

EVALUATION OF COST EFFECTIVE AND BIOLOGICALLY EFFICIENT CROPPING SYSTEMS AND THEIR ECONOMICS

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ABSTRACT

Aim: Comparative evaluation of various cropping systems and assessment of their economics.

Study design: Descriptive statistics was used and each treatment was replicated quadruple times using randomized block design.

Place and duration of study: Department of agronomy, CSA University of Agriculture and Technology, Kanpur, Uttar Pradesh, India from 2016-2018.

Methodology: We undertaken traditional cropping systems to find out the efficient cropping systems in terms of economic value.

We implemented randomized block design in the field level to layout the different crops according to the various seasons in terms of space and time. Various inputs like water, fertilizers, chemicals etc. applied accordingly as per their recommendation. Different types of cultural practices are implemented to fulfil the crop needs. Timely samples are drawn from all the crops to analyze the characteristics of their biological yield. The final value of crops are computed as per their market price.

Result: Among the five different cropping systems Hyb. Rice- Potato recorded the highest net monetary return of Rs. 87954.80 ha⁻¹ followed by Maize-Potato (Rs. 64888.50 ha⁻¹), Rice- Wheat (Rs.39262.40 ha⁻¹), Maize-Wheat (Rs.34884.00 ha⁻¹) and Maize -Mustard (Rs.13122.50 ha⁻¹).

Conclusion: On the basis of overall productivity biological efficiency and economic return it may infer that Hyb. Rice-Potato crop sequence is treated as best biologically efficient system, if adopted by the farmers can go a long way in enhancing the productivity return.

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Key words: Cropping sequence, Biological yield, Return on investment, System productivity

1. INTRODUCTION

Planning and adoption of suitable cropping is essential for ensuring the most rational use of land and increasing the productivity/unit area/unit time so that farmers can get maximum net return from the cropping system. Cropping system signifies the sequence of crops grown over a specific piece of cultivated land and to increase the benefits from the available resources. Therefore, the basic approach in an efficient cropping system is to increase production and economic returns (Yadav *et al.* 1998). A flexible cropping system helps in capturing economic opportunities and environmental realities (Gangwar *et al.* 2004) and in ensuring balanced farm growth at regional level (Reddy and Suresh 2009). Hence, selection of component crops needs to be suitably planned for efficient utilization of resource base and to increase overall productivity (Anderson 2005). Rice-Wheat cropping system (RWCS) is the world's largest agricultural production system occupying around 12.3 m ha in India and around 85% of this area falls in Indo-Gangetic plains (IGP) (Ladha *et al.*, 2003; Timsina and Connor, 2001). This system requires high input resources for higher productivity resulted higher cost unit area⁻¹ and time. Following continuously the same system has adverse effect on soil health, ultimately decline in factor productivity of the system (Kumar and Yadav, 1993). Keeping in view the wider adaptability of rice-wheat cropping systems, an effort was made to find out the alternative cropping system with regards to productivity, remunerative, sustainability and resource conservation.

2. MATERIALS AND METHODS

The field experiment was conducted during 2016-17, 2017-18 at Student's Instructional Farm, C.S.Azad university of Agriculture and Technology, Kanpur to identify the remunerative and streamlined cropping systems. The soil was neutral to slightly alkaline of alluvial type having pH 7.9, 0.51 % organic carbon, available nitrogen (268 kg ha⁻¹) low in available phosphorus (16.5 kg ha⁻¹) and medium in available potash (220 kg ha⁻¹). A total of five cereal based crop (two rice based and three maize based) T₁-Rice- Wheat, T₂ -Maize-Wheat, T₃ -Hyb. Rice-Potato, T₄ - Maize-Mustard and T₅ - Maize -Potato sequences were tested in randomized block design with four replications. The system productivity and economic analysis of each year have been computed to evaluate the efficiency of different crop sequences. Land use efficiency was worked out by taking total duration of crop in individual crop rotation divided by 365 days (Tomar and Tiwari, 1990). The profitability values in terms of Rs ha⁻¹day⁻¹ were calculated by net monetary return of the rotation divided by total duration of the crop in that rotation.

3. RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads:

3.1 Biological yield and system productivity:

The mean analysis of two years revealed that in Hyb. Rice based cropping system the highest biological yield of potato was obtained in Hyb. Rice-Potato crop sequence. The highest system productivity obtained through Hyb. Rice-Potato crop sequence followed by Maize-Potato over all crop sequences evaluated. So that it concludes Hyb. Rice-Potato is well efficient cropping system(Devkantetal,2013)(Table 1).

3.2 Land use efficiency and Return per rupee investment:

Land use efficiency is the sum of crop duration's of cultivated crops in a cropping system per year. Duration of Rice, Maize, Mustard and Potato crops were taken as 120 days and for wheat it is 110 days. Hyb. Rice-Potato cropping system was observed as best economical sequence by fetching Rs. 2.72 on per rupee investment while Maize-Potato cropping system was the next best economical sequence by fetching Rs. 2.58 on investment of one rupee (Yadavetal,2005)(Table 2).

3.3 Economics and profitability:

The economic analysis revealed that highest gross return of Rs. 209594.80 ha⁻¹ was recorded through Hyb. Rice-Potato crop sequence followed by Rs. 176338.50 ha⁻¹ by Maize-Potato crop sequence. Hyb. Rice-Potato cropping system fetched highest net monetary return of Rs.87954.80 ha⁻¹ and ranked as best remunerative crop sequence and followed by Maize-Potato cropping system (Rs. 64888.50 ha⁻¹). On the profitability front, Hyb. Rice-Potato sequence produced maximum of Rs. 240.97 ha⁻¹ day⁻¹ while Maize - Potato sequence produced at the tune of Rs. 177.77 ha⁻¹ day⁻¹ of profitability followed by Rice-Wheat (Rs.107.56 ha⁻¹ day⁻¹), Maize- Wheat (Rs. 95.72 ha⁻¹ day⁻¹) and finally Maize-Mustard (Rs. 35.95 ha⁻¹ day⁻¹)(Yadavetal,2005) (Table 3).

Table 1. Biological yield of different cropping systems (mean of two years)

Crop sequence	Biological yield (kg/ha)			
	Kharif		Rabi	
	Grain	Straw	Grain	Straw
T ₁ : Rice- Wheat	3209.85	3851.82	2839.48	3493.80
T ₂ : Maize- Wheat	1882.72	5913.54	3148.12	3935.16
T ₃ : Hyb. Rice- Potato	5262.31	6052.43	13533.86	0.00
T ₄ : Maize-Mustard	1913.56	5984.52	1157.40	4120.34
T ₅ : Maize-Potato	1975.29	6320.24	15709.77	0.00
SEM	44.19	78.12	54.62	75.57
CD (P=0.05)	136.15	240.70	168.31	232.85

Table.2 Land use efficiency and return on investment of cropping systems (mean of two years)

Crop sequence	Land use efficiency (%)	Return Rupee ⁻¹ invested
T ₁ : Rice- Wheat	63.01	2.52
T ₂ : Maize- Wheat	63.01	2.52
T ₃ : Hyb. Rice- Potato	67.75	2.72
T ₄ : Maize-Mustard	65.75	2.18
T ₅ : Maize-Potato	67.75	2.58

Table.3 Economics and profitability of different cropping systems (mean of two years)

Crop sequence	Cost of cultivation (Rs. ha ⁻¹)	Gross returns (Rs. ha ⁻¹)	Net returns (Rs. ha ⁻¹)	B:C Ratio (Rs. ha ⁻¹ day ⁻¹)	Profitability
T ₁ : Rice- Wheat	75400	114662.40	39262.40	1.52: 1	107.56
T ₂ : Maize- Wheat	66000	100884.00	34884.00	1.52: 1	95.72
T ₃ : Hyb. Rice- Potato	121640	209594.80	87954.80	1.72: 1	240.97
T ₄ : Maize-Mustard	71000	84122.50	13122.50	1.18 :1	35.95
T ₅ : Maize-Potato	111450	176338.50	64888.50	1.58: 1	177.77

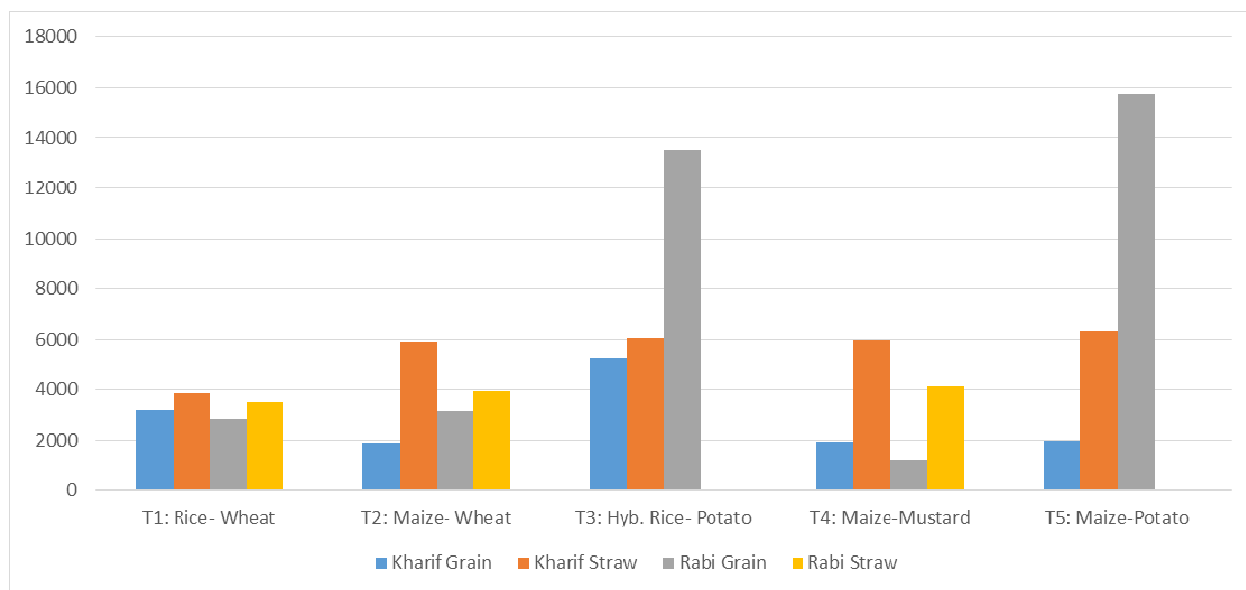


Fig. Biological yields of different cropping systems

4. CONCLUSION

Thus it may be concluded that traditional rice-wheat system could not able to improve the profitability as well as biological efficiency per unit area and time. Replacing traditional rice –wheat system with maize based intensive and biological efficient crop sequences could enhance the total productivity, economic return and favourable impact on soil health. On the basis of overall productivity biological efficiency and economic return it may infer that maize-potato crop sequence is treated as best biologically efficient systems while next best biological efficient crop sequence is rice –wheat, if adopted by the farmers can go a long way in enhancing the productivity return.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

Authors' contributions

This work was carried out in collaboration between all authors. Authors RB and KH designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author AKP managed the analysis of study. Author PRK managed the literature searches. All authors read and approved the final manuscript.

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