Research Article

Determinants of Rice Productivity in District Nasirabad, Balochistan

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Abstract | The study attempts to identify the factors that determine the rice productivity in the district Nasirabad, Balochistan. In the rural areas of Pakistan, farmers do not utilize all available resources efficiently. Therefore, it leads to inefficient choices which subsequently affect the production. This study evaluated determinants of rice production in the district Nasirabad, Balochistan by employing Neo-Classical and Cobb-Douglas production functions. The findings of the study show that education, fertilizers, rent, training and total area under the rice crop (wetland), labor, capital, availability of input, and rice prices are the key components that leave a positive and noteworthy impact on rice production in the District. Nevertheless, physical capital, experience, and age of the farmers have an adverse effect on rice production. Conclusively, it is proposed that the government should introduce precise programs for the upgradation of water systems, farmers' training, input, and credit accessibility to enhance spur rice productivity.

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Introduction

Pakistan is typically an agrarian economy as agriculture contributes to 23.7 percent of Gross Domestic Product (GDP) and gives employment to 46 fraction of the labor force of the country (Wing and Finance, 2018). This demonstrates the significance of agriculture sector of the country. Pakistan having a large land area with a variety of agro-ecological conditions that provides a conducive environment for major agricultural crops including rice (Khan et al., 2015). Among others, rice is the premier significant yield of the country as well as critical for food security. As rice is a key food of general masses in Pakistan and roughly 70 percent of family units in Pakistan depend on rice as a staple food (Wing and Finance, 2018). Rice is an exceptionally rich diet and accounts for 46 percent and 35 percent calories and protein respectively. Therefore, rice is considered as the most significant cash crop in Pakistan, which is a fundamental wellspring of nourishment and income of the millions of family units in the country (Shaikh et al., 2016). Furthermore, rice nourishment is the most accessible, fundamental and inexpensive source for the general masses. Nevertheless, rice is one of the most accessible and huge staple nourishment sources in Pakistan as well as in the globe. Further, rice sustenance is catering the issue of food security in Pakistan. In this manner, effective rice production is crucial for Pakistan to spur the income of the farmers, cater hunger and food insecurity, GDP and export revenue (Khan et al., 2018).

In Asia, both tropical and subtropical regions have contributed 90 percent to world rice production. Despite the fact, most of the farmers in these regions are small and marginalized. In Pakistan, in the last decades, rice production has become faster than other staple crop yields such as white and maize because of Chinese hybrid rice seeds. The rice production is increased by approximately 18 percent in country between 2000 and 2010, with an annual growth rate of 1.6%. Nevertheless, ironically, Pakistan positions eighth among the world's greatest rice producers, however shortly after that the country has lost its place in top ten producers (Wing and Finance, 2018).

Presently Pakistan is making decent efforts to feed its growing population as the annual population growth rate is 2.8 percent which leads to a steady increase in per capita rice consumption, and hence to quench this surge requires an appropriate policy to spur the rice production to meet the growing demand. Nevertheless, Pakistan's per acre productivity of rice is low in comparison to other neighboring countries (Shaikh et al., 2016). Notwithstanding, an enormous influx of high yield from China, Pakistan per hectares production is still less than 2.56 tons per hectares. Nevertheless, the world average per hectare production is 4.7 tons. Though, among other low production efficiencies, the technical skill of the farmers, unavailability of inputs, training, and inappropriate use of fertilizers are also contributing factors for this low per hectare productivity in Pakistan. Thus, this study attempted to identify the key factors which are responsible for this truncated productivity. The objective of the study to analyze the key factors behind rice productivity in district Nasirabad, Balochistan. Nasirabad is considered as the green belt and lifeline of Balochistan agriculture production. Moreover, 40 percent of Balochistan rice production originates from this territory, which is one of the cores and notable rice-delivering territories in the province (Shaikh et al., 2016).

Presently in the existing literature some importance studies are also underlined the issue, few notable studies among them are, Mundlak et al. (1997), Zohir et al. (2002), Akinbile (2007), Tanko et al. (2016), Khan et al. (2018), Jan et al. (2019), which highlighted the determinants of the rice production in difference countries. Nevertheless Iqbal et al. (2001), Mundlak et al. (1997) and Memon et al. (2015) underscored the issue specifically in Pakistan but no study has been conducted in Nasirabad Balochistan. Finally, the rest of the study is arranged in a subsequent way: the next section offers material and methods and model specification of the production function, nonetheless, the latter two sections contain the interpretation of the empirical results and conclusion.

Martials and Methods

Study area

The study was conducted in district Nasirabad. Presently, Nasirabad consists of four tehsils i.e. Baba Kot, Chattar, Dera Murad Nasirabad Mali and Tambo. Nasirabad is named after the great Nasir Khan Noori. Geologically, the Nasirabad district contains a flat area with no highland elements. The area consists of alluvial soils and has slopes from north to south with a terrain size of 50 to 170 meters above sea level. The climate in the Nasirabad district is tremendously hot in summers and lovely in winter. The rainy season is mainly during monsoons in the months of July and August. Nasirabad is part of the tropical agro ecological zone with a potential total agricultural area of 215,728 hectares (GoP, 2009), which makes up about 63.7% of the total geographical area of the district of Nasirabad. Rice is one of the chief cash crops and predominant in the district. Rice production accounted for over 70% of irrigation land. Nevertheless, most of the rice production comes from Dera Murad, Nasirabad Mali and Tambo.

Selection of sample size

The total number of rice producers in the region is 147,160. The 200-sample size was based on the following formula (Yamani) which is reported in Table 1. For the collection of data, a partially constructed questionnaire was developed.

The factors which are responsible for rice production, typically can be classified into five categories: labor, capital, land, socioeconomic topographies and other subsidiary inputs which all-inclusively explain in Table 2.

Model of the study

Following by Tintner (1944), Heady (1946) the study used both the Neo-Classical production function (NCPF) and Cobb Douglas Production Function (CDPF) to find out the determinants of rice productivity.

$$Y_t = f(L_t, K_t, Z) \quad \ldots(1)$$

Where: agriculture output (Y_t), labor (L_t), and physical capital (K_t), however, Z is a vector of all other determinants which are potentially related to the rice production such as labor, capital, land, seeds, herbicides and pesticide, credit, and fertilizers, cost of farm size, fuel, operating cost, monthly income, rice price, input cost, technology, education, age, credit sources, marketing, gender, experience and other services and irrigation costs. Considering the Equation 1, the model of the NCPF is reported below. Moreover, all variables are taken in log form to obtain the elasticities.

$$lnY_t = \alpha + \alpha_1 lnL_t + \alpha_2 lnK_t + \alpha_3 lnMY_t + \alpha_4 lnC_t + \alpha_5 lnMR_t + \alpha_6 lnEU_t + \alpha_7 lnAG_t + \alpha_8 lnCS_t + \alpha_9 lnG_t + \alpha_{10} lnEX_t + \alpha_{12} lnAF_t + \alpha_{12} lnAPW_t + \alpha_{13} lnPS_t + \alpha_{14} lnRP_t + \alpha_{15} lnWL_t + \alpha_t lnWL_t + \varepsilon_t$$

Where: (Y) Rice Production, (L_t) Labor, (K_t) Capital, (MY) Monthly Income, C) Input Cost, (MR) Marketing, (EU) Education, (AG) Age, (CS) Credit Sources, (G) Gender, (EX) Experience, (AF) Appropriate use of fertilizers, (APW) Appropriate use of pesticides/weedicides, (PS) Price of seed, (RP) Rice Price, (WL) Wetland area and (t) represents given time of period and (ε_t) residual term in the equation.

Similarly, the general form of the CDFP function is:

$$Y = AL^{\alpha}K^{\beta}$$

Based on a CDFP the mathematical form of the rice production function is projected by including all the possible determinates of rice production. Hence the stochastic form of the CDFP can be expressed as:

$$lnY_t = \alpha + \alpha_1 lnL_t + \alpha_2 lnK_t + \alpha_3 lnMY_t + \alpha_4 lnC_t + \alpha_5 lnMR_t + \alpha_6 lnEU_t + \alpha_7 lnAG_t + \alpha_8 lnCS_t + \alpha_9 lnG_t + \alpha_{10} lnEX_t + \alpha_{12} lnAF_t + \alpha_{12} lnAPW_t + \alpha_{13} lnPS_t + \alpha_{14} lnRP_t + \alpha_{15} lnWL_t + \alpha_t lnWL_t + \varepsilon_t$$

Results and Discussion

The descriptive statistics of the study reveals that the average age and experience of the farmers are 45 years and 12 years respectively (Table 3). Hence, it can be easily concluded majority of the growers involved in rice production in Nasirabad are fairly seasoned and have a suitable level of experience. The high experience of the farmers is indicated that they have been associated with rice production for long. The education status of the growers is quite discouraging, about 40 percent of the growers are completely illiterate, while the rest have some formal education; a clear majority 37 percent are just attending primary school. Hence, because of soaring illiteracy of the farmers, they cannot apply emerging technologies, and procedures associated with contemporary agriculture. Subsequently, they focus solely on their outdated farming techniques. In addition, as a result of elevated illiteracy among the farmers' majority sell their productivity through an intermediary person, albeit just 25 percent of the farmers doing marketing by themselves. The income status of the farmers is additionally not significantly overpowering, a significant chunk that is 65 percent of the farmers monthly income below 15,000 PKR. It shows that most farmers are living beneath the poverty line. Due to these financial limitations, the farmers cannot invest in their farms. In this way, we easily presume that farmer poverty is a big obstruction to achieve a high level of per acre productivity. Subsequently, poor farmers consistently acquiesce to credit yet because of restricted wellsprings of credit, 70 percent received loans from the informal sector, whilst merely 10 percent of the farmers get loans from Zarai Taraqiati Bank Ltd (ZTBL). Moreover, nearly all farmers in the study area are men and have a small piece of land for farming.

Results of the study model

The results of the NCPF reveal that the lead variable has the precise magnitudes and signs as claimed by the notions of economic theories. Capital and labor have significant encouraging impact on rice production, and paddy regions in the Nasirabad show that they can assimilate increasingly capital and input to stimulate the productivity. Additionally, the results clearly exhibit that capital could play significant role in agricultural production, as the marginal productivity of capital is sophisticated than labor.

Moreover, seeds, herbicides and pesticide, credit, fertilizers, fuel, operating cost, monthly income, rice price, technology, education, credit sources, marketing, and gender have positive and significant impact on rice productivity. Nevertheless, experience, cost of farm size, input cost and age and irrigation costs are adversely connotated to the productivity. As majority of the farmers in the area is marginalized and deprived so it is fairly challenging for them to use appropriate inputs in rice production. Therefore, the prices of the inputs are significantly adversely connotated with the production of rice as the farmers have no capacity to bear the cost of the expensive inputs for rice production. Therefore, a one percent

Table 1: *Selection of the sample size.*

Tahsil	Population	n	N	Ni	NI= n/N ×Ni [1]
Baba Kot	49,459	200	147,160	14,837	20
Chattar	75,330	200	147,160	22,599	31
Dera Murad Nasirabad Mali	234,581	200	147,160	70,374	96
Tamboo	131,168	200	147,160	39,350	53
Total	490,538	----	------	147,160	200

n: Total sample size i.e. 200. **Source:** *Local Government, Balochistan, 2005. [1]Yamane (1967), formula is used for the selection of the sample size.*

Table 2: *Variables of the study.*

Variables	Description	Definition	Unit
QR	Rice production	Per acre rice production	Tons
MY	Monthly Income	Less than 15,00, between 15,000-25,00 and above 25,000	PKR
RP	Rice Prince	Per Kilogram	PKR
WL	Wetland area	Less than 3, between 3 and 5 and more than 54 4	hectare
L	Labor	Daily wage of a labor	Per hour
K	Capital	Price of capital	
C	Input Cost	Price of inputs used in rice production	
T	Technology (ratio QR to wetland)		ratio
EU	Education	Illiterate, Primary, Metric, Secondary and Graduate	Categorized variable
AG	Age	20-25,25-35,35-45,45-55,55-65 and 65-75	Years
CS	Credit source	Government bank, ZTBL, Private bank, and informal sector	Categorized variable
MR	Marketing of Rice	Self, Middleman and Agencies	Categorized variable
G	Gender	Male and female	Binary Variable
EX	Experience	Less than 5, between 5 and 10 and more than 10	Years
AF	Appropriate use of fertilizer	Binary Variable	Per Kilogram
APW	Appropriate use of pesticides/weedicides	Binary Variable	Per Kilogram
SR	Price of seed	Price of seed per kilogram	Per Kilogram
PR	Ploughing rate	Price of tractor per hour	Per hour

surge in inputs price hit adversity the rice out 0.0210 percent. Similarly, as long-term availability of training, form size, training, use of improved practices and technology have an incredible potential to push the per acre productivity of the rice in the district to a next level.

The results of the CDPF reveal that tractor hours, farm size, number of irrigations, seed variety, number of laborers, fertilizers, education are statistically significant at 1% and 5% level while, pesticides, farming experience, are found insignificant. In the light of the study results, we can declare that rice production is already subject to increasing return to scale, as disclosed by CDPF.

The R-Square value of the regression is 0.75 which is very suitable and shows that the regression is the best fit. Moreover, the value of R-Square further indicates that 75% of the variations in dependent variable are explained by independent variables of the model (Table 4).

Table 3: *Descriptive statistics of the variables.*

Characteristic	Categories	Percentage	Mean	Min	Max
Age	14-25 years	20	45	14	64
	25-35 years	25			
	35-45 years	40			
	45-55 years	10			
	55 years and above	5			
Experience	1-5 years	40	12	01	18
	5-10 years	35			
	10-15 years	18			
	15 years and above	7			
Education	Illiterate	40	Primary	0	16 years
	Primary	37			
	Middle	13			
	Matric	5			
	HSSC	4			
	BA/ BSc and above	1			
Gender	Male	90	Dummy	0	1
	Female	10			
Marketing	Self-Marketing	25	Dummy	0	1
	Marketing via middleman	75			
Monthly Income (PKR)	15000	65	16,012	10,000	30,000
	15000-20000	20			
	20000-25000	15			
Credit Sauces	ZTBL	10	Dummy	0	1
	Informal Sector	90			

Table 4: *Results of the Neo-classical and Cobb-douglas production functions.*

Variable	Description	NCPF	Probability	CDPF	Probability
Constant	Intercept	12.234	0.3150	8.9130	0.4140
L	Labor	0.4099	2.1321	0.3120	4.5130
K	Capital	0.10212	3.4101	0.0125	5.7312
MY	Monthly Income	0.0151	1.321	0.1819	0.3451
C	Input Cost	0.0201	2.1320	0.0219	2.9530
M	Marketing	0.1700	0.3120	0.3122	1.3420
T	Technology	0.2141	0.1890	0.0921	1.2130
EU	Education	0.0219	3.9810	0.1021	4.9010
AG	Age	-0.2370	1.4582	0.1600	4.8330
CS	Credit	0.0241	2.0913	0.3211	6.4210
G	Gender	0.2095	1.9023	0.0010	2.6100
EX	Experience	0.0841	0.9721	0.0321	.02341
AF	Appropriate use of Fertilizers	0.1200	1.0910	0.3120	3.7000
APW	Appropriate use of PandW	0.2141	0.1890	0.0921	1.2130
PS	Rice seed	0.0043	4.0912	0.0312	3.1281
RP	Rice Price	0.0012	3.09012	0.0312	4.0911
WL	Wetland area	0.04521	3.0812	0.04689	5.8922
R-square	0.7510		R-square	0.7100	
Adj-R^2	0.7101		Adj- RS	0.6801	
F-stat	34.510		F-stat	41.270	
Prob(f-stat)	0.0000		Prob(f-stat)	0.0000	
DW	1.9021		DW	2.1920	

Source: *Authors own estimations from primary data.*

Conclusions and Recommendations

The study investigated the factors which determines rice production in the Nasirabad. Data from the farmers was accumulated through a well-devised questionnaire. Two hundred samples were carefully chosen and investigated by using random sampling methods. The preponderance of the factors has a positive impact on rice production in Nasirabad, apart from the experience of growers and the soaring cost of input, as veteran farmers are reluctant to use emerging techniques and technologies in the production. Consequently, it is the obligation of the management to inspire and support farmers for the usage of fertilizers and emerging approaches in agriculture production and afford them loans on the small interest rate, via speedy and robust process, and teach them via adults' education programs in evening times. Additionally, it is also responsibility of the state to train and inspires the farmers' state of the art practicing and methods. In addition, government must be provided interest-free loans to the farmers over time in accordance with farmers' banking requirements. Agricultural training programs must be launched to transfer knowledge and awareness among rice producers; inputs must be provided at doorstep on subsidized rate for the farmers, physical infrastructure should be improved more as farmers demands, modern farming methods should be introduced to the farmers in the study area.

Novelty Statement

This study is the first of its kind to identify the factors that determine the rice productivity in the district Nasirabad, Balochistan, and put forward significant recommendations to the policymakers.

Author's Contribution

Umar Kayat and Khalid Khan developed the first draft of the manuscript and supervised data collection, field survey, and data analysis. Saima Liaqat furnished the questionnaire and led the data analysis and its interpretation. The authors completed this manuscript under the supervision of Guo Xiangyu.

Conflict of interest

The authors have declared no conflict of interest.

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