of the population (i.e. 40% of total labor force of Pakistan) is employed in agriculture. Agriculture sector constitutes the single largest contributor to the national GDP and has enjoyed steady growth for the last three decades of the 20th century, significantly contributing to poverty reduction during the 1970s and 80s. Agriculture is not only the main source of foreign exchange earnings but also plays a vital role in the supply of raw material for industries. The main food crops are wheat, rice, maize, bajra, jowar and barley. According to Pakistan Agriculture and Economy Policy Report the crop sector has gradually declined from 65% of agricultural activity in 1990-91 to 48% in 2006-07 due to rapid growth in population [1]. It is an emergent demand of time to give due notice to spatial adaptation of agriculture.

The districts of Balochistan province have been selected for the present study. Crop productivity studies are important in Balochistan due to the rapid growth of population and food requirements which need constant vigil. The province has diversified soil and physical relief and arable land is limited, therefore it is necessary to increase the crop production. Productivity is the ratio of the output to the input in relation to capital, labor, land and overall resources employed in agriculture. Many geographers and economists have explained a number of methods for productivity measurement i.e. ranking coefficient method used for measurement of agricultural productivity and also for international comparisons [2-3]. The productivity evaluation index used that account all human and physical factors coalesce to produce agricultural crops [4]. Shafi, introduced Agricultural Productivity Coefficient Index [5]. A new technique developed by Singh for calculating agricultural efficiency per unit area carrying capacity [6]. For measuring agricultural productivity Spare and Deshpande introduced a Weight Rank Index [7]. Hussain also developed a technique to measure agricultural productivity in 1976. He expressed agricultural production in terms of monetary values [8]. Many geographers have applied (TFP) Total Factor Productivity with Cobb-Douglas Production Function and primary product yield or conventional yield to develop an indicator for crop productivity measurement [9-10]. Geographers have studied single or multiple features of agriculture and tried to regionalize Some
deal with magnitude of area and yield under various crops, others have suggested energy, value, ranking and productivity coefficients. A number of geographers proposed Index of Productivity for deciphering the levels of productivity [11-12]. Agricultural productivity may be defined as the ratio of the index of total agricultural output to the index of total input used in farm production. Productivity is defined in economics as the output per unit of input or getting same output from smaller input and further suggested that increase in productivity is generally due to more efficient use of all or some factors of production i.e. land, labour and capital [13].

The purpose of this study is to investigate the spatial variation in agricultural productivity, evaluate the major crop productivity and methods of measurement of agricultural productivity. Agricultural productivity may be taken as the most significant indicator to demonstrate the spatial pattern of agricultural growth. The study is aimed to help in agricultural development plans on a balanced basis in order to reduce the regional inequality.

2. STUDY AREA

Balochistan geographically is bounded by 60° 52' east longitude to 24° 54' north latitude and 70° 17' east longitude to 32° 6' north latitude. The total geographical area of the province is 347190 km² covering 44% of the country's land area. According to the 1998 census, the province had 656 588 5 inhabitants which was 4.96% of the total population of the country. 23.9% of the population lived in urban areas while 76.1% in rural areas with population density being around 18.9 persons per km² [14].

The province has 32 districts namely Awaran, Barkhan, Bolan, Chagai, Dera Bugti, Gwadar, Harnai, Jaffarabad, Jhal Magsi, Kalat, Kech (Turbat), Kharan, Kohlu, Khuzdar, Killa Abdullah, Killa Saifullah, Lasbela, Loralai, Mastung, Musakhel, Nasirabad, Nushki, Panjgur, Pishin, Quetta, Sherani, Sibi, Washuk, Zhob, Ziarat, Lehr and Sohbatpur. The soil of Balochistan is mainly, broadly classified into three groups shallow, medium and deep soils.

The climate of the province is semi-arid continental having uniform aridity. It has diversified precipitation, recording between 200-350 mm per annum but many parts having as low as 50 mm per annum. Precipitation during monsoons is through intense showers, while in winter it receives rain and snow through western disturbances. The daily mean minimum and maximum temperatures vary with location and elevation ranging between -3º to 38º Celsius. Some parts have temperatures below freezing point for about more than 90 days during summer. High elevated locations delay the spring planting. Uplands have more severe climates for temperate crop production in West Asia.
with scanty and erratic precipitation (which to some extent are mitigated by water harvesting practices) and substantial cold stress at elevations of 1500m above mean sea level (amsl). Cold-resistant, drought-tolerant winter crops are required for eastern and southern areas and drought-resistant, short-season crops for more western and northern areas.

3. DATA AND METHODOLOGY

District-wise crops of Balochistan data has been collected from Agriculture Census Organization (ACO) for the period 1981-82 to 2009-2010 [15]. Administratively Kharan, Chagi, Sibi and Jaffarabad districts have been bifurcated and created into four new districts namely Washuk, Nushki, Lehri and Sohbatpur respectively, but Agricultural Census Organization is continually reporting the former district data. Climate data (viz. precipitation, temperature, etc.) of meteorological stations located in Balochistan have been obtained from Centralized Data Processing Center (CDPC), Pakistan Meteorological Department (PMD), Karachi, Pakistan for climatic review. Wheat, rice, maize, jowar, bajra and barley are main food crops and were considered for calculating the productivity. The Crop Yield and Concentration Indices Ranking Coefficient technique has been chosen in order to delimit the weaker areas from the point of view of agricultural productivity and relative crop yield, to assess the regional level of food production inequality, computed into Average Ranking Coefficient and Concentration Indices in ranking order [16]. The spatial distribution of Yield Index Ranking Coefficient of various crops for Balochistan during two spells of 14 years of periods i.e., 1980-81 to 1994-95 (referred as first spell) and 1995-96 to 2008-09 (referred to as second spell) and one 29 years of period i.e. 1980-81 to 2008-209 (referred to as total period in this study) were computed using the selected technique. The technique is as follows:

\[ Y'_i = \frac{Y_i}{Y_R} \times 100 \]

Where:

- \( Y_i \) = the yield index of \( i^{th} \) crop
- \( Y_u \) = the average yield per hectare in unit component of \( i^{th} \) crop
- \( Y_R \) = the average yield per hectare in the entire region of \( i^{th} \) crop

4. RESULTS AND DISCUSSION

Wheat, rice, maize, jowar, bajra and barley have been noted as the important food crops of Balochistan. Wheat and jowar account for more than 50% of the total cultivated area of the province. Jowar can be grown both as \textit{rabi} and \textit{kharif} crops. Wheat is more common in dry areas. Its cultivation is confined to the areas receiving adequate and timely irrigation.

Crop productivity changes have occurred in response to many technological developments during the last couple of decades. The adoption of seeds, fertilizers and irrigation have resulted in increase of farm production and diversification of the production pattern. Soil conservation measures adopted have also been responsible for increasing the production. All these factors interacting with each other have helped enhance the changes in agricultural production.

Regional imbalance in agricultural productivity of Balochistan province has been measured by using Index method. While applying this method, the six crops grown in most of the districts were selected. High productivity was mainly confined between south eastern to north eastern districts of the province excluding south western parts of the province. Thus Sibi, Harnai, Bolan, Jaffarabad and Nasirabad etc. recorded high productivity. This category of productivity is mainly observed in central parts of the province. Precipitation in the province was highly variable with reference to both space and time. The mean annual total precipitation in the province is about 250 mm. About 8.8% of the irrigated area is under \textit{karez} irrigation [17]. \textit{Karez} was probably introduced in the southern part of the province from Iran and to the northern part from Afghanistan [18]. Only 4.6% of the total area is cultivated through \textit{karez} [19]. About 50 % of the total cultivated area in the province is entirely dependent on precipitation and is under dry land crop production. The western and south western parts of the province record low productivity. These parts consist of Kharan, Washuk and Gwadar districts. Precipitation is uncertain, irrigation facilities are not developed, agricultural implements are old, hence yield of crops are low. The combined effect of all these factors lead to low agricultural productivity.

4.1. Wheat

Wheat productivity index for the first spell has been depicted in Figure 2a, for the second spell in Figure 2b and for the total period in Figure 2c. The average
productivity of wheat in the province was 82.1, 84.9 and 83.7 kg/ha during the study periods, 1980-81 to 1994-95, 1995-96 to 2008-09 and 1980-81 to 2008-09, respectively. There were only six districts which recorded yield above 95 kg per hectare, namely Nasirabad, Jafferabad, Lasbela, Quetta, Bolan and Jhal Magsi, which all together contributed to 25.6% of the wheat output of the province. Harnai, Sibi, Lasbela, Mastung, Qilla Saifullah, Nasirabad, Bolan and Jafferabad districts yielded more than 95 kg per hectare i.e., 37.76% contribution during the period 1980-81 to 1994-95. Lasbela, Khuzdar, Jhal Magsi, Bolan, Nasirabad and Jafferabad districts recorded high productivity index (more than 95 kg per hectare) with 24.78% contribution during the period 1995-96 to 2008-09. Lasbela, Bolan, Nasirabad and Jafferabad were the four districts that had higher productivity index during all the three study periods. High to moderate productivity change was observed in Qilla Saifullah, Mastung, Sibi and Harnai. Low to moderate productivity change prevailed in Kharian, Washuk, Ziarat and Dera Bugti. Moderate to high productivity level have been deciphered in Jhal Magsi and Khuzdar while only one district Musakhel revealed moderate to low category, between the first and second spells. During the total study period six districts showed high, six low while the remaining eighteen districts revealed moderate productivity index during the total period.

4.2. Rice

Rice productivity index for the aforesaid three periods have been depicted in Figures 3a to 3c. The average productivity of rice in the province was 71.7 kg/ha during the total period while in the first spell it was 67.4 and in the second it was 77.6. Nushki was the only district which had maximum yield in all three selected periods while Panjgur, Sherani and Bolan which recorded minimum yield (36.7 kg per hectare) during the first spell, Washuk recorded 37.2 kg per hectare in the second and Bolan 36.5 kg per hectare during the total study period. In the first spell, two districts (Nasirabad and Bolan) recorded 27.2%, while in the second spell four districts (Gwadar, Jafferabad, Bolan and Dera Bugti) revealed 52.2%. With reference to the total period, three districts (Jafferabad, Nasirabad and Bolan) recorded 35.07% contribution of
rice production in the province. Low to moderate productivity level was observed in Washuk, Kharan and Khuzdar. Moderate productivity index was observed in Qilla Saifullah during all three periods. Gwadar was the only district where moderate to high productivity level prevailed. With reference to total study period, four districts fell in high, three showed low while remaining five districts revealed productivity level between 60.01 to 36.5 kg per hectare.

4.3. Bajra

The average productivity of bajra in the province was recorded at 105 kg per hectare. Fifteen districts produced the crop (Figure 4c). The productivity index in eight districts was found to be above the mean of the province, whereas seven districts produced below mean. Chagai, Panjgur and Nushki had high level of bajra productivity. Moderate productivity was recorded in Musakhel and Dera Bugti districts. Washuk, Kharan, Gwadar, Sibi, Harmai, Loralai and Barkhan revealed low productivity index. Low to moderate productivity index was observed in Dera Bugti and Gwadar; with high to low in Barkhan (Figures 4a to 4b).

4.4. Barley

Figures 5a to 5c shows barley crop productivity index for the three different study periods, 1980-81 to 1994-95, 1995-96 to 2008-09 and 1980-81 to 2009-2010 respectively. Barley was harvested throughout the province. Most part of the province showed moderate production. High productivity index for all three study periods prevailed in districts namely, Sibi, Harmai and Pishin. For the total study period average productivity index was recorded as 108 kg per hectare. Gwadar was the only district which recorded low productivity index. Moderate to low productivity index was also observed in Bolan and Jhal Magsi. High to moderate productivity index was found in Washuk, Kharan, Mastung, Panjgur and Kech.

4.5. Jowar

There are wide variations in the yield of Jowar in the region under study. The average productivity index by region as a whole was 97.4 kg per hectare. The district wise yield ranged from 41.3 to 148.8 kg per hectare. Six districts recorded a yield index level of greater than...
110 kg per hectare. Very high productivity index was observed in Awaran district with an average productivity index of 148.8 kg per hectare. The improved dry farming techniques, assured supply of water, use of new strains of seeds, proper use of fertilizers, and modern methods in Jowar cultivation were factors responsible for higher production. Moderate level of productivity has been noted in thirteen districts namely, Chagai, Nushki, Washuk, Kharian, Ladhela, Khuzdar, Jhal Magsi, Nasirabad, Dera Bugti, Sibi, Harnai, Loralai and Barkhan. Six districts have low productivity with output per hectare of less than 80 kg per hectare. Low to moderate productivity index has been observed in Washuk and Kharian. Moderate to high in Gwadar, Chagai, Nushki and Loralai. High to moderate in Bolan, Jhal Magsi, Musakhel and Jaffarabad districts.

4.6. Maize

The average productivity index of maize in the province as a whole was 95.6 kg per hectare. The district wise average yield index ranged from 76.3 in Chagai to 119.1 kg per hectare in Musakhel districts. High to moderate productivity has been observed in Sibi, Pishin and Harnai. Overall three districts, namely Chagai, Nushki and Lasbela recorded low yield index level of less than 85 kg per hectare. The districts Pishin, Killa Saifullah, Zhob, Sherani and Khuzdar recorded moderate productivity index level between 85 and 100 kg per hectare and Kalat, Sibi, Harnai, Kohlu, Loralai, Barkhan and Musakhel districts revealed high productivity index level greater than 100 kg per hectare. Average productivity index was observed in Musakhel district with 119.1 kg per hectare and minimum productivity index of 76.3 kg per hectare.

5. CONCLUSION

The analysis reveals that there is great variation in level of agricultural productivity throughout the study region. Out of total cultivable land only 25.20 percent of the study area is high productivity region, whereas 36 percent area of the study region reveals low level of agriculture productivity. Relatively high level of productivity is observed in Nasirabad, northern Balochistan and Quetta district. Low level of productivity is confined to 4 districts which fall mostly in

Figure 6: Jowar Productivity Index for (A) first spell (B) second spell (C) total period.

Figure 7: Maize Productivity Index for (A) first spell (B) second spell (C) total period.
the drought prone areas having inadequate, irregular and insufficient rainfall. Another group of districts belongs to high use of irrigation water where one crop (wheat) is continuously cultivated.

The aforesaid analysis clearly indicates that there are rare variations in level of agricultural productivity in the region. While formulating development of productivity policies care should be taken such that districts with low level of agricultural productivity should be given top priority so that they may come at par with high productivity areas and the concept of regional planning and social justice may be fulfilled.

**REFERENCES**


