Int.J.Curr.Microbiol.App.Sci (2018) *7*(11): 1433-1439

International Journal of Current Microbiology and Applied Sciences
***ISSN: 2319-7706* Volume 7 Number 11 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.711.165

Evaluation of Crop Diversification and Intensification in Rice and Maize Based Cropping Sequences in Central Plain Zone of Uttar Pradesh

Rentapalli Balaji*, Karam Husain and Uma Shankar Tiwari

Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India

**Corresponding author*

Keywords

Rice, Maize, Economics, Profitability

Article Info

Accepted:
12 October 2018
Available Online:
10 November 2018

A B S T R A C T

An experiment was executed with ten crop sequences during 2010-17 at C.S. Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh under All India Coordinating Research Project on Cropping Systems. All these sequences were evaluated for yield, economics, profitability and to identify the remunerative cropping sequence among rice and maize based cropping sequences. Results revealed that Hyb. Rice-Wheat and Maize-Mustard-Onion cropping sequences were most economically efficient among rice and maize based cropping sequences respectively. Hyb. Rice-Wheat fetched highest B: C ratio of 3.24 followed by Maize-Mustard-Onion (3.21) while lowest B: C ratio (1.86) was recorded by Maize + Green gram-Potato-Wheat. Highest crop profitability (Rs.774.79 /ha/day) and system profitability (Rs.1075.28 /ha/day) were recorded by Maize + Black gram-Potato-Onion cropping sequence followed by Maize + Garlic-Green gram (G+R) (Rs. 758.34 /ha/day and Rs. 890.04 /ha/day, respectively).

Introduction

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 percent 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 per unit area 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). So,

diversification has been envisaged as a new strategy for enhancing and stabilizing productivity and soil health, making Indian agriculture competitive and increasing net farm income and economic security toward achieving the sustainable agricultural development. Both Rice-Wheat and Maize-Wheat cropping systems are predominately practiced under irrigated as well as rain fed production system in lndo-Gangetic Plains. As a whole, cultivation of both rice and wheat crop is costly time consuming, energy exhaustive and tedious. Hence, there is an urgent need for diversification and intensification of cropping system in rice based cropping system by improving the productivity and profitability per unit area per unit time without jeopardizing the soil health. The inclusion of crops like oil seeds, pulse and vegetable will improve the economic condition of the farmers owing to higher price and higher volume of their main and by-products.

Crop diversification shows lot of promises in alleviating these problems besides, fulfilling basic needs for cereals, pulses, oilseeds and vegetables and, regulating farm income, withstanding weather aberrations, controlling price fluctuation, ensuring balanced food supply, conserving natural resources, reducing the chemical fertilizer and pesticide loads, ensuring environmental safety and creating employment opportunity (Gill and Ahlawat, 2006). Crop diversification has been recognized as an effective strategy for achieving the objectives of food security, nutrition security, income growth, poverty alleviation, employment generation, judicious use of land and water resources, sustainable agricultural development and environmental improvement (Hedge *et al.*, 2003).

Cropping systems in central plain zone region aims to make agriculture achieving more employment and income generating, poverty alleviation and comparative advantage in new trade regime. Keeping above facts in view, the present investigation "Evaluation of crop diversification and intensification in rice and maize based crop sequences in central plain zone of Uttar Pradesh" under All India Coordinated Research Project on Cropping Systems was carried out.

Materials and Methods

The field experiment was conducted during 2010-17 at Student's Instructional Farm, C.S. Azad university of Agriculture and Technology, Kanpur under All India Coordinating Research Project on Cropping Systems to identify the remunerative cropping sequence among rice and maize based cropping sequences. The soil was neutral to slightly alkaline of alluvial type having pH 7.8, EC 0.18 dsm^{-1}, 0.55 % organic carbon, available nitrogen (223 $kgha^{-1}$), low in available phosphorus (14 $kgha^{-1}$) and medium in available potash (216 $kgha^{-1}$). A total of ten cereal based crop (four rice based and six maize based) Rice-wheat (T_1), Hyb. Rice-wheat (T_2), Hyb. Rice-wheat-green gram (G+R) (T_3), Maize-wheat (T_4), Maize-mustard-onion (T_5), Maize-mustard-green gram (G+R) (T_6), Maize + green gram-potato-wheat (T_7), Maize + black gram-potato-onion (T_8) Maize-garlic-green gram (G+R) (T_9) and Scented rice-wheat-okra (T_{10}) sequences were tested for their economics and profitability. Crop profitability in term of Rs/ha/day was calculated by net monetary returns of the rotation divided by total duration of the crop in that rotation. System profitability in term of Rs/ha/day was calculated by dividing net returns (Rs/ha) in a sequence by 365 days.

Results and Discussion

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

Economic evaluation of different crop sequences

The economic analysis of the treatment is most important for the farmer's point of view regarding implementation of the practices evolved under any investigation. The economic analysis includes cost of cultivation, Gross Monetary Returns, Net Monetary Returns on per hectare area basis as well as the B: C ratio as affected by various treatments.

Cost of cultivation (Rs. /ha)

In the present study, cost of cultivation was calculated considering the prevailing market prices of inputs and operations. Perusal of results (Table 1) revealed that Maize + black gram-potato-onion crop sequence needed maximum investment (Rs. 165800/ha/year) mainly because of high cost of seed of potato and onion seedlings for growing all the component crops. Under Maize + greengram-potato-wheat crop sequence, cost of cultivation is slightly reduced as Rs.147250/ha/year due to lower seed cost of wheat as compared to onion. Maize-wheat system required significantly lesser investment as Rs.67300/ha/year than the above crop sequences (Table 1). All diversified intensive crop sequences as a whole needed more investment to grow their respective crop components than the both existing crop-sequences, due to labour intensiveness and cost involve in diversification.

Gross monetary returns (Rs. /ha)

Gross monetary returns were calculated considering prevailing market price of the produce. In the present study, Maize + black gram-potato-onion system was on top (Rs. 448599 /ha) followed by Maize-garlic- green gram (G+R) (Rs. 407294/ha), Maize-mustard-onion (Rs. 350687.26/ha), Hyb. Rice-wheat-green gram (G+R) (Rs. 306654.70/ha), Maize + greengram-potato-wheat (Rs.273611.25/ha), scented rice–wheat-okra (Rs.267093/ha), Hyb. Rice-wheat (Rs. 262325.64/ha), Rice-wheat (Rs.197064.67/ha), Maize-mustard-greengram (G+R) (Rs. 191827.37/ha) and lowest GMR was recorded in Maize-wheat (Rs. 191547.16/ha).

Jain *et al.,* (2015) also reported that Maize diversified crop sequence having any leguminous crop in that crop sequence, gave higher gross returns. Rai and Tiwari (2012) and Tiwari *et al.,* (2015) were also recorded the optimum the diversification /intensification of maize based cropping system with potato and onion could give the maximum GMR as compared to other crop sequences.

Net monetary returns (Rs. /ha)

The net monetary returns per unit area were calculated by subtracting cost of cultivation with gross monetary return. In the present field study, the Net monetary returns almost followed the similar trends as to gross monetary return under different crop - sequences. All diversified intensive crop–sequences fetched significantly higher NMR as compared to Rice-wheat and Maize-wheat crop sequences.

In the present study, Maize + black gram-potato-onion system fetched maximum net monetary returns of Rs.282799/ha and the lowest was with Maize-mustard-greengram (G+R) (Rs. 111927.37/ha) system (Table 1). However, the next best crop-sequences were Maize-garlic- greengram (G+R) with NMR of Rs. 276794.75/ha followed by Maize-mustard-onion (Rs. 241387.16/ha). The higher net monetary returns recorded with Maize + black gram-potato-onion crop sequence was due to fact that this sequence produced maximum yield as compared to other crop sequences (Table 2).

Table.1 Cost of cultivation, GMR, NMR, BC ratio system profitability and crop profitability of each crop sequence during 2016-17

Crop rotations	Cost of Cultivation (Rs./ha)	Gross Monetary Returns (Rs./ha)	Net Monetary Returns (Rs./ha)	B:C ratio	System Profitability (Rs./ha/day)	Crop Profitability (Rs./ha/day)
T_1:Rice-Wheat	76750.00	197064.67	120314.67	2.57	329.62	450.61
T_2: Hyb. Rice-Wheat	80900.00	262325.64	181425.64	3.24	497.05	679.49
T_3: Hyb. Rice-Wheat-Green gram (G+R)	108200.00	306654.70	198454.70	2.83	543.71	603.20
T_4:Maize-Wheat	67300.00	191547.16	124247.16	2.85	340.40	552.20
T_5: Maize-Mustard-Onion	109300.00	350687.26	241387.16	3.21	661.33	849.95
T_6: Maize-Mustard-Green gram(G+R)	79900.00	191827.37	111927.37	2.40	306.65	427.20
T_7:Maize+Green gram-Potato-Wheat	147250.00	273611.25	126361.25	1.86	346.19	513.66
T_8:Maize+Black gram-Potato-Onion	165800.00	448599.00	282799.00	2.71	774.79	1075.28
T_9: Maize-Garlic-Green gram (G+R)	130800.00	407294.75	276794.75	3.12	758.34	890.01
T_{10}: Rice-Wheat-Okra	105650.00	267093.00	161443.00	2.53	442.30	479.05
CD (P=0.05)	-	9145.41	13405.00	0.15	25.06	34.25

Table.2 Yield recorded during 2016-17

Crop rotations	KHARIF		RABI		ZAID
	Grain (kg/ha)	Straw (kg/ha)	Grain (kg/ha)	Straw (kg/ha)	Grain (kg/ha)
T_1:Rice-Wheat	4952.38	5942.85	4380.95	5388.57	-
T_2: Hyb. Rice-Wheat	8120.00	9338.00	4690.00	5768.70	-
T_3: Hyb. Rice-Wheat-Green gram(G+R)	8381.00	9721.96	4810.00	5772.06	835.00
T_4:Maize-Wheat	2905.00	9121.70	4857.14	6071.42	-
T_5: Maize-Mustard-Onion	2950.00	9233.50	1785.71	5920.45	12928.75
T_6: Maize-Mustard-Green gram (G+R)	3070.86	10011.75	1922.22	6357.14	920.67
T_7:Maize+Green gram-Potato-Wheat	3000.00**(M)**	8879.75 **(M)**	20880.75	-	-
	381.00 **(GG)**	1413.75 **(GG)**	3435.50	3626.75	
T_8:Maize+Black gram-Potato-Onion	3047.75 **(M)**	9753.75 **(M)**	24238.00	-	13950.00
	452.00 **(BG)**	1446.50 **(BG)**			
T_9: Maize-Garlic-Green gram (G+R)	3118.75	10041.71	6714.25	-	976.00
T_{10}: Rice-Wheat-Okra	4786.00	8518.75	4357.25	4923.50	3262.00

Higher net returns due to higher total production of crops due to crop intensification was also recorded by Yadav *et al.,* (2008), Rai and Tiwari (2012) and Tiwari *et al.,* (2015) also recorded maximum NMR with Maize + black gram-potato-onion crop sequence as compared to other crop sequences.

Benefit cost ratio

All cropping systems tested under present investigation gave the B: C ratio more than 2.00 except for Maize + greengram-potato-wheat (1.86). The B: C ratio of Maize + greengram-potato-wheat was the lowest because of GMR and cost of cultivation fetched in this crop sequence. The B: C ratio was maximum with Hyb. Rice-Wheat (3.24) followed by Maize-mustard-onion (3.21), Maize-garlic- greengram (G+R) (3.12), Maize-wheat (2.85), Hyb. Rice-wheat- green gram (2.83), Maize + black gram-potato-onion (2.71), Rice-wheat (2.57), scented rice–wheat-okra (2.53) and Maize-mustard-greengram (G+R) (2.40). The crop - sequences those obtained with the B: C ratio of 2.02 to 2.36 had higher indices of profitability than remaining crop-sequences. Similar results were recorded by Yadav *et al.,* (2008). Rai and Tiwari (2012) and Tiwari *et al.,* (2015) also recorded similar results of higher B: C ratio with Hyb. Rice-wheat crop sequence as compared to other crop sequences.

System and crop profitability (Rs. /ha/day)

In the present study, Maize + blackgram-potato-onion crop sequence showed highest system and crop profitability (774.79 and 1075.28 Rs./ha/day) over all other rice and maize based crop sequences followed by Maize-garlic-green gram (G+R) (758.34 and 890.01 Rs./ha/day), Maize-mustard-onion (661.33 and 850 Rs./ha/day) whereas lowest system and crop profitability (306.65 and 427.20 Rs./ha/day) were recorded in Maize-mustard-green gram (G+R) crop sequence and followed by Rice-wheat (329.62 and 450.61 Rs./ha/day). The system and crop profitability of Maize + blackgram-potato-onion was recorded the highest owing to the fact that this sequence fetched maximum net monetary returns per unit area (Table 1). Sharma *et al.,* (2015) also recorded the highest crop and system profitability in rice and maize diversified crop sequences.

Cost of cultivation (Rs. 1,65,800/ha), Gross monetary returns (Rs. 4,48,599/ha) and Net monetary returns (Rs. 2,82,799/ha) were observed substantially higher in Maize + black gram-potato-onion crop sequence. The differences were significant in the case GMR and NMR. Benefit: cost ratio was recorded the highest with Hyb. Rice-Wheat crop sequence. The system (Rs. 774.7/ha/day) and crop (Rs. 1075.2/ha/day) profitability were recorded the highest with Maize + black gram-potato-onion crop sequence. On the basis of overall productivity and economic return it may infer that Hyb. Rice-Wheat crop sequence is treated as best economically remunerative cropping sequence while next best economical cropping sequence is Maize-Mustard-Onion, if adopted by the farmers can go a long way in enhancing the productivity return.

References

Anderson R I. 2005. Are some crops synergistic to following crops? Agron. J. 97(1): 7-10.

Gangwar B, Katyal V and Anand K. V. 2004. Stability and efficiency of cropping system in Chhattisgarh and Madhya Pradesh, Indian. J. Agric. Sci. 74 (10): 521-528.

Gill, M.S. and Ahlawat, I.P.S., 2006. Crop diversification – its role towards

sustainability and profitability. Indian J. Ferti., 2(9): 125-138.

Hedge, D.M., Tiwari, P.S. and Rai, M, 2003.Crop diversification in Indian Agriculture. Agril. Situ. India, pp. 351-354.

Jain N.K., Singh Hari, Dashora L.N., Mundra S.L., 2015. Maize (*Zea mays*)-wheat (*Triticum aestivum*) cropping system: Intensification through introduction of pulses. Indian Journal of Agronomy 60 (3): 347-351.

Kumar, Alok and D.S. Yadav, 1993. Effect of long term fertilization on soil fertility and yield under rice-wheat cropping system. J. Indian Soc. Soil Sci. 41(1): 178-180.

Ladha, J. K., D. Dawe, H. Pathak, A. T. Padre, R. L. Yadav, Bijay-Singh, Yadvinder-Singh, Y. Singh, P. Singh, A. L. Kundu, R. Sakal, N. Ram, A. P. Regmi, S. K. Gami, A. L. Bhandari, R. Amin, C. R. Yadav, S. Bhattarai, S. Das, H. P. Aggarwal, R. K. Gupta, and P. R. Hobbs. 2003. How extensive are yield declines in long-term rice-wheat experiments in Asia? Field Crops Research 81: 159–180.

Rai, J. and Tiwari, U.S., 2012. Economics and productivity of biological efficient and profitable cropping systems in central plain zone of Uttar Pradesh. International Journal of Agricultural Sciences Volume 8 (1):125-127.

Reddy B N and Suresh G. 2009. Crop diversification with oilseed crops for-maximizing productivity, profitability and resource conservation. Indian J. Agron. 54(2): 206-14.

Sharma, S.K., Rana, S.S., Subehia, S. K. and Negi, S.C., 2015. Production potential of rice-based cropping sequences on farmers' fields in low hills of Kangra district of Himachal Pradesh, Himachal Journal of Agricultural Research 41 (1): 20-24.

Timsina, J., and D. J. Connor. 2001. Productivity and management of rice-wheat cropping systems: Issues and challenges. Field Crop Research 69: 93–132.

Tiwari, U.S., Naushad Khan., Yadav, M. P. and Mayank Dubey, 2015. Effect of different cropping systems on crop productivity, profitability and soil properties in alluvial tract of Uttar Pradesh, India. Indian Journal of Ecology 42(2): 476-478.

Yadav, R.L., 1998. Factor productivity trends in a rice–wheat cropping system under long-term use of chemical fertilizers. Exp. Agric, 34: 1-18.

Yadav, R.L., Kamta Prasad, Gangwar, K.S., and Dwivedi, B.S., 1998. Cropping system and resource use efficiency. Indian J. Agric. Sci. 68: 548-558.

How to cite this article:

Rentapalli Balaji, Karam Husain and Uma Shankar Tiwari. 2018. Evaluation of Crop Diversification and Intensification in Rice and Maize based Cropping Sequences in Central Plain Zone of Uttar Pradesh. *Int.J.Curr.Microbiol.App.Sci.* 7(11): 1433-1439.
doi: https://doi.org/10.20546/ijcmas.2018.711.165