

Aspects of rice cultivation in Punjab, India

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ABSTRACT

The present study was conducted with a view to bring out various aspects of rice cultivation in Punjab, India. The study has been based on the sample of 100 rice growers spreading over five districts of the state during 2008-09. The dominant variety PR-106 has lost importance and became out dated over the years. The cultivation of Pusa-44 has increased from merely 16.6 per cent in 1991-92 to as high as 35.2 per cent in 2008-09. The gross return from per hectare production of rice was ₹ 54585. The total variable cost of cultivation per hectare was ₹ 17657, leaving behind ₹ 36927 as returns over variable costs from rice cultivation in sample growers. The regression analysis indicated that there existed scope for further increase in the use of insecticides/pesticides, manures/fertilizers and irrigation for improving the yield of rice in Punjab. The problem of occurrence of stem borer was 'moderate' for 51.6 per cent of rice growers as per their perceptions. Bacterial blight and false smut were the major diseases for rice crop accounting for about 6.3 and 2.7 per cent of rice area, respectively. The problem of weeds, as experienced by the rice growers was not very serious. Timely planting, use proper plant protection measures and providing irrigation at the right time were the most desired practices at the farmers own level for yield improvement by rice growers.

Key words: rice, cultivation, economics, constraint analysis, Punjab

Rice is the major source of protein and calories for the mass of Asia (Job and Nandamohan, 2004). Major advances have occurred in rice production during the last four decades due to adoption of green revolution technology encompassing wide scale adoption of high yielding and disease, and insect resistance varieties of rice. India is the second largest producer of rice in the world next only to China. India has great diversity of food grain crops but rice is one of the major food grain crops for majority of the Indian population. India is a natural repository for multitude of long and short-grained aromatic rice, nurtured and conserved by the farmers of northwestern sub Himalayan regions for centuries (Sananse *et al.* 2004). Punjab is one of the most fertile regions of India ideal for wheat-growing. The farmers of Punjab have adopted the rice crop on a large scale only since mid seventies. Barring some areas in the southwestern districts and Kandi belt, rice is grown all over Punjab. Realizing well the significance of this crop from food security point of view, it becomes pertinent to have a detailed study encompassing varietal distribution, various crop management and marketing

practices, cost benefit analysis and resources use efficiency etc. in the state. The present study has therefore, been carried out with the specific objectives to bring out varietal distribution of rice acreage in the state, study the economics and the resource use efficiency of rice cultivation in the state, and analyze the production, constraints confronted by rice growers in Punjab.

MATERIAL AND METHODS

The Punjab state being dominant in cereal-based cropping system, rice and wheat are being grown on about 66 per cent and 83 per cent of the cultivated area in wet and dry seasons, respectively in the state. Based on the concentration of rice cultivation, the study covered five districts namely, Amritsar, Tarntaran, Gurdaspur, Kapurthala and Hoshiarpur. From each selected district, one Tehsil/block with maximum concentration of rice cultivation was selected for the field level data. These tehsils/blocks were Ajnala, Tarntaran, Batala, Mukerian, and Sultanpur. From each tehsil/block, a cluster of five villages was selected for

data collection and a sample of 20 rice cultivators was randomly chosen from each selected cluster. Thus the final sample of 100 rice cultivators was ultimately selected for the detailed study. The required information and data pertaining to the parameters such as family composition, literacy, farm size, asset ownership, management practices, cropping pattern, input use, cost and return and production constraints of rice cultivation etc. were collected from the farmers with the help of an especially designed schedule for the purpose. The survey was conducted during 2008-09. The interpretations of data were based on the simple tabular analysis. The regression analysis was also carried out to study the yield response of rice in the state. Weighted average ranks were calculated for the constraint analysis. In order to study the yield response of rice, Cobb-Douglas production function (Power function) and Linear Production Function were tried taking the dependent variable (Yield of rice hectare⁻¹) and various independent variables like human labour, machine use, seed, fertilizer, insecticides/pesticides, fertilizers, herbicides etc. in value term (₹ hectare⁻¹). The following linear regression model was found better fit in terms of the value of coefficient of multiple determination, level of significance and logical signs of different independent variables for basmati as well as non-basmati rice :

$$Y = a_0 + a_1x_1 + a_2x_2 + a_3x_3 + a_4x_4 + a_5x_5 + a_6x_6 + a_7x_7 + u$$

Where,

Y = Yield of rice ha⁻¹

x₁ = Human labour

x₂ = Machine labour

x₃ = Seed

x₄ = Seed treatment

x₅ = Insecticide/pesticides

x₆ = Manures and fertilizer

x₇ = Irrigation

a₀ = Intercept

a_i's = Regression coefficients of respective independent variables

u = Error term

In order to estimate the cost of production rice, the various inputs purchased from the market were valued at the actual price paid by the farmers and the home produced inputs like seed and FYM etc. were estimated at the prevailing market prices for such inputs in the local market in a particular area. The family labour and owned machine used at the farm were

assessed at the engaging wage rate for hiring casual labour and the prevailing custom hiring charges for such machines during survey period. The interest on the total variable cost was taken @ 9 per cent per annum for half of the crop period. The total output both main product as well as by-product was evaluated at the market prices, actually realized by the farmers. The total cost included human labour (family + hired) for all the farm operations, machine expenses (owned + hired) for all the farm operations, seed (farm produced + purchased), seed treatments, insecticides, pesticides, manures, fertilizers, irrigation charges and interest on working capital @ 9 per cent per annum for half of the crop period. The gross income hectare⁻¹ of rice crop has been estimated by multiplying the per hectare production of main product and by-product with their respective post harvest period prices. The net income has been calculated by deducting total cost per hectare from the gross income per hectare. The cost per unit of main output has been worked out by deducting the gross income of by product from the total cost and then divided by the total yield of main product.

RESULTS AND DISCUSSION

Considering the area under different rice varieties in 1991-92, 69.8 per cent was under PR-106 followed by R-8/Jaya (7.6 per cent) and Pusa 44 (6.6 per cent). About 8.0 per cent area of total rice was under "other" local varieties that included Satha, Sharbati, Lalmudh etc. (Table 1). The popularity of variety PR-106 has declined to merely 12.4 per cent up to 2000-01 whereas; variety like Pusa-44 has become much more popular among the rice growers in the state covering 40.4 per cent of total rice area. The varieties included under "other" also have grown on 29.6 per cent of total rice cultivation. Further up to the year 2006-07 more volatile varieties shift has been recorded. The variety PR-106 has lost importance totally and became out dated. The cultivation of Pusa-44 has increased from merely 16.6 per cent in 1991-92 to as high as 35.2 per cent in 2008-09. The trends showed volatile varietal shift from PR-106 towards Pusa-44, others (Satha, Sharbati, Lalmudh etc.) and basmati rice in Punjab during the study period.

The gross return from per hectare production of rice was ₹ 54585. The total variable costs of cultivation per hectare were ₹ 17657 the promised returns over variable costs was ₹ 36927 (Table2). The

Table 1. Varietal distribution of rice acreage in Punjab

Variety	PR106	PR108	PUSA44	R-8/ JAYA	PR111	PR103	Basmati	Other varieties*	Total
1991-92	69.8	3.3	6.6	7.6	-	2.8	1.9	8.0	100
1992-93	62.4	2.6	12.9	9.9	-	3.3	7.0	1.9	100
1993-94	49.8	8.1	18.6	7.3	1.5	4.1	4.0	6.6	100
1994-95	52.2	7.5	15.8	14.3	4.5	0.1	3.0	2.6	100
1995-96	40.3	7.7	17.8	15.1	9.8	0.9	3.9	4.5	100
1996-97	37.4	8.5	19.4	13.0	14.9	1.2	3.0	2.6	100
1997-98	25.4	5.4	31.4	10.0	21.8	1.3	3.9	0.8	100
1998-99	23.1	2.5	30.5	9.9	22.0	1.2	5.0	5.8	100
1999-00	24.3	2.3	26.9	7.7	10.7	0.7	4.6	22.8	100
2000-01	12.4	1.6	40.4	5.2	5.8	0.2	4.8	29.6	100
2001-02	4.7	2.7	19.2	0.7	4.4	-	4.1	64.2	100
2002-03	3.5	2.0	22.5	1.8	5.1	-	6.2	58.9	100
2003-04	3.3	2.0	23.7	1.8	5.1	-	8.1	56.0	100
2004-05	2.6	2.4	30.7	0.5	5.5	-	8.5	49.8	100
2005-06	1.8	1.2	38.8	0.3	10.9	-	5.4	41.6	100
2006-07	1.3	1.6	34.2	1.0	9.7	-	8.2	44.0	100
2007-08	1.3	1.7	35.1	1.0	9.3	-	5.9	45.7	100
2008-09	1.3	1.6	35.2	1.0	9.7	-	6.2	45.0	100

Source: Extension surveys, Department of Economics, PAU, Ludhiana * Other varieties include Satha, Sharbati, Lalmudh etc.

results brought out that 59 per cent variation in the yield value of rice could be explained by these explanatory variables, taken together (Table 3). The coefficients of explanatory variables viz., insecticides/pesticides, manures/ fertilizers and irrigation were found to be positive and statistically significant at 5 per cent level

Table 2. Economics of rice cultivation, sample growers, Punjab

Variable costs	(₹ ha ⁻¹)
1. Human Labour	3199.3
2. Machine Expenses	6987.3
3. Seed and seed treatment	662.3
4. Insecticides & Pesticides	2176.2
5. Manures and Fertilizers	3436.8
6. Irrigation	807.1
7. Interest on working capital	388.5
Total variable cost	17657.5
Yield (t ha ⁻¹)	5.85
Price (₹ qtl ⁻¹)	930
Value of main product	54405
By-product (qtl ha ⁻¹)	6.0
Price (₹ qtl ⁻¹)	30.0
Value of by-product	180.0
Gross returns	54585
Net returns over variable cost	36927.5

showing the further scope of enhancing the yield value of rice per hectare through increasing the dose of these inputs. On the whole, there was a need to further increase the use of insecticides/pesticides, manures/ fertilizers and irrigation for improving the yield of rice in Punjab.

The various rice production constraints, biotic (insect-pests, disease, weeds), abiotic constraints (lack of irrigation facility, non-availability of quality seeds,

Table 3. Linear regression of the sample rice growers, Punjab

Particulars	Regression coefficient
Yield in value terms	
Constant	21804.4*(3635.43)
Human Labour	-0.65 (0.59)
Machine Expenses	-0.81 (0.94)
Seed	13.30* (8.96)
Seed treatment	78.42 (57.08)
Insecticides & Pesticides	4.11* (1.43)
Manures & Fertilizers	2.50* (0.71)
Irrigation	14.24* (5.94)
R- square	0.59

Figures in parentheses indicate the standard error.

*Significant at 5 per cent level.

non-availability of fertilizers, shortage of labour, lack of credit, low yield, etc.) and marketing constraints (price variability, storage losses, transport, market demand, etc.) as perceived by the sample rice growers were studied.

Table 4. Frequency of occurrence of major insect-pests during last 10 years in the field of the sample rice growers in Punjab

Particulars	Rice growers (Per cent)
Stem borer	
Slight	13.0
Moderate	43.0
Severe	2.0
Rice hispa	
Slight	8.0
Moderate	12.0
Severe	1.0
Leaf folder	
Slight	9.0
Moderate	23.0
Severe	2.0
Planthopper	
Slight	9.0
Moderate	7.0
Severe	-

The problem of occurrence of stem borer was ‘moderate’ for 43.0 per cent of rice growers as per their perceptions (Table 4). According to the perception 23.0 per cent rice growers leaf folder was perceived it as ‘moderate’ problem. Among the diseases bacterial blight and false smut were the major problematic

Table 5. Frequency of occurrence of major diseases during last 10 years in the rice field of the sample growers, Punjab

Particulars	Rice growers (Per cent)
Bacterial blight	
Slight	20.0
Moderate	25.0
Severe	1.0
False smut	
Slight	4.0
Moderate	10.0
Severe	0
Blast	
Slight	5.0
Moderate	2.0
Severe	1.0

diseases for rice crop. About 6.3 and 2.7 per cent of rice area was affected by bacterial blight and false smut, respectively (Table 5). The problem of weeds, as experienced by the rice growers was not very serious. The intensity of weeds simply varied from ‘slight’ to ‘moderate’ across majority of the farmers under the year of study. Low yield, non-availability of disease resistant varieties, lack of irrigation facilities and non-availability of quality seeds were the major input constraints as reported by the rice growers (Table 6). The other constraints in order of importance were shortage of labour, lack of credit, non-availability

Table 6. Various abiotic constraints faced by the sample rice growers in Punjab

Particulars	Weighted rank
Lack of irrigation facility	1.34
Non-availability of quality seeds	0.9
Non-availability of fertilizers	0.4
Non-availability of chemicals/ pesticide	0.2
Shortage of labour	1.2
Non-Availability of machinery	0.2
Lack of credit	0.5
Non suitable land	0.2
Low yield	1.5
Non availability of disease resistant varieties	1.5

Note: Rank 1=3, Rank 2=2, and Rank 3=1

of fertilizers, non- availability of machinery, non suitable land and non-availability of chemical/pesticides during the period of study.

The most desired practices for increasing the yield of rice crop from the different options offered to the respondents, timely planting, use proper plant protection measures and providing irrigation at the right time were the most desired practices at the farmers

Table 7. Perceptions of the sample rice growers with regard to yield enhancement possibilities at their own level, Punjab

Particulars	Weighted rank
Increase the plant population	0.6
Use more fertilizer	1.0
Timely planting	1.8
Timely weeding	0.5
Provide irrigation at the right time	0.9
Use proper plant protection measures	1.1

Note: Rank 1=3, Rank 2=2, and Rank 3=1

Table 8. Multiple suggestions given by the sample rice growers on research priorities to increase rice yield in Punjab

Particulars	Multiple response
High yielding varieties	83.0
Dwarf varieties	0
Pest resistant varieties	25.0
Low input requiring varieties	19.0

own level for yield improvement (Table 7). Some other practices in order of importance were the use fertilizers, increase the plant population and timely weeding.

The major desired areas of research by the scientists to increase the rice yield as perceived by sample farmers from various options viz. like high yielding varieties, dwarf varieties, pest resistant varieties

low input requiring varieties, majority of the growers wanted scientists to evolve high yielding rice varieties (Table 8).

The total variable costs of cultivation per hectare were ₹ 17657, leaving behind ₹ 36927 as returns over variable costs from rice cultivation on sample growers. The regression analysis has brought out that there existed scope to further increase of insecticides/pesticides, manures/ fertilizers and irrigation for improving the yield of rice in Punjab.

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