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Evaluation of Economic Viability and Constraints in Growing Pulse Based Crop Rotations at Small Farms of Punjab

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Research Article

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ABSTRACT

Data was collected during 2014-15 and 2015-16 from 120 small farmers of 12 villages from randomly selected Amritsar and Gurdaspur districts of Punjab, India, to evaluate the performance of various pulse based crop rotations viz. rice-wheat-summer moong/mash (summer pulse based crop rotation(SPBCR1)), Rice-sugarcane-summer moong/mash (summer pulse based crop rotation(SPBCR2), Arhar-Wheat (main pulse based crop rotation(MPBCR3)), Rice-lentil(main pulse based crop rotation(MPBCR4)), Arhar-lentil(pulse-pulse based crop rotation(PPBCR5) compared to the existing non-pulse based crop rotation i.e rice-wheat cropping system as (non-pulse based crop rotation (NPBCR6)). Rice equivalent yield in SPBCR1 (129.42q/ha) and SPBCR2 (126.58q/ha) was found statistically at par but observed significantly higher compared to all other crop rotations. Rice equivalent yield in NPBCR6 (99.28q/ha) witnessed significantly higher than MSPBCR3 (87.43q/ha), MSPBCR4 (87.20q/ha) and PPBCR5 (68.52q/ha), gross returns (Rs. 185063.46/ha), net returns (Rs118116.83/ha), crop profitability (Rs. 334.58/ha/day) and system profitability (Rs. 323.61/ha/day) compared to all other cropping systems. Benefit cost ratio was significantly higher in MSPBCR3 (1.99) than all other crop rotations and SPBCR1 (1.76), MSPBCR4 (1.74) and PPBCR5 (1.66) witnessed significantly higher benefit cost ratio than NPBCR6 (1.55). Among various problems faced by small farmers for cultivation of pulse crops, low production and productivity, low market price of the produce, marketing problems, non availability of suitable varieties and high cost of cultivation was ranked-I (65.28%), ranked-II (57.98%), ranked-III (56.31%), ranked-IV (55.83%) and ranked-Vth (51.44%) respectively. The other problems such as unpredictable

weather conditions, major price fluctuations, lack of harvesting mechanization, large number of pests and diseases and non- availability of labor etc were found important with less than 50 per cent of mean value.

INTRODUCTION

Rice and wheat are staple food crops of India and grown over an area of 82 percent of the total cropped area in Punjab with 30 and 35 percent contribution in central pool of these crops respectively. The production and productivity of these crops has been reached to their highest levels and farmers of Punjab state are adding more and more quantity of inputs to maintain the present level, which makes crop cultivation more costly day by day. This rice-wheat monotonous system also pulled the cultivation of other crops to degraded or marginal lands which were otherwise have prime position in crop rotations before the introduction of green revolution which destructed all the natural resources to greater extent. Pulses were severely affected and grown as a last preference among farmers of Punjab state even when all the 22 districts of Punjab state fall under food security mission since 2013. The majority of the Indian population is vegetarian and pulses are the only source of protein for their diet. Moreover a large number of farmers in Punjab were with small holdings (below 2hectares) of land with limited resources and low purchasing power. Although pulse crops need very limited input resources to cultivate which fits suitably in the budgets of small farmers and are a better option to save the natural resources at large but even though farmers of Punjab have very passive approach towards pulse cultivation and their inclusion in persisting crop rotations. Therefore keeping in view the gravity of the above problems with special reference to address the prevalent problems of the small farmers, the present study was under taken to evaluate the economic viability of various pulse based crop rotations. SPBCR1, SPBCR2, MSPBCR3, MSPBCR4 and PPBCR5 compared to the popularly grown non-pulse based crop rotation i.e. NPBCR6 and to shortlist the major issue and problems of the small farmers of Punjab for pulse cultivation [1].

METHODS AND MATERIALS

The present study was conducted on basis of a survey conducted in Amritsar and Gurdaspur districts of Punjab, India which were selected randomly among six important pulse growing districts of the state. Two blocks were purposively selected from each randomly selected district and three villages were selected from each block i.e. 12 villages in all and 120 small farms cultivating pulse and non-pulse based crop rotations (20 small farmers/crop rotation) were selected to made the sample size. Six pulse and non pulse based crop rotations i.e. Rice-wheat-summer moong/mash (Summer Pulse Based Crop Rotation (SPBCR1)), Rice Sugarcane Summer Moong/Mash (summer pulse based crop rotation(SPBCR2) - a two year rotation, Arhar-Wheat (main pulse based crop rotation(MPBCR3)), Rice-lentil(main pulse based crop rotation(MPBCR4)), Arhar-lentil (pulse-pulse based crop rotation(PPBCR5) and Rice-wheat as (non-pulse based crop rotation(NPBCR6)) were selected to evaluate economic viability in terms of total cost, gross returns, net returns, number of days field was occupied, crop profitability and system profitability. Information regarding input usages of various variable input cost components viz. seed rate, fertilizers, seed bed preparation, weed control measures, plant protection measures, harvesting & threshing and miscellaneous (expenses in terms of repair of implements, interest on capital invested in cash and kind etc.) was collected to know the economic viability of pulse based crop rotations as compare to non pulse based crop rotations. The yield data of all the crops was converted to rice equivalent yields using following formula, so as to facilitate the statistical analysis following the procedure outlined by Gomez and Gomez (1984) [2].

$$\text{Rice equivalent yield (kg/ha)} = \text{Component crop yield (kg/ha)} \times \frac{\text{Price of the component crop (Rs/kg)}}{\text{Price of rice crop of NPBCR5 (Rs/kg)}}$$

The economics of different pulse and non-pulse based crop rotations was calculated from the pre-requisites (as suggested by devasenapathy such as crop wise total cost of cultivation, sale price of the produce, duration of crop in the field and calculations were made to find gross returns, net returns, benefit cost ratio (B:C ratio), crop profitability and system profitability. Sale price of the output was worked out on the basis of prevalent price of the produce in local market in Rs/q basis. Gross returns (Rs/ha) were calculated from the prevalent market price of the crop produce obtained from different pulse and non-pulse based crop rotations. Net returns (Rs/ha) indicate the total profit earned by the farmer and was calculated by reducing total cost from gross returns in each crop rotation.

Benefit cost ratio shows the returns or benefits on per rupee invested for cultivation of crops. Wider the ratio more will be the profit. It was calculated upon dividing net returns by total cost of cultivation. The crop profitability (Rs/ha/day) was calculated upon dividing net profit by total number of days the field was occupied by the crop. A crop rotation showing high crop profitability (Rs/ha/day) needs to be preferred over the low crop profitability. System profitability (Rs/ha/day) refers net profit/ unit area/ unit time in a calendar year. Rotation with higher profitability was considered economically beneficial and advisable to enhance the income of the farmer. The problems of the small farmers of the study area were evaluated through a pre-tested questionnaire to highlight the issues and problems of pulse growing farmers through Geretts rank value testing method.

RESULTS AND DISCUSSION

Rice equivalent yield: Pooled data of two years indicated that rice equivalent yield (Table 1) in SPBCR1 (129.42q/ha) and SPBCR2 (126.58q/ha) was found statistically at par but recorded significantly compared to all other crop rotations. Rice equivalent yield in NPBCR6 (99.28q/ha) witnessed significantly higher than MSPBCR3 (87.43q/ha), MSPBCR4 (87.20q/ha) and PPBCR5 (68.52q/ha). MSPBCR3 (87.43q/ha) and MSPBCR4 (87.20q/ha) were observed statistically at par but calculated significantly higher than PPBCR5 (68.52 q/ha). PPBCR5 968.52q/ha) was found significantly lower than all other crop rotations selected for study. Increase in productivity due inclusion of pulses in prevalent cropping systems was also reported by Ali and Singh. The inclusion of moong bean in rice-wheat cropping system increased the total productivity of the system [3].

Table 1. Grain yield and rice equivalent yield of different pulse and non-pulse based crop rotations.

Particulars	Grain yield (q/ha)			*Rice equivalent yield q/ha
	Kharif	Rabi	Summer season	
SPBCR1 (Rice-wheat-summer moong/mash)	61.01	45.94	6.96	129.42
SPBCR2(Rice-sugarcane-summer moong/mash)**	61.84	776.50	6.78	126.58***
MSPBCR3 (Arhar-wheat)	10.15	49.43	-	87.43
MSPBCR4 (Rice-lentil)	64.11	10	-	87.20
PPBCR5 (Arhar-lentil)	11.50	13.25	-	68.52
NPBCR6 (Rice-wheat)	54.35	44.31	-	99.28
CD (0.05)	-	-	-	6.16

Gross returns: The gross returns (table 2) received from SPBCR1 (Rs.185063.46/ha) were significantly higher by 18.32, 29.56, 33.45, 46.74 and 23.57 per cent than SPBCR2 (Rs.151166.03/ha), MSPBCR3 (Rs. 130357.91/ha), MSPBCR4 (Rs.123166.86/ha), PPBCR5 (Rs.98565.72) and NPBCR6 (Rs.141450.86/ha). Gross returns obtained from SPBCR2 were recorded 13.77, 18.52, 34.80 and 6.43 per cent significantly higher than MSPBCR3, MSPBCR4, PPBCR5 and NPBCR6. Gross returns from NPBCR6 were found significantly lower than CR1 and CR2 but significantly higher than MSPBCR3, MSPBCR4 and PPBCR5 by 7.84, 12.93 and 30.32 per cent respectively. Gross returns from MSPBCR3 and MSPBR4 were statistically at par but significantly higher with 24.39 and 19.97 per cent respectively than PPBCR5. Gross returns received from PPBCR5 were significantly lower than all other crop rotations selected for study. Inclusion of moong and mash in existing cropping systems.

Total cost: Total cost (Table 2) was found significantly lower in PPBCR5 (Rs. 36949.94/ha) as compared to all other crop rotations selected for study. Between SPBCR1 and SPBCR2, total cost of variable input cost components in SPBCR2 (Rs. 64630.46/ha) was significantly lower than SPBCR1 (Rs.66946.64/ha) but observed significantly higher than all other rotations. Total cost in NPBCR6 (Rs. 55380.14/ha) was observed significantly lower compared to SPBCR1 and SPBCR2 but significantly higher than MSPBCR3 (Rs. 43577.56/ha), MSPBCR4 (Rs. 45012.49/ha) and PPBCR5. Total cost of variable input components was found significantly lower in MSPBCR3 as compared to MSPBCR4 and all other crop rotations selected for study except PPBCR5.

Net returns: Net returns (Table 2) from SPBCR2 (Rs. 118116.83/ha) were significantly higher compared to all other crop rotations selected for study. Net returns received by small farmer of the study area from MSPBCR4 (Rs.78154.37/ha), SPBCR2 (Rs.86535.56/ha) and NPBCR6 (Rs.86070.72/ha) were found at par, which may be due to high cost of cultivation but witnessed significantly higher than MSPBCR4 (Rs.78154.37/ha) and PPBCR5 (Rs.61615.79/ha). MSPBCR4 was registered significantly higher net returns than PPBCR5. Minimum and significantly lower net returns were recorded in PPBCR5. These results were found in accordance with Kumar and Ali (1998). Pulse crop cultivation in rice-wheat cropping system helps to increase production and profitability of the system when grown after rice. The inclusion of moong bean in rice-wheat cropping system helped to increase the net returns of the system.

Benefit cost ratio: Benefit cost ratio represent return value of per rupee invested by the farmer on a particular crop rotation. Higher benefit cost ratio represents more returns on per rupee invested as compare to those with lower. Benefit cost ratio (Table 2) was found significantly higher in MSPBCR3 (1.99) as compare to all other crop rotations selected for study. Benefit cost ratio in SPBCR1 (1.76) and MSPBCR4 (1.74) was recorded statistically at par but significantly higher than PPBCR5 (1.66), NPBCR6 (1.55) and SPBCR2 (1.33). Benefit cost ratio in PPBCR5 (1.66) was found significantly higher than NPBCR6 (1.55) and SPBCR2 (1.33). B:C ratio in NPBCR6 was observed significantly higher than SPBCR2 where it was recorded significantly lower compared to all other crop rotations selected for the study. More returns on per rupee invested were also endorsed.

Number of days taken in field: Less number of days helps in early vacation of field and timely completion of sowing operations for the next season crop. Among various crop rotations selected for study, crops in PPBCR5 (278.17 days) took significantly lower number of days whereas SPBCR1 (352.79 days) took significantly higher number of days in the field. Crops in SPBCR2 (346 days) took significantly lower number of days as compare to SPBCR1 (352.79). Among MSPBCRs and NPBCR6, MSPBCR4 took significantly lower (282.50) number of days as compare to MSPCR3 (293.80) and NPBCR6 (294.95), which were found statistically at par to each other. Comparison between NPBCR6 and SPBCRs (i.e. SPBCR1 and SPBCR2) indicates that crops in SPBCRs took significantly higher number of days in the field than NPBCR6. Numbers of days were recorded significantly lower in MSPCR4 (282.50) compared to MSPCR3 (293.80) and NPBCR6 (294.95) which were found statistically at par with each other [4]. These results coincide with the Annual Report.

Table 2. Profitability analysis of various pulse and non-pulse based crop rotations.

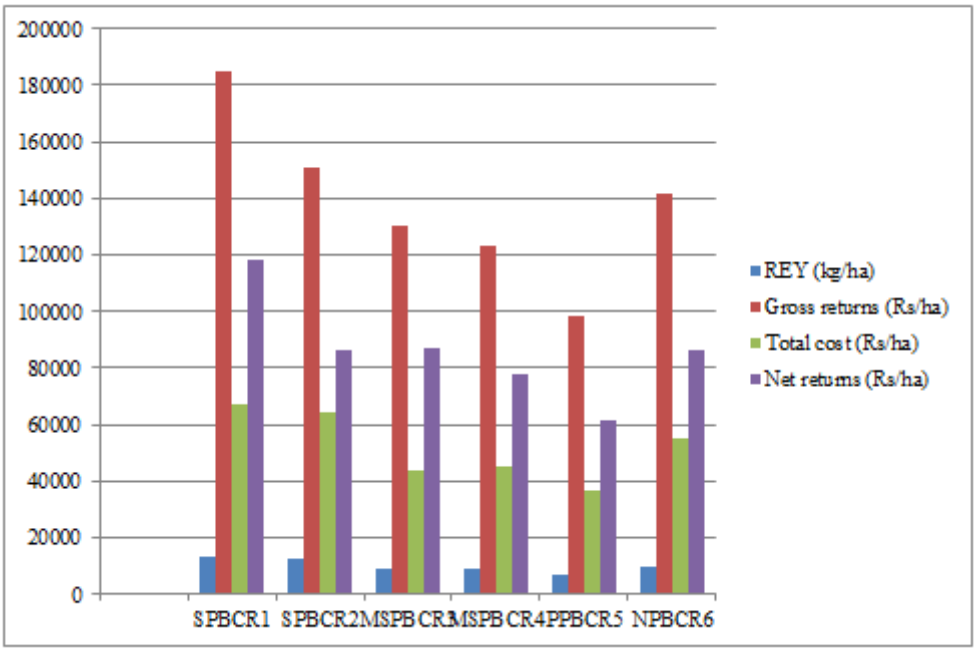
Particulars	Gross returns (Rs/ha)	Total cost (Rs/ha)	Net returns (Rs/ha)	B:C	No of days	Crop profitability (Rs/ha/day)	System profitability (Rs/ha/day)
SPBCR1	185063.46	66946.64	118116.83	1.76	352.79	334.58	323.61
SPBCR2	151166.03	64630.46	86535.56	1.33	346.00	249.31	237.08
MSPBCR3	130357.91	43577.56	86780.35	1.99	293.80	295.16	237.75
MSPBCR4	123166.86	45012.49	78154.37	1.74	282.50	276.39	214.12
PPBCR5	98565.72	36949.94	61615.79	1.66	278.17	220.97	168.81
NPBCR6	141450.86	55380.14	86070.72	1.55	294.95	291.48	235.81
CD (0.05)	**8536.70**	**2096.69**	**6579.86**	**0.07**	**3.02**	**5.73**	**18.03**

Crop profitability: Crop profitability indicates Rs/ha/day profit during the crop stand in field in a particular crop rotation. Higher crop profitability of a particular system indicates superiority over the other. Crop productivity in SPBCR1 (Rs.334.58 /ha/day) was found significantly higher whereas in PPBCR5 (Rs. 220.97/ha/day) it was found significantly lower as compare to all other crop rotations selected for study. Comparison between SPBCRs shows that the crop profitability in SPBCR1 (Rs.334.58/ha/day) was significantly higher than SPBCR2 (Rs.249.31/ha/day). Between MSPCRs, crop profitability was recorded significantly higher in MSPCR3 (Rs.295.16/ha/day) compared to MSPCR4 (Rs.276.39/ha/day). In NPBCR6 the crop profitability (Rs.291.48/ha/day) was found significantly lower than SPBCR1 (Rs 334.58/ha/day) but statistically at par with MSPBCR3 (Rs.295.16/ha/day) and significantly higher than MSPBCR4 (Rs. 276.39/ha/day), SPBCR2 (Rs. 249.31/ha/day) and PPBCR5 (Rs. 220.97/ha/day). Crop profitability in MSPBCR4 (Rs. 276.39/ha/day) was recorded significantly higher than SPBCR2 (Rs. 249.31/ha/day) and PPBCR5 (Rs. 220.97/ha/day). Crop

profitability in SPBCR2 (Rs. 249.31/ha/day) was found significantly higher than PPBCR5 (Rs. 220.97/ha/day). Improvement in crop profitability due to inclusion of pulses in rice-m wheat cropping system was also endorsed in Annual Report (2018). The improvement in crop profitability by introduction of pulse crops in rice fallow system.

System profitability: System profitability indicates the profitability of a particular system in a calendar year in Rs/ha/day. A system with higher system profitability was considered superior over the other with less system profitability. The system profitability was found significantly higher in SPBCR1 (Rs. 323.61/ha/day) as compare to all crop rotations selected for study. System profitability in MSPBCR3 (Rs.237.75/ha/day), SPBCR2 (Rs.237.08/ha/day) and NPBCR6 (Rs.235.81/ha/day)were recorded as at par but was registered significantly higher than MSPBCR4 (Rs.214.12/ha/day) and PPBCR5 (Rs.168.81/ha/day). System profitability in MSPBCR4 (Rs.214.12/ha/day) was observed significantly higher than PPBCR5 (Rs.168.81/ha/day). System profitability was recorded significantly lower in PPBCR5 (Rs.168.81/ha/day). Improvement in system profitability with inclusion of summer moong in rice- wheat cropping system (Figure 1) [5].

Figure 1. Comparative performance rice equivalent (REY), total cost, gross returns and net returns of various pulse and non-pulse based crop rotations.



Problems of the farmers: The major problems faced by the small farmers of the study area in pulse crop cultivation were evaluated with the help of Geretts rank test to know the suitable reasons for passive approach of the farmers in pulse crop cultivation and ranked according to the mean value (%) of the problem. About ten problems were outlined by the small farmers of the study area. Among these problems, low production and productivity was ranked-lst with 65.28 per cent of mean value. Low market price of the produce ranked –IInd (57.98%), marketing problems ranked IIIrd (56.31%), non-availability of suitable variety was ranked at IVth place (55.83%) and high cost of cultivation was observed at the Vth (51.44%) place as some of the major problems faced by small farmers. The other relevant problems which acquired less than 50 per cent of the mean value were unpredictable weather conditions, major price fluctuations, lack of harvesting mechanization, large number of pests and diseases and non- availability of labor at rank VIth (46.54%), VIIth (45.23%), VIIIth (43.58%), IXth (40.93%) and Xth (40.78%) respectively. The similar problems related to pulse crop cultivation were also highlighted in the Annual Report.

CONCLUSION

Average data of two years indicated that rice equivalent yield in SPBCR1 (129.42q/ha) and SPBCR2 (126.58q/ha) was found statistically at par but observed significantly higher compared to all other crop rotations. Rice equivalent yield in NPBCR6 (99.28q/ha) witnessed significantly higher than MSPBCR3 (87.43q/ha), MSPBCR4 (87.20q/ha) and PPBCR5 (68.52q/ha), gross returns (Rs. 185063.46/ha), net returns (Rs118116.83/ha), crop profitability (Rs. 334.58/ha/day) and system profitability (Rs. 323.61/ha/day) compared to all other cropping systems. Benefit cost

ratio was recorded significantly higher in MSPBCR3 (1.99) compared to all other crop rotations. Returns from per rupee invested in SPBCR1 (1.76) and MSPBCR4 (1.74) were recorded statistically at par but significantly higher than PPBCR5 (1.66) and NPBCR6 (1.55). PPBCR5 was also witnessed significantly higher benefit cost ratio than NPBCR6 (1.55). Among various problems faced by small farmers for cultivation of pulse crops, low production and productivity, low market price of the produce, marketing problems, non availability of suitable varieties and high cost of cultivation was ranked-I (65.28%), ranked-II (57.98%), ranked-III (56.31%), ranked-IV (55.83%) and ranked-Vth (51.44%) respectively. The other problems were found important with less than 50 per cent of mean value viz. unpredictable weather conditions (rank VIth (46.54%)), major price fluctuations (VIIth (45.23%)), lack of harvesting mechanization (VIIIth (43.58%)), large number of pests and diseases (IXth (40.93%)) and non- availability of labor (Xth (40.78%)).

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