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Assessment of rice based cropping system for higher productivity and profitability

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Abstract

We are in the verge of booming population and climate change the very resources like land, water, nutrient and energy for crop production is diminishing. Efficient utilization of all available resources becomes the only potent option for sustaining the agriculture so that we produce enough to feed the present population without endangering the resources for future generations. Cropping system helps in maximizing system productivity on annual basis, facilitate higher efficiency in utilization of resources and sustainability of farm resources and environment in long term. Rice is the main staple food grain crop of India therefore rice-based cropping systems form an integral part of agriculture here. We conducted an experiment to access the various rice based cropping system for higher productivity and profitability. Among them Rice - Field Pea shows significantly higher rice equivalent yield (45.62 q/ha). The same treatment i.e., Rice – Field pea continue to performed well even in production efficiency (47.44 kg/ha/day), system profitability (605.10 ₹/ha/day) and also in Rice Equivalent Yield of the system (99.62 q/ha) showing significantly higher performance than the other rice based cropping system. In land use efficiency Rice – Maize and Rice – Field pea cropping sequence was found to be the highest with the value of 57.53%.

Keywords: Rice, field pea, maize, toria, lentil, rice equivalent yield, cropping system, production efficiency, system profitability, land use efficiency

Introduction

Rice (*Oryza sativa* L.) is one of the most important cereal crops in the world. In 2019 rice contributed about 782 million tonnes out of the total cereal production (2714.7 million tonnes) in the world (FAO, 2019) [1]. India was the second largest producer of rice in 2018. India in 2018 produced 172.58 million tonnes of rice which is about 54.21% of the total cereal produced (318.32 million tonnes) in that year (FAO, 2019) [1]. Estimates show that by 2050 we would require to produce about 50 percent more than what we are now to be able to feed the population. Land, water, nutrients and energy are critical to enhance agricultural productions. Shortage of any one of them may hamper the yield seriously. In present era with increased urbanization, climatic change and booming population, there seems to be no scope of increasing any of these resources. So efficient utilization of the available resources seems to be the only potent option i.e., increasing the number of crops per unit area per unit time.

In developing countries like India, the most important challenge is to provide sufficient food for the growing population at affordable price from a fixed cultivated land area. Cropping system as a system it aims at maximizing system productivity on annual basis, facilitate higher efficiency in utilization of resources and sustainability of farm resources and environment in long term. Rice being a staple food for Indian population is widely grown in both the season. Therefore rice-based cropping system form an integral part of agriculture. One of the main strategies to increase intensity and income in rice - based cropping system of farm family is to have second crop after rice. Rice - based cropping system approach becomes very much important for improving the productivity, generating additional income, employment and condition of the small and marginal farmers. Keeping the above discussed point in view, the present research was conducted to assess the economics, system productivity of rice-based cropping system and to identify a suitable rice-based cropping system.

Materials and Methods

Present experiment was undertaken during May 2018 to March 2019 at Keibung under KVK Imphal west, Manipur, in Randomized block design with four replications consisting of five

rice based cropping system as treatments namely, Rice-Fallow, Rice-Maize, Rice-Lentil, Rice-Field Pea and Rice-Toria. Recommended package of practices was strictly followed while the crops was raised.

To study the Biometrical studies of both Kharif and Rabi crop, representative sample of five plants were selected randomly from each plot and labeled in order to assess the treatment effects. For comparing efficiency of cropping system certain parameters such as Land use efficiency (%), Rice equivalent yield of the cropping system (q/ha), Productivity of the system and profitability of the system was taken to consideration. Lastly Economics of both *Kharif* and *Rabi* crop and Cropping system was also worked out.

Result and Discussion

1) Rice equivalent yield/total productivity

Based on the experimental result Rice-Field pea cropping system produced significantly more rice equivalent yield than other rice based cropping system while the rest of the cropping sequence still recorded much higher Rice equivalent yield than Rice-Fallow cropping system (Table 1). The inclusion of one more crop will definitely allow to increase the net productivity in a year than fallow. Higher production potential of Field pea along with good grain yield of rice and

better market price of Field pea must be the key point for attaining higher REGY. Similarly, higher rice equivalent yield (REY) through inclusion of pea in rice-based crop sequence has been reported by (Tiwari *et al.*, 2002; Ali *et al.*, 2012) [2, 6].

2) Production efficiency (system productivity) Kg/ha/day

Among the different rice based cropping system, maximum production efficiency was obtained in rice field pea cropping system (Table 1). While rest of the cropping systems under comparison were at par with each other. This was due to highest total productivity in terms of REY (q/ha) of this sequence in which the contribution of field pea is quite obvious.

3) System profitability (Rs/ha/day)

The profitability Rs/ha/day of different rice based cropping sequence was observed highest in Rice-Field pea cropping system (Table 1). Compared with other cropping sequence Rice-fallow cropping system was found to give the lowest profitability. The higher profitability could be attributed to higher productivity as well as net return of the sequences. Similarly, high values of profitability have been reported by several workers (Prakash *et al.*, 1999; Samant, 2015) [3, 4].

Table 1: Indices for comparing the efficiency of different rice based cropping system

Treatments	Total productivity REY (q/ha)	Production efficiency (system productivity) (Kg/ha/day)	Profitability of the system (Rs/ha/day)	Total duration of the cropping system (No. of days)	Land use efficiency (%)
Rice-Fallow	46.82	42.56	418.91	110	30.14
Rice-Toria	86.85	43.43	535.76	200	54.79
Rice-Field pea	99.62	47.44	605.10	210	57.53
Rice-Lentil	84.40	44.42	532.05	190	52.05
Rice maize	90.00	42.86	555.00	210	57.53
S.Em±	2.47	1.29	39.18	-	-
CD at 5%	5.39	2.81	85.37	-	-

4) Land use efficiency

Higher land use efficiency was observed in Rice-Field pea and Rice-Maize cropping sequence data pertaining to land use efficiency is given in table 1. Since the rice-field pea and rice-maize cropping system were able to occupy field for the

longer duration their land use efficiency was highest among all the cropping systems. Addition of one crop increases the land use efficiency for all the cropping system as compared to leaving land as fallow.

Table 2: Economic of different rice based cropping system

Treatments (Cropping system)	Cost of cultivation of system	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
Rice - Fallow	47550.00	93630.00	46080.00	1.97
Rice - Toria	63860.00	171012.50	107152.50	2.68
Rice - Field pea	72170.00	199240.00	127070.00	2.76
Rice - Lentil	67715.00	168805.00	101090.00	2.49
Rice maize	71565.00	188115.00	116550.00	2.63
Sem±	-	7802.02	7802.02	0.11
CD at 5%	-	16999.14	16999.14	0.25

5) Economic

Economic of different rice based cropping system includes cost of cultivation gross return, net return per hectare basis and B:C ratio were statistically analysed and are presented in table 2. It is evident from the data that Rice-Field pea recorded significantly higher gross return (Rs 199240/ha), Net return (127070) and B:C ratio of 2.76 as compared to the cropping system. While, Rice-fallow give the lowest value in all the economic studies. i.e., gross return of Rs 93630/ha, Net return of Rs 46080 and B:C ratio of 1.97.

In case of cost of cultivation Rice-Field pea has the highest cost of cultivation and Rice-fallow has lowest cost of

cultivation. The results are in agreement with Tiwari *et al.* (2002) [2], Subimal *et al.* (2003) [5] and Prakash *et al.* (1999) [3] where Rice-pea cropping gives highest gross return, Net return and economic efficiency from different rice based cropping system (Bastia *et al.*, 2008) [7]. This may be due to the higher yield in Field pea crop and the higher price as compared to another crop.

Conclusion

Based on the experimental findings Rice-Field pea prove to be the best cropping system among different rice based cropping system on basis of total productivity REY (q/ha),

production efficiency (kg/ha/day), profitability of the system and in all the economic i.e., gross return, net return and B: C ratio as compared to other rice based cropping system. However other Rice based cropping system are also found to be performing better in all the parameter as compared to the Rice-fallow cropping system. However, in land use efficiency Rice-Maize and Rice-Field pea share the same efficiency in land use.

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