Research Article

Determinants of Rice Productivity in District Lower Dir, Khyber Pukhthunkhwa, Pakistan

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Abstract | Rice play key role as a staple food in Pakistan and is grown anywhere where water is available. This crop is also grown in rural area of Lower Dir district which play vital role in the economy of the farming community. Till today no study was arranged in this district to analyze the situation. Seeing to its importance the present study was started in 2016 and completed in2018. The major objectives of the study were to determine the factors which affect the production per acre of rice and analyze the problems and constraints faced to rice grower in the study area. The universe of the study was Lower Dir District which consist of seven tehsil while on the basis of more production only two tehsils Balambat and Lalqila were purposively selected The total rice growers number in this district was37557, Balambat 6121 and Lalqila 5167which make total in both tehsils 11228. Through Yamani Formula 100 sample size was fixed and distribute the sample according to proportionate formula between two tehsil, Balambat 54 and Lalqila 46. Similarly, semi structured questionnaire was used for data collection while descriptive statistics and Cob Douglass Production Function were used for data analysis. The results indicate that all rice grower were literate while the secondary level was more than the other level, followed by intermediate level. Similarly, in category of family size the number in above 15 category was found more than the other categories followed by 8-15 category. The Cob Douglass Production function result indicate the constant value 5.434 and found significant which shows that if other variables remove from the model then production of rice will be 5.434 Kg per acre averagely of the respondents. According to analysis Farm Size, Tractor hours, Fertilizers, Number of irrigations, Farmer's education were found significant at 5% level while , Seed Variety, Pesticides, Farming experience, Number of labors were found non-significant at 5% level. The R-Square value was 0.92 which means that 92% variation is explained by the independent variables on the dependent variable in the model. It seems very good fitted model as R-Square is much high for it. The F-statistic value was found 113.97 which shows that model overall is significance. Few problems and constraints were observed such as lack of credit facilities; Lack of agriculture education and awareness programs; Expensive Agriculture Inputs; Tenancy and Land rent problems; Farm to market roads and small plots hurdles in production of rice etc in the study area. On the basis of problems and constraints, policy recommendation for control measures are given as:- Credit should be provided without interest rate in time according to requirement to farmers by bank; Agriculture extension programs should be launched for transfer of knowledge and for awareness of rice growers; Inputs should be provided at door step on subsidized rate to farmer; Legal programs should be arranged for farmer awareness in the study area; Road facilities should be provided to farmer for pick and drop of input and output; Several farm plots should be combined and modern farming be practiced on the farm for enhancement of rice productivity in the study area.

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Introduction

Agriculture is the most ancient and important profession in human history which started about ten thousand years ago while its originated from south and north china, Africa, New Guinea and some American regions. Agriculture is the main source of food and playing vital role in human survival. Agriculture basically comprises of farming or land cultivation, livestock like dairy farming, poultry farming, fisheries, bee keeping and limited forestry. Pakistan is an agrarian economy and the contribution of agriculture sector to national income has been crucial so far. Agriculture contributes about 19.8% to GDP, about 66% of the population lives in rural areas and engaged in agriculture directly or indirectly. Agriculture provides about 42.3% employment to the total labor force. 68% of the total exports are from agriculture sector while the shares of other sub components of Agriculture sector are as follows; (cropping contributes 23.55%, Livestock 58.55%, Forestry 2.06% and Fishing 3.17%) (Economic Survey 2015-16, Ministry of finance government of Pakistan). Several methods were developed which had made tremendous contribution to the overall agriculture production in the twentieth century. Modern farming is a result of the green revolution of the twentieth century. It is the transformation of traditional agriculture to the modern one and the green revolution that took place in Mexico provided base to modern farming. The process of green revolution was started in 1943 in Mexico. The major objectives were land reforming, better management of farms, enhancing of food production, agriculture support to national industrial sector and ultimately to contribute to national growth and development. The program result was found successful which latter on made Mexico the wheat and maize improvement center of the world (Chauhan et al., 2012).

The green revolution program was launched by India in 1961 while, Pakistan introduced this program in 1960. In 1972 organic movement was started and pesticides and nitrogen fertilizers were introduced while in 1996 commercial agriculture were initiated where genetically improved seeds and plants were cultivated on commercial basis (Chauhan et al., 2012). In today's modern agriculture focus is on food supply which ultimately leads to food self-sufficiency and on the other side contributing to national growth and development in the form of exports. Among crop rice play key role as a staple food and supply over half food to the world's population. It is the predominant dietary energy source for 17 countries in Asia and the Pacific while 9 countries in North and South America however 8 countries in Africa. Rice provides 20% of the world's dietary energy, while wheat supplies 19%, maize 5% (World Rice Production Report, 2016).

Table 1: *World major rice producing countries (thousand tons) 2016.*

Name of Country	China	India	Indonesia	Bangladesh	Pakistan
Production	144850	106500	36600	34515	6640

Source: *World rice production,* https://www.worldriceproduction.com/

Table 1 indicates world major rice producing countries for year 2016. According to table China's production was 144850,000 tons while India produced 106500,000 tons, Indonesia 36600,000 tons, Bangladesh produced 34515,000 tons while rice production in Pakistan was 6640,000 tons. The above-mentioned data shows that rice is grown around the world on large scale and has great contribution to the world economy. The share of rice of Pakistan is also appreciable on world level. From the above table, it is also clear that rice is grown around the world on large scale and contributing an appreciable share towards world economic growth. Subsequently, in 2016 the rice production in Pakistan was 6640,000 tons while in Khyber Pakhtunkhwa was 104000 tons which makes 1.48 percent share out of the total production of Pakistan, wheat production in Pakistan was 25478,000 tons and in Khyber Pakhthunkhwa was 1155,000 tons which makes 4.53 percent share

of the total Pakistan production. The total maize production in Pakistan was 4695,000 tons and the share of Khyber Pakhthunkhwa was 886,000 tons which makes 18.87 percent share in total production of Pakistan. The coverage of the sugarcane in whole Pakistan was 62652,000 tons and KP share was 5080000 tons which makes 8.11 percent share of the whole Pakistan. The total production of tobacco in Pakistan was 130000 tons while the share of KP was 91000 tons, so it makes 70% share of the whole Pakistan (Agric. Statistics of Pakistan 2015-2016).

Table 2 shows District wise area, production and yield per hectare of rice in Khyber Pakhthunkhwa 2012-2015. According to Table 2, in 2012-13 the total cultivated area of the Khyber Pakhthunkhwa was 38168 hectares and production was 78265 tons while per hectare yield was 2051 Kg. However, in 2013-14 the total cultivated area was 44442 hectares and production was 95948 tons and per hectare yield was 2489 Kg. Similarly, in 2014-15 the total cultivated area was 46212 hectares, production 103636 tons and per hectare yield was 2243 Kg.

In 2012-13 the total cultivated area of Swat district was 5698 hectares, production13840 tons and per hectare yield was 2429 Kg while in 2013-14 the total cultivated area was 5559 hectares, production 13834 tons and per hectare yield was 2489. Similarly, in 2014-15 the total cultivated area was 6649 hectares, production 17246 tons and per hectare yield was 2594 Kg.

While in 2012-13 the total area of D.I. Khan district was 6215 hectares, production 13479 tons and per hectare yield was 2169 Kg. Subsequently in 2013-14 the total cultivated area in D.I Khan was 12554 hectares, production 27795 tons and per hectare yield was 2214. Similarly in 2014-15 the total cultivated area in D.I.Khan was 12733 hectares, production was 29943 tons and per hectare yield was 2352 Kg.

In 2012-13 the total area of the Malakand district was 4930 hectares, production 10582 tons and per hectare yield was 2146 Kg while in 2013-14 the total area cultivated in Malakand was 4960 hectares, production 10861 tons and per hectare yield was 2190. However, in 2014-15 the total cultivated area in Malakand was 4970 hectares, production 10201 tons and per hectare yield was 2053 Kg.

In 2012-13 the total cultivated area in Dir Upper district was 4149 hectares, production 8222 tons and per hectare yield was 1977 Kg while in 2013-14 the total area cultivated area in Dir Upper was 4150 hectares, production 8613 tons and per hectare yield was 2075. Similarly, in 2014-15 the total cultivated area in Dir Upper was 4200 hectares, production was 8716 tons and per hectare yield was 2075 Kg. In 2012-13 the total cultivated area of Lower Dir district was 4253 hectares, production was 6960 tons and per hectare yield was 1636 Kg while in 2013-14 the total area cultivated with rice in Lower Dir was 4278 hectares, production was 8681 tons and per hectare yield was 2029. In 2014-15 the total area cultivated with rice in Lower Dir was 4310 hectares, production was 9935 tons and per hectare yield was 2305 Kg.

In 2012-13 the total cultivated area in Mansehra district was 2319 hectares, production was 5125 tons and per hectare yield was 2210 Kg while in 2013-14 the total cultivated area in Mansehra was 2320 hectares, production was 5398 tons and per hectare yield was 2327. Subsequently, in 2014-15 the total area cultivated in Mansehra was 2317 hectares, production was 5672 tons and per hectare yield was 2448 Kg.

In 2012-13 the total area of the Chitral district cultivated area was 1807 hectares, production was 3440 tons and per hectare yield was 1904 Kg while in 2013-14 the total area cultivated in Chitral was 1809 hectares, production was 3451 tons and per hectare yield was 1908. Similarly, in 2014-15 the total cultivated area in Chitral was 1855 hectares, production was 3710 tons and per hectare yield was 2000 Kg.

In 2012-13 the total area of the Battagram district was 1886 hectares, production was 3358 tons and per hectare yield was 1780 Kg while in 2013-14 the total area cultivated in Battagram was 1816 hectares, production was 3621 tons and per hectare yield was 1994. Similarly, in 2014-15 the total cultivated area in Battagram was 1767 hectares, production was 3646 tons and per hectare yield was 2063 Kg.

It is obvious from discussion that rice crop is one of the major crops of Pakistan. After wheat, rice is the second major food crop and is one of the major sources of food in Pakistan. In Khyber Pakhtunkhwa rice is the third major food crop after wheat and maize. In the year 1981-82, District Dir lower was ranked second after Swat in the production of rice along with area cultivated in rice. In year 2008-09

this district became first in cultivation in rice crop but production-wise it was ranked fourth after D.I Khan, Swat and Malakand in Khyber Pakhtunkhwa. If we further see this decline in production of rice in Dir lower in 2014-15 this district became 4th production-wise and area-wise which is a matter of concern (Crop reporting services Peshawar, 2016). It was the need of the day to study that what factors are responsible for rice yield and this research has empirically analyzed that how different factor inputs like farm size, land preparation, use of hybrid seeds, use of pesticides and use of chemical fertilizers, farmer's education, farmer's experience, labor and irrigation affect per acre rice yield in the study area.

Rice crop is one of the major crops in the study area of district Dir lower. To the best of our knowledge this type of study has not been undergone where the effect of different factor inputs on rice productivity has been studied in the study area. It is a matter of the great significance to conduct a research study on rice crop production in district Dir lower. Seeing to its importance the present study was arranged to determine the factors which affect the production of rice in the study area and what type of constraint and problems faced to rice growers in the study area.

Materials and Methods

Universe of the study area

Dir lower is one of the 26 districts of Khyber Pakhtunkhwa province of Pakistan. According to the 1998 census; the total area of the district is about 1583 square kilometers, while the population is around 717649 with 3.42% growth rate. The population density is 453 (persons/square kilometer) and sex ratio of the population in district Dir lower is 98 males to 100 females. Urban and rural population of Dir lower is 44335 and 673314 respectively. This district is comprised of seven tehsils however, only two tehsils namely Balambat and Lalqila on the basis of more production were selected purposively. Tehsil Balambat population is 130113 and tehsil Lalqila has population of 109674 (Development indicators Khyber Pakhtunkhwa, 2016). Adult literacy ratio of Dir lower is 49% out of which 74% is male and 26% female. Ratios of urban and rural literacy rates are 66% and 48% respectively. If talk about agriculture in district Dir lower, so Wheat, Maize and Rice are major crops grown in this district. Total number of farmers in this district is 37557 out of which 6121 are from Balambat tehsil and 5167 from tehsil Lal-qilla. As the present research deals only rice crop so here is a glimpse of rice in our study area. In Table 3 district-wise area and production of Rice has been presented in which the district under study is on fourth position. In year 2012-13 the total area cultivated with rice is 4253 hectares and total production of rice was 6960 tons. Similarly, in year 2013-14 total area cultivated with rice was 4278 hectares and total production of rice8681 tons. In the same way, total area cultivated with rice in 2014-15 was 4310 hectares and total production is 9935 tons (KP Bureau of statistics report, 2016). From the above discussion, the importance of Dir lower is quite obvious regarding rice production in the province of Khyber Pakhtunkhwa. Therefore, it is necessary to conduct a research in district Dir lower to empirically investigate the factor inputs that effect

Table 2: *District-wise area (hectares), production (tons) and yield (kg) per hectare of rice in Khyber Pakhtunkhwa 2012-13 to 2014-15.*

District	2012-13			2013-14			2014-15		
	Area	Production	Yield per Hectare in KG	Area	Production	Yield per Hectare in KG	Area	Production	Yield per Hectare in KG
K.P.K	38168	78265	2051	44442	95948	2159	46212	103636	2243
Swat	5698	13840	2429	5559	13834	2489	6649	17246	2594
D.I. Khan	6215	13479	2169	12554	27795	2214	12733	29943	2352
Malakand	4930	10582	2146	4960	10861	2190	4970	10201	2053
Dir Upper	4159	8222	1977	4150	8613	2075	4200	8716	2075
Dir Lower	4253	6960	1636	4278	8681	2029	4310	9935	2305
Mansehra	2319	5125	2210	2320	5398	2327	2317	5672	2448
Chitral	1807	3440	1904	1809	3451	1908	1855	3710	2000
Battagram	1886	3358	1780	1816	3621	1994	1767	3646	2063

Source: *Crop Reporting Services, Development Statistics Khyber Pakhtunkhwa, Peshawar 2016.*

rice production in this area. It has been examined that how different factors like farm size, land preparation, use of genetically improved seeds, use of pesticides and chemical fertilizers affect per acre rice production in district Dir lower.

Sampling procedure

Through Yamane (1967), s formula 100 farmers were selected and according to allocation proportionate formula 54 farmers from tehsil Balambat and 46from tehsil Lal qilla were selected. Whole process of the selection is given as. S = N/[1+N(e^2)] Where, S is total sample size, N is number of farmers in both tehsils and "e" is chances of error in selecting a farmer (precision which is set at 10% or 0.10). This suggests total sample size of 100 respondents. After determining the total sample size further select the farmers according to proportionate ratio from both tehsils which is as given. Taking e = 0.10 (10%) and using n = 6121 number of farmers in Balamabat tehsil, N = 11288 number of farmers in both tehsils, the given formula suggests a sample of 54 farmers from tehsil Balamabat and 46 from tehsil Lalqila and the selection process is given as follows;

n_i= (n/N)*S where; i(1,2) i^{th} tehsil, S = required sample size, N = total number of farmers in both tehsils

n_i = number of farmers selected from each tehsil, Similarly, for tehsil lal-qilla the proportionate ratio of sample is 46 using the same formula for number of farmers n = 5167 in this tehsil. All process is given in Table 3.

Table 3: *Tehsil-wise distribution of farmers.*

District	Selected area	No. of farmers	Sample size
Dir lower	Tehsil Balambat	6121	54
	Tehsil Lal-quilla	5167	46
Total	= 2	11288	100

Source: *Development statistics Khyber Pakhtunkhwa 2016.*

Data type and collection tools

The research study is based on primary data, for this purpose a semi-structured questioner was used to gather information of different input factors as described in the goal of the study. The data for the study was gathered directly from the rice growers through face to face interviews. The interviews conducted in farming field and Hujras (Public interaction place in village). The data was collected about rice yield, farm size, use of modern machinery, labor, fertilizers, pesticides and high yielding seed varieties. The data about land preparation, number of irrigation and years of schooling was also collected. All this data was collected for year 2016. However, secondary data in the form of published research articles, reports, thesis, newspaper etc.

Data analysis

After the collection of required data from the selected respondents, the data was punched into SPSS software for analysis. Both descriptive as well as inferential analysis was done. Data was regressed according to the production function as described in the model specification section. Different tests like student t-test have been used to check the individual significance of all the independent variables and F-test has been used to check the overall significance of the model. R-square was used to check the goodness of fit of the overall model. Results of descriptive analysis was elaborated in table separately and results for inferential analysis have been presented in separate tables along with their coefficients and t-values. Main dependent variable of this study is Rice yield per acre in mounds while explanatory variables that we have used in our study are as follows; first explanatory variable is farm size in acres, second explanatory variable is use of chemical fertilizers used in kg per acre, third explanatory variables is use of pesticides in Pakistani rupees, fourth explanatory variable is use of genetically improved seeds or hybrid seeds and we have used a dummy variable for it. Fifth explanatory variable is land preparation and was used a proxy for this variable as number of hours of tractor. Sixth explanatory variable is of labor used per acre of land and was used a proxy of number of labors hired per acre. Seventh explanatory variable is farmer's education in years. Eighth explanatory variable is farmer's experience in years, and ninth explanatory variable is irrigation and has used number of times water given to rice crop.

Model specification

Cobb-Douglas type production function was used to empirically estimate various inputs combinations determining rice yield. This model has been widely used for determination of input output relation, inputs elasticity and economies of scale in agriculture.

Baksh et al. (2005) has also used Cobb-Douglas

production function for determination of the impact of different inputs on farm productivity. In order to empirically determine the relationship among inputs and farm productivity ordinary least square (OLS) technique was used.

Cobb-douglas type production function of rice is as follows:

$$\ln RY = \beta_1 + \beta_2 \ln FS + \beta 3 \ln DS + \beta_4 \ln TRACH + \beta_5 \ln FERT + \beta_6 \ln PST + \beta_7 \ln FEXP + \beta_8 \ln LAB + \beta_9 \ln NOIRR + \beta_{10} FEDU + u \quad \ldots\ldots 1$$

Where;
In RY is the natural log per acre rice yield in Kg; ln FS is natural log of Farm size; DS is dummy variable for seed variety (DS= 1, if farmer grows hybrid rice and DS=0 otherwise).

In TRACH is the natural log of tractor hours hired for land preparation
In FERT is the natural log of fertilizers used in Kg
In PST is the natural log of pesticides used in Pakistani rupees

LnFEXP is natural log of farmer's experience in years
lnLAB is natural log of no. of labors per acre
lnNOIRR is natural log of no. of times water given to rice crop
lnFEDU is natural log of farmer's education in years and β_1 is constant β_2, β_3,β_4,β_5,β_6, β_7, β_8, β_9, and β_{10} are coefficients of explanatory variables u is the error term capturing the impact of all omitted explanatory input variables.

Results and Discussion

Table 4 indicates age wise distribution of the sampled respondents in the study area. According to Table 4 in age 20-30 category the respondents number is 18 percent, in 30-45 age category the number is 47 percent, in 46-60 age category the respondents' number is 28 percent while in above 60 categories the respondents' number is only 7%. The highest number was found in 30-45 category which followed by 46-60 age category and the lowest number is present in above category. The table data explain that majority respondents are mature which play key role in the development of rice productivity. This table indicates that in age 20-30 categories show that there are not too many young farmers in the study area while in age 30-45. The number of respondents is the middle age. In 46-60 age category the second highest number of respondent is from this one. In above 60 age category the number of respondents is quite little as farming as the game of young and middle age people.

Table 4: *Age wise distribution of sampled respondents in the study area.*

Age category in years	Frequency	Percent
20-30	18	18
30-45	47	47
46-60	28	28
Above 60	7	7
Total	100	100

Source: *Field survey 2016.*

Table 5 represents educational level of the respondent in the study area. According to table that 5% respondents have only primary level of education, 43% of the respondents having secondary education, 39% of sampled respondent's intermediate levels of education, and only 13% of respondents have more than 12 years of education. The highest numbers of respondents have secondary level of education and lowest number of respondent is primary level of education.

Table 5: *Educational level of the sampled respondents in the study area.*

Education category	Frequency	Percent
Primary	5	5
Secondary	43	43
Intermediate	39	39
BA/BSC	13	13
Total	100	100

Source: *Field survey 2016.*

Table 6 represents experience-wise distribution of sampled respondents in the study area. According to the table, experience is distributed in 3 categories from less than-10 years of experience the number of respondent is 28 percent and from 10-20 category the number of respondent is 58 percent and above 20 year of experience the number of respondent is 14 percent. The highest number was found in 10-20 categories and lowest number was present in above 20 years of experience. It is great interest to see that in study area respondents are highly experienced but there are some other constraints due to which rice productivity is not up to the mark. Similarly, 14% of sampled respondents have more than 20 years of

faming experience.

Table 6: *Experience-wise distribution of sampled respondents in the study area.*

Experience category	Frequency	Percent
Less then-10 years	28	28
10-20 years	58	58
Above 20 years	14	14
Total	100	100

Source: *Field survey 2016.*

Table 7 represents category-wise distribution of family size of the sampled respondents in the study area. According to the table less than 8 categories the number of respondents are 4 percent and 8-15 category the number of respondent is 37 percent and above 15 categories the respondent number is 59 percent. The highest number of sampled families fall in the last category that 59 percent respondents have more than 15 members in their families, and the lowest number of sample respondent is less than 8 categories in the study area. It is clear from the table that majority live in the study area combined.

Table 7: *Category-wise distribution of family size of sampled respondents in the study area.*

Category	Frequency	Percent
Less than 8	4	4
8-15	37	37
Above 15	59	59
Total	100	100

Source: *Field survey 2016.*

Table 8 indicates income distribution of sampled respondents in the study area. This table show that only 2 percent sampled respondents have less than Rs 100,000 category and 70 percent of the sampled respondents have Rs 100,000-Rs 300,000 family income per annum and similarly, 28 percent of sample respondents have more than Rs 300,000 categories. The highest number of respondents falls in 100,000-300,000 income categories and the lowest number of respondents fall less than 100,000 categories. According to the table, people in the area are not totally dependent upon farming except few ones and they have some other income sources like, small businesses, government jobs and especially foreign remittances.

Table 9 represents land size distribution in the study area. According to the table in category less than 0.5 acres the respondent number is 36 percent and 0.5-1.5 category a number of respondent is 56 percent and 8 percent respondent fall in above 1.5 categories. The highest number of respondent present in 0.5-1.5 category's and the lowest was found in above 1.5category. The study area mostly comprised hilly area and farm size is relatively small. Farm size is one of the major explanatory variables and it is conclude that as farm size gets larger rise productivity also enhance in study area.

Table 8: *Family income distribution of sampled respondents in the study area.*

Income category	Frequency	Percent
Less than Rs.100,000	2	2
Rs.100,000- Rs300,000	70	70
Above Rs.300,000	28	28
Total	100	100

Source: *Field survey 2016.*

Table 9: *Land size distribution of the sampled respondents in the study area.*

Farm Size in Acres	Frequency	Percent
Less than 0.5	36	36
0.5-1.5	56	56
Above 1.5	8	8
Total	100	100

Source: *Field survey 2016.*

Table 10 shows the seed variety grown by sampled respondents in the survey area. This research study takes two varieties i.e. local and hybrid and in data obtained it can be seen that 54% respondents grow hybrid seed and 46% respondents grow local seed and results found a positive relationship between high yielding variety seeds and rice productivity.

Table 10: *Seed Variety Used by Sampled Respondents in the Study area.*

Seed Variety	Frequency	Percent
Local	46	46
Hybrid	54	54
Total	100	100

Source: *Field survey 2016.*

Total cost and revenues of rice production

This section comprises of details about the average total cost of rice production in the study area. Here

it is explained that what types of cost is incurred by farmers and what is the ratio on average to the total average cost per unit of land.

Table 11: *Average cost per acre of rice production by sampled respondents in the study area.*

Particulars	Average share of the cost items
Land preparation	4494
Seed	2121
Labor	3060
Fertilizers	3200
Farmyard manure	1100
Pesticides	947
Final harvesting	6526
Land rent	48425
Total average cost	69873

Source: *Field survey (2016).*

Table 11 represent averages cost per Acers of rice production by sampled respondents in the study area. This table explains that land preparation is one of the crucial inputs, it is obvious that on average farmer bears cost of Rs. 4494 per acre. Land preparation means to make farm prepared for sowing rice crop, starting from plugging via tractor or bullocks to finally leveling for sowing. Similarly, seed is also one of the major and important inputs of rice crop. In the study area, it came out that mostly local or old variety of seed is used as its demand is high in the local market and is liked by the most people. On the other hybrid seed is relatively more productive but due to low market demand, farmers do not prefer to grow high yielding varieties in the study area. From the cost analysis, it is found that on average seed cost of rice crop is Rs. 2121 per acre. In the same way, the average cost of labor of rice crop per acre is Rs. 3060. Rice crop is not more labor demanding but mostly labors are hired on few occasions such as sowing and harvesting. In survey information about chemical fertilizers and farmyard manure was also collected. After analysis, it is obvious that on average farmers bear costs of Rs. 3200 for chemical fertilizers and Rs. 1100 for farmyard manure respectively. Usage of pesticides and spray on rice crop is also very important as there is always threat of different diseases and insects attack on the crop. To cope with such situation and protecting rice crop from these attacks, farmers must use different pesticides and on average they bear cost of Rs. 947 per acre. To take the reward of what farmers have sown and have taken care of is the stage of harvesting period of rice crop but at this stage they must bear some costs like paying for crop cutting, threshing, bagging and transporting etc. In the survey farmers told about these costs and after analyzing we came to know that on average farmers bear Rs. 6526 as final harvesting cost. Land rent is one of the most important among agriculture inputs. Farmers either cultivate their own land or they rent it in. Different terms and conditions might be there when agreement is made. For example, farmer either must share half of the total agriculture produce and total cost incurred by farmer is to be shared by land owner, he has to pay cash money as rent on annual/seasonal basis without sharing agriculture output with land owner. In the study area mostly prevail these cases and farmers pay land rent on average of Rs. 48425. From the above table, on average farmer incur cost of Rs. 69873 on the production of rice crop per acre in the survey area.

Table 12 shows Average Cost, Revenue and Net Revenue of Rice Per Acre of the Sampled Respondent in the study area. It means that this study simply computes the average cost of one-acre land cropped with rice beard by farmer and on other hand it simply computes the average revenue or market value of the output produced in the same land. This process is commonly known as cost and benefits analysis. Here average cost and average output is compared and conclusion is made about that where farmer is benefitting while growing rice in the study area or not. In our analysis, indicates that average cost of per acre rice production is Rs. 69876 and farmer gets average revenue of Rs. 117940 from rice production. Simply deducting cost from revenue, the farmers get the net benefit of Rs. 48064 that farmer obtains when he crops one acre of land in the survey area.

Table 12: *Average cost, revenue and net revenue of rice per acre of the sampled respondent in the study area.*

Yield	Quantity	Market Rate/50kg	Total Amount in Rs.
Rice	2000 kg	2440	97600
By Product			20340
Total Revenue			117940
Total Cost			69876
Net Revenue			48064

Source: *Field survey (2016).*

Estimation of rice production function

This section presents details about econometric

analysis of rice production function that is estimated to reflect the production process in an appropriate way. Before application of the Cob Douglass Production Function assumptions of the model were tested. There was no multi Collinerity among the independent variables because the VIF was found less than the 5. Through shapero Kalmagro test normality of the data was checked and data was found normal while for hetrodocity unit root test was applied and no heterodocity was found in the data. Then Cobb-Douglas production function was used which is the most suitable one in an input output analysis. Such kind of production function has been used by many researchers like, Ahmad et al. (2003), where they have estimated model for different determining factors of crops yield. There in this research they have incorporated major agriculture inputs as explanatory variables in the production function i.e. farm size, tractor hours, fertilizers, number of irrigations, farmer's education, farming experience, number of labors, pesticides and seed type. After empirical estimation of model, the following explanatory variables show significant impact on rice productivity. Having the following model, it can be predicted rice production increases, if there an improvement in the explanatory variables.

Table 13 represents estimated results of the Cobb-Douglas production function for rice production in the study area. According to Table 13, the constant value is 5.434 which shows that if other variables keep constant then production of rice will be 5.434 mds. The coefficient of the farm size is 0.571 and highly significant which show that if other variables keep constant and 1% increase will occur in the farm size, the production will be increased 0.571%. The coefficient of the seed variety is 0.047 and non-significant. It indicates that if 0.047% improvement will be occurred in the production of rice.

Similarly, the coefficient of tractor hours is 0.171 and significant at 5 percent level confidence. It shows that if all variables keep constant then 1% increase in tractor hours improve the production 0.171 percent. The fertilizer coefficient is 0.203 and significant at 5 percent confidence level. It reflects that if other variables keep constant of the model then 1% increase in the fertilizer improve the production 0.203%. The coefficient of pesticide is -0.006 and non significant. It shows that if 1% increase will occurred in the pesticide then 0.006% decrease will be occurred in the production of rice. The coefficient of the farming experience is -.021 and non significant at 5 percent confidence level. It explains that if other variables keep constant then 1% increase in the experience decrease the production of rice 0.021%.

Table 13: *Estimated results of the cobb-douglas production function for rice production in the study area.*

Model	Coefficients		t-stat	P-value
	B	Std. Error		
(Constant)	5.434	0.402	13.504	.000
Farm Size in Acres	0.571	0.073	7.775	.000
Seed Variety	0.047	0.036	1.306	.195
Tractor hours	0.171	0.072	2.376	.020
Fertilizers in Kgs	0.203	0.048	4.237	.000
Pesticides in Rupees	-0.006	0.046	-0.131	.896
Farming Experience	-0.021	0.029	-0.704	.483
No. of labors	0.075	0.058	1.290	.200
No of irrigations	0.174	0.063	2.778	.007
Farmer's education	0.262	0.073	3.576	.001

Source: *Field survey, R-square 0.92, F-value 113.971.*

The number of labors coefficient is 0.075 and non significant at 5 percent level. It indicates that if all variables keep constant and one percent increase will be occurred in number of labors then 0.075% improvement will be occurred in the rice production. The number of irrigation coefficient is 0174 and found significant at 5 percent confidence level. It shows that if all variables keep constant then 1%increase in irrigation number will improve the rice production 0.0174 percent. The farmer education coefficient is 0.262 and is significant at 5 percent confidence level. It explains that if all variables keep constant then 1% education level will improve the production of rice 0.262%. In empirical analysis R-Square is 0.92 which means that 92% variation in the dependent variable (Rice yield) is explained by the independent variables incorporated in the model. It seems very good fitted model as R-Square is much high for it. The F-statistic indicates overall model is significance.

Table 14 shows problems and constraint faced by sampled respondents in the survey area. According to the table 84% sampled respondents are unsatisfied regarding the problem of credit facilities in the study area which leads to create financial constraint for the rice growers. Similarly, regarding the problem of government sector agriculture education and awareness problems in the survey area, 78% of sampled

respondents are found unsatisfied and therefore the rice production is affected adversely. Table also explains that, 91% of sampled respondents face financial problem in the survey area as the prices of agriculture inputs are very high for example, prices of chemical fertilizers, pesticides, seeds and other technical machinery. From the table it is obvious that there are certain regarding tenancy and land ownership in the study area and 91% of the sampled respondents face these problems and leading to affect rice production adversely in the area because the tenants are uncertain about the future of land ownership and therefore they hesitate to invest in farming. There is also problem of farm to market road in the survey area and according to the table, 82% sampled respondents face this problem and there is lack of access to the farms affecting rice production in the study area adversely.

Table 14: *Major problems and constraints faced by rice growers in the study area.*

Name of Tehsil	Types of problem											
	I		II		III		IV		V		Average	
	NO	%	NO	%	No	%	No	%	No	%	No	%
Balambat	45	83	37	69	48	89	50	93	46	85	45	83
Lalqila	39	85	41	89	43	93	41	89	36	79	40	87
Total	84	84	78	78	91	91	91	91	82	82	85	85

Field Survey 2016; **I:** *Lack of Credit facilities,* **II:** *Government sector Agriculture education and awareness programs,* **III:** *Expensive Agriculture Inputs,* **IV:** *Tenancy and Land rent problems,* **V:** *Farm to market roads.*

Conclusions and Recommendations

This study concludes that there is positive and significant relation between farm size and rice production. Mostly farms are of small size and an increase in farm size gets larger production of rice. It might be done by cultivating more area with rice crop or by increasing existing farm size by combining several plots. Similarly, land preparation also has positive and significant effect on rice productivity. Farm preparation in a better way by ploughing it deeply and leveling it properly and fertility testing leads to increase productivity in positive way. In modern farming chemical fertilizers are considered most important and chemical fertilizers having positive and significant effect on rice productivity at right quantity and at right time application of the chemical fertilizer. Number of irrigations also has positive and significant effect on rice production and with increase in water quantity lead to increase rice productivity. Educated farmers aware of modern farming and farming issues, in more easy way than illiterate farmers. There are some results which establish negative relation among rice productivity, like farming experience and prices of pesticides. It means that farming experience lead to enhance productivity to a certain level but beyond it does not contribute to rice production and an increase in pesticide's price leads to decline its use and further declines rice production but both these variable inputs are found insignificant and therefore both are unimportant in this study. Similarly, seed and number of labor both are found insignificant. It means that whether farmers grow local seed or hybrid there is not a significant difference in rice production between the two and if farmer employs more and more labor to the land it does not enhance rice production in the survey area and reasons have been discussed so far. Few problems and constraints were observed in the study area such as lack of credit facilities; Lack of agriculture education and awareness programs; Expensive Agriculture Inputs; Tenancy and Land rent problems; Farm to market roads etc. On the basis of problems and constraints policy recommendation for control measures are given as Most of the rice output is produced for self-consumption due to two reasons; As policy, government should make it sure for these local rice growers to access national as well as international markets. Local farmers should be encouraged for wheat and maize crops along with rice. These can be used as alternative food items leading to market rice output in larger amount and further leading to earn maximum profits for rice growers; Comprising of hilly area, farm size is very small (average 0.74 acre) in rice cropping area which is major hurdle to get more output. Rice should be cropped on larger farms and more land should be brought under cultivation and it is also possible to combine several farm plots and modern farming be practiced on it. In study area both hybrid and local seeds of rice are grown but demand is more for local and hybrid is not preferred so much due to consumer tastes in region. Local seed is not a high yielding variety but it is grown due to local market demand and hybrid rice productivity is although more but is not grown on large scale. Therefore, if market access is given it would be more profitable for high yielding variety rice growers; Effective extension programs be arranged in the area to aware rice growers about new agriculture techniques and proper knowledge of each stage of rice crop; There is lack of availability of certain seeds, chemical fertilizers and pesticides on governmental

level and rice growers must buy from retailers on high prices, so these facilities be provided on their door steps ; There is lack of knowledge and education on rice grower's behalf and they are not aware of their rights regarding tenancy and therefore they are exploited by the landlords. It is the need of day that certain legal awareness programs be launched in the study area to control such exploitation and there is lack of credit facilities in the study area, so credit should be provided on low interest rate or Istisna type bank loan should be provided to farmer in the study area; Transportation facilities should be provided in the study area because it plays key role in rice marketing.

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Author's Contribution

Syed Amjad Kamal Jan: Presented the idea and conducted the research, collected the data from the field and wrote the manuscript.

Naushad Khan: Helped in writing up and supervised the whole project.

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